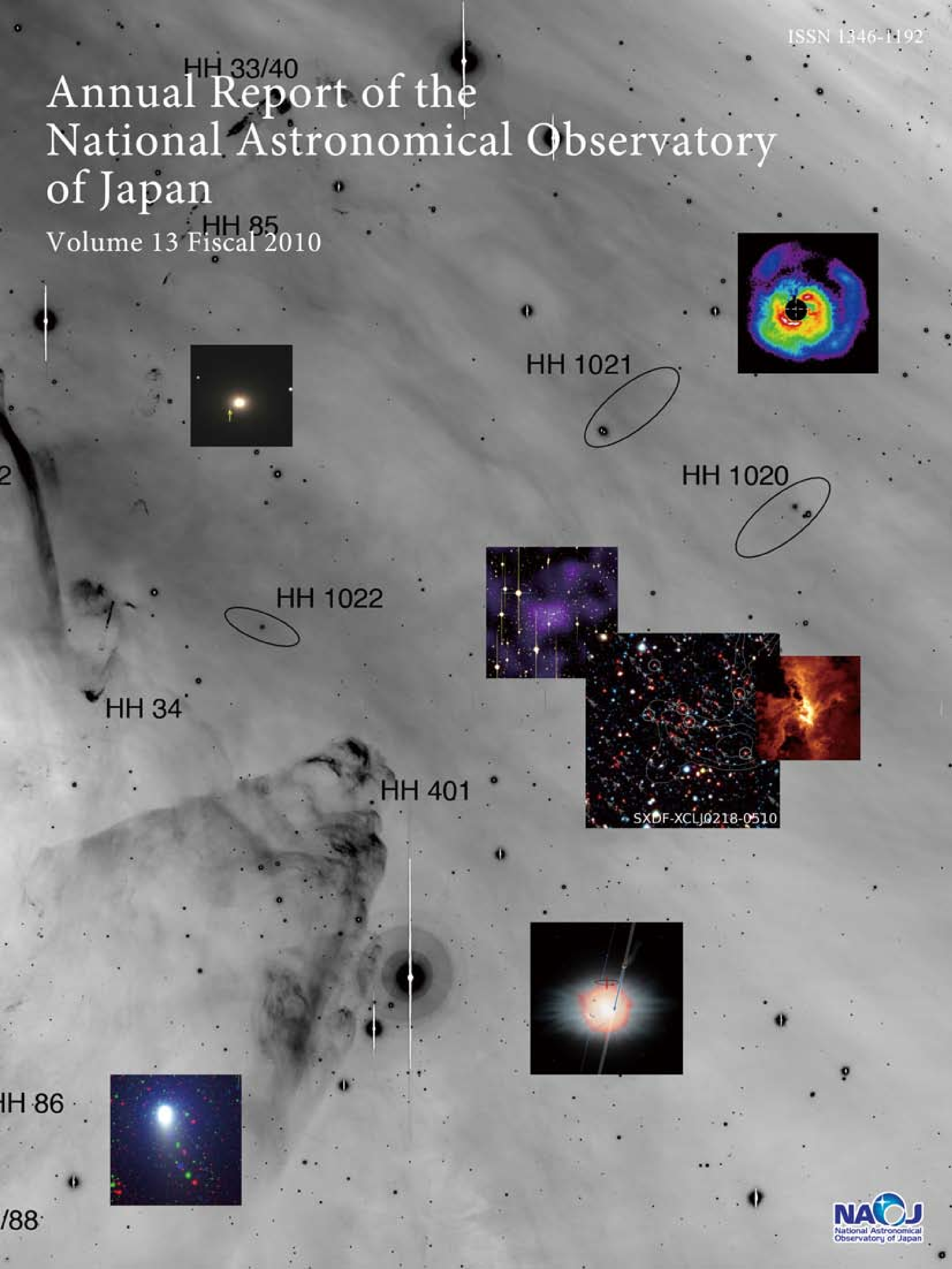
ISSN 1346-1192

Annual Report of the National Astronomical Observatory of Japan

Volume 13 Fiscal 2010



NAOJ
National Astronomical Observatory of Japan

Cover Caption

A large molecular cloud, Lynds 1641 in Orion, imaged by the Prime Focus Camera (Suprime-Cam) of the Subaru telescope. Many jets, accompanied by Herbig-Haro objects, which are produced by newborn stars, were newly discovered (Reipurth et al. Astronomical Journal 140, 699, 2010).

Postscript

Editor Publications Committee
HANAOKA, Yoichiro
UEDA, Akitoshi
OE, Masafumi
SÔMA, Mitsuru
NISHIKAWA, Jun
MIYOSHI, Makoto
YOSHIDA, Haruo

Publisher National Institutes of Natural Sciences
National Astronomical Observatory of Japan
2-21-1 Osawa, Mitaka-shi, Tokyo 181-8588, Japan
TEL: +81-422-34-3600
FAX: +81-422-34-3960
http://www.nao.ac.jp/

Printer **Kyoshin Co., Ltd.**
1-20-19, Miyamae, Suginami-ku, Tokyo 168-0081, Japan
TEX: +81-3-3331-0950
FAX: +81-3-3331-2541

Annual Report of the
National Astronomical Observatory of Japan
Fiscal 2010

TABLE OF CONTENTS

II Publications, Presentations

Annual Report of the
National Astronomical Observatory of Japan
Fiscal 2010

Shoken MIYAMA
Director General of NAOJ

PREFACE

We are pleased to present the Annual Report of the National Astronomical Observatory of Japan (NAOJ) for fiscal 2010.

On March 11, 2011, Japan was hit by the biggest earthquake ever recorded. The earthquake and subsequent tsunami destroyed a number of houses and buildings and claimed large number of lives (the number of people deceased and missing has exceeded 20,000.) It is hard to imagine the heartache and difficulty that the bereaved families are going through. I would like to express my deepest sympathies to the victims and their families.

Some of the NAOJ facilities were also damaged by the earthquake including VERA antenna of the Mizusawa VLBI Observatory in Oshu, two VLBI antennas in Takahagi and Hitachi, and 45-m antenna in Nobeyama. Damaged antennas will be restored with allocated disaster restoration budget. Two NAOJ campuses in Mizusawa and Mitaka had no serious damages, but in some rooms, books and files on the shelf fell down on the floor. In addition to these direct damages, electricity to the Mizusawa campus was cut for several days and employees during the business trip were prevented from returning home due to paralyzed transportation network over a few days. In the Mitaka campus too, many employees were unable to get home on the day of the earthquake and they were forced to stay at their office or Cosmos-Kaikan (accommodation for researchers visiting the Mitaka Campus.) Although the earthquake caused widespread damage in northeastern Japan, there were no casualties among NAOJ employees, their families or postgraduate students studying at NAOJ.

Tokyo Electric Power Company executed planned power outage in the Kanto Region including Tokyo for several weeks after the earthquake to make up for the shortage of its generating capacity due to the shutdown of the reactors at the Fukushima Daiichi nuclear plant. To respond to the nationwide efforts to save energy, we set up a task force to control power consumption at the NAOJ facilities and decided to use electricity at the Mitaka campus in the following order of priority: (1) Development of the ALMA receivers and HyperSuprimeCam for Subaru Telescope, which are under development in global partnership; (2) Operation of open-use instruments; (3) Advancement of researches; and (4) Maintaining appropriate work environment (e.g. using air conditioner). For further reduction, we requested degraded operation of super computers that consume vast amounts of electricity.

Having experienced a big earthquake, we became aware of various problems of our safety procedures such as evacuation from the building, safety confirmation of employees, and prompt setup of an emergency headquarters. As for myself, I was in central Tokyo on business at the time of the earthquake and could not get back to Mitaka for paralyzed traffic. We learned from this experience that nothing is predictable in a chaotic situation just after the disaster. To be more prepared for emergency, we are developing new safety measures as follows: (1) Ensuring emergency communication contact and making plans for prompt setup of an emergency headquarters with various cases in mind; (2) Preparing emergency communication means such as satellite telephone system between Mitaka and other branches (we learned that ordinary communication tools become unavailable just after the earthquake.); (3) Building stockpiles of blankets and emergency food for persons unable to return home and preparing public-address system that can be used even during power outage; (4) Establishing a backup system of valuable data for risk diversification by making use of NAOJ facilities located in various places in Japan; and (5) as a future challenge, discussing the provision of in-house power generation system in case of a blackout.

After the nuclear accident at the Fukushima Daiichi nuclear plant, Japan was terrified by radioactive materials leaking from the plant. Although the NAOJ Mitaka campus is located far from the nuclear plant (over 200 km away) and the radiation level does not seem so high, some of the foreign researchers left Japan for fear of radioactive contamination. Moreover, many of the international conferences scheduled for 2011 were cancelled, and we had to make various arrangements for it.

In the affected Tohoku region (northeastern Japan), many postgraduate students were temporarily prevented from studying at their universities. NAOJ provided some rooms at the Mitaka campus to support them. We will continuously make every effort to provide assistance for the disaster victims.

The other sad news was the passing of three professors emeritus at NAOJ: Masaki Morimoto in November 2010; Shinzo Enome in March 2011; and Yasujiro Wako in April 2011. I was really shocked by the news of their sudden passing. They were all distinguished astronomers and I learned a lot from them. I would like to extend my profound gratitude to them and offer my deepest condolences to their families.

I would not go into the details of the activities of each project and division here, which will be described in detail under the section of Scientific Highlights, but I'd like to touch on the progress of ALMA that announced its first call for proposals for Early Science Operation at the end of March 2011. Open-use observation with sixteen 12-m antennas is scheduled to start from October 2011. Although the performance of ALMA in the Early Science Operation phase falls far short of that in the full-scale operation phase with fifty-four 12-m antennas and twelve 7-m antennas, ALMA already boasts the world's highest performance at millimeter/submillimeter wavelengths. With the angular resolution 10 times better than Subaru or Hubble Space Telescope, ALMA is about to explore new astronomy. I hope ALMA will achieve unprecedented results and contribute to the growth of young researchers who will work all over the world.

Another event I should mention here is the 50th anniversary of the Okayama Astrophysical Observatory (OAO). We are very pleased that the observatory has achieved many scientific results over the past 50 years in cooperation among a lot of people, including those working in the observatory, former employees, and neighboring local municipal offices. It would be no exaggeration to say that the scientific achievements, technologies, and know-how of open-use operations obtained at the OAO led to the success of Subaru Telescope in Hawaii. The OAO is expected to play a central role in the inter-university project that will start from 2012, as well as in a joint development of the 3.8-m telescope with Kyoto University and Nagoya University. With the upcoming completion of the 3.8-m telescope, we are making a future plan for the OAO with a new form of installation in mind toward the realization of the Thirty Meter Telescope (TMT), which is a big challenge in the field of optical and infrared astronomy. We will continuously make our best effort toward high goals, while discussing the future role of the OAO.

Shoken Miyama

Shoken MIYAMA
Director General of NAOJ

I Scientific Highlights

(April 2010 – March 2011)

Chromospheres in Metal-Poor Stars Revealed from the He I 10830 Å Line

TAKEDA, Yoichi
(NAOJ)
TAKADA-HIDAI, Masahide
(Tokai University)

The atmospheric temperature of a star like the Sun gradually decreases with height, from $T \sim 6000$ K in the photosphere down to $T \sim 4000-5000$ K at the temperature minimum. However, as we go further upward, the temperature begins to rise again, reaching up to $T \sim 10^4$ K at a thin layer called "chromosphere". While such a temperature rise (chromospheric heating) must be caused by the transformation of some type of extra energy into thermal energy, it is generally believed that the dissipation of the magnetic energy in the magnetically active region may be responsible for this. One evidence supporting this view is the fact that the chromospheric activity tends to be lower for older stars (Skumanich law), which may be reasonably interpreted as the tendency of slower rotation for more aged stars (having suffered deceleration for a longer time), along with the above-mentioned scenario that magnetic fields created by rotation-induced dynamo are the cause of the chromospheric heating.

However, this activity–age–rotation relation has been confirmed only for comparatively young population I disk stars (with ages on the order of $\sim 10^{8-9}$ years), and little is known about the existence of chromospheres in very old metal-poor halo stars (age of $\sim 10^{10}$ years). Since rotation is likely to have almost come to rest in such old stars because of having suffered the long-lasting deceleration mechanism (magnetic braking), we may expect that chromospheres do not exist in these stars.

In order to confirm this expectation, we investigated whether the high-excitation He I line at 10830 Å (chromospheric indicator because its visibility means the existence of a high-temperature layer of $T \sim 10^4$ K) is observed in 33 disk/halo stars of various metallicities (from [Fe/H] ~ +0.3 down to [Fe/H] ~ −3.7) based on the high-dispersion spectra ($R \sim 20000$) obtained on 2009 July by using IRCS+AO188 of the Subaru telescope.

We then found, rather unexpectedly, that this He I 10830 Å line is seen in absorption in almost all stars, the strength of which is nearly constant irrespective of the metallicity at [Fe/H] < −0.5 (cf. Figure 1). Actually, even BD+44 493 (the most metal-poor star among our sample, which must be very old with an extremely low metallicity of [Fe/H] = −3.7) clearly shows an absorption feature of this line (Figure 2). This is an evidence that chromospheric activity at a basal level persists even for very old stars, despite that their rotations are considered to be slowed down and incapable of sustaining a dynamo, suggesting that some kind of chromospheric heating mechanism independent of rotation/magnetism (e.g., acoustic heating) may take place. Accordingly, we suspect that two types of chromospheres exist:

——(1) The rotation-dependent chromospheric activity (seen in less-aged population I stars still rotating appreciably), for which organized magnetic fields generated by the dynamo mechanism is responsible.

——(2) The "basal" chromosphere of the minimum level (ubiquitously existing but detectable only in old population II stars of very slow rotation), sustained by nonmagnetic/ non-rotation mechanism (such as the dissipation of acoustic waves).

See [1] for more details of this study.

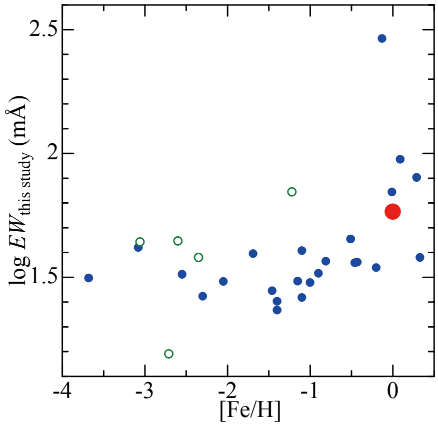


Figure 1: Logarithmic equivalent width (log *EW*) measured for the He I 10830 line, plotted against the metallicity ([Fe/H]). The results for 24 dwarfs (log $g > 3$) and 9 giants (log $g < 3$) are discriminated by filled (blue) and open (green) symbols, respectively. The Sun is indicated by the large (red) filled circle.

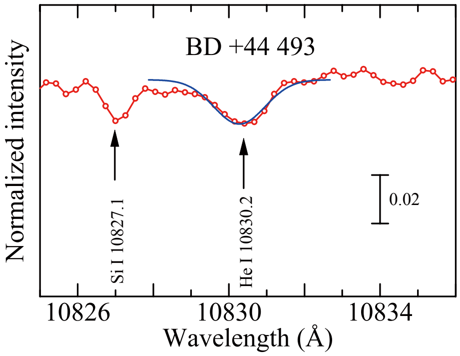


Figure 2: The spectrum of BD+44 493 ([Fe/H] = −3.7) in the neighbourhood of the He I 10830 line (red symbols). The blue solid line represents the Gaussian-fit function used for evaluation of the equivalent width.

Reference

[1] Takeda, Y., Takada-Hidai, M.: 2011, *PASJ*, **63**, S547.

The AGN–nuclear-starburst connections in a high-luminosity AGN population

IMANISHI, Masatoshi
(NAOJ)

ICHIKAWA, Kohei, TAKEUCHI, Tomoe
(Kyoto University)

KAWAKATU, Nozomu
(University of Tsukuba)

OI, Nagisa, IMASE, Keisuke
(GUAS/NAOJ)

Recent observations have shown that supermassive blackholes (SMBHs) are ubiquitously present at the center of galaxy spheroids (bulges and elliptical galaxies) and that the masses of SMBHs and galaxy spheroidal stars are correlated, suggesting that SMBHs and galaxies interact and coevolve each other.

Active Galactic Nuclei (AGNs) are the objects which convert gravitational energy generated through active mass accretion onto a SMBH, to radiative energy, and are shining very brightly. SMBHs in AGNs are in a growing-up phase, so that it is important to investigate the properties of star-formation (starburst) in AGNs, in order to understand the interplay and co-evolution of SMBHs and stars in the universe.

To observationally tackle this issue, it is indispensable to use an indicator with which to disentangle AGN and starburst activity clearly. Polycyclic Aromatic Hydrocarbons (PAH) emission features, seen in infrared 3–20 μm spectra, are detected in star-forming regions, but not in AGNs, because of the PAH destruction by strong Xrays from AGNs. Thus, PAH emission is a good probe of starburst activity. Furthermore, effects of dust extinction at infrared 3–20 μm are so small, compared to UV and optical wavelength ranges, that starburst luminosity is reasonably quantifiable from the observed PAH emission.

Previous observations have indicated that in a low- to moderate-luminosity AGN population, AGN and nuclear starburst luminosities positively correlate, namely, mass accretion onto a SMBH is higher in an AGN accompanied with more luminous nuclear starburst activity. However, it is observationally unclear whether the same relation holds in a high-luminosity AGN population. Theoretically, two contradictory scenarios were proposed.

(1) The mass accretion rate onto a central SMBH is controlled by starburst-induced viscosity, so that AGN luminosity should increase with increasing nuclear starburst luminosity. In this case, a similar luminosity correlation between AGN and nuclear starburst is expected in a high-luminosity AGN population.

(2) When nuclear starburst activity is intense, a large amount of gas is consumed for a starburst, and thus the remaining amount of gas accreted onto a SMBH decreases. In this scenario, starburst activity should be relatively weaker in a high-luminosity AGN population, compared to low- to moderate-luminosity AGNs. It was desirable to observationally distinguish between these two scenarios.

We have performed infrared 3–4 μm (L-band) slit spectroscopy of 30 PG QSOs, the representative high-luminosity AGN population in the local universe, using the IRCS infrared spectrograph attached to the Subaru 8.2 m telescope. Based on the observed luminosity of the 3.3 μm PAH emission feature, we quantitatively estimated the nuclear starburst luminosity in these objects and confirmed that the AGN – nuclear-starburst luminosity correlation holds in a wide luminosity AGN range (Figure 1)[1], supporting the scenario (1).

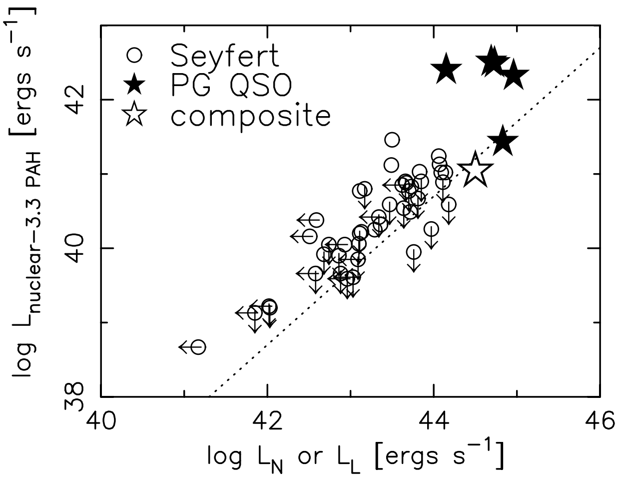


Figure 1: The abscissa and ordinate are indicators of AGN and nuclear starburst luminosities, respectively. Stars are the results for PG QSOs (= high-luminosity AGNs) obtained in this work. Filled stars are objects with detectable 3.3 μm PAH emission in individual spectra. Open star is the plot for the composite spectrum of PAH-undetected sources in individual spectra. Open circles are the plots for Seyfert galaxies (= low- to moderate-luminosity AGNs) previously studied. The nuclear starburst to AGN luminosity ratios are similar in AGNs with a wide luminosity range.

Reference

[1] Imanishi, M., et al.: 2011, *PASJ*, **63**, S447.

Active supermassive blackholes deeply buried in luminous infrared galaxies, unveiled with AKARI infrared satellite

IMANISHI, Masatoshi
(NAOJ)

NAKAGAWA, Takao, SHIRAHATA, Mai
(ISAS/JAXA)

OHYAMA, Yoichi
(ASIAA/TAIWAN)

ONAKA, Takashi
(University of Tokyo)

Luminous infrared galaxies (LIRGs) emit the bulk of their large luminosities ($>10^{11}\,L_\odot$) in the infrared, and thus must possess luminous energy sources hidden behind dust. Most LIRGs are gas-rich mergers, and the dust obscured energy sources can be merger-induced starburst activity (energy generation by nuclear fusion reaction inside stars) or AGN activity (the release of gravitational energy generated by a mass-accreting supermassive blackhole, and conversion to radiative energy) or the combination of the two. Since LIRGs are the dominant galaxy population in the distant universe at $z > 1$, in terms of the cosmic infrared radiation density, understanding the hidden energy sources of the LIRG population is important to uncover the history of galaxy formation and supermassive blackhole growth in the early universe. Distant LIRGs are generally too faint to investigate in detail with existing observing facilities, so that comprehensive understanding of nearby LIRGs continues to play an important role.

For this purpose, infrared spectroscopy at $\lambda > 2.5\,\mu$m is effective, because effects of dust extinction are small. Furthermore, Polycyclic Aromatic Hydrocarbons (PAH) emission features, found in this infrared wavelength range, can be used to distinguish between a starburst and an AGN, because the features are seen only in a starburst, but not in an AGN (due to PAH destruction by AGN's strong X-ray radiation). Finally, the optical depths of dust absorption features in this infrared wavelength range can be used to discriminate a starburst, where stellar energy sources and dust are spatially well-mixed, or a buried AGN, where the energy source (= a compact mass-accreting supermassive blackhole) is more centrally-concentrated than dust.

In nearby ultraluminous infrared galaxies with $L_{IR} > 10^{12}\,L_\odot$, since the compact nuclear regions (< several 100 pc) dominate the total luminosities, narrow slit spectroscopy using infrared spectrographs attached to ground-based large telescopes and Spitzer infrared satellite has been widely applied to understand the physical nature. However, for LIRGs with $L_{IR} < 10^{12}\,L_\odot$, spatially-extended emission is important, so that spectroscopy with large apertures is indispensable to quantitatively estimate the relative energetic importance of starbursts and buried AGNs.

We have performed infrared 2.5–5 μm slitless spectroscopy of >100 nearby LIRGs, using the IRC infrared instrument onboard the AKARI infrared satellite, and separated starburst-dominated LIRGs and buried AGN important sources, based on infrared spectral shapes (Figure 1). We found the trend that the energetic importance of buried AGNs increases with increasing galaxy infrared luminosity (Figure 2)[1,2].

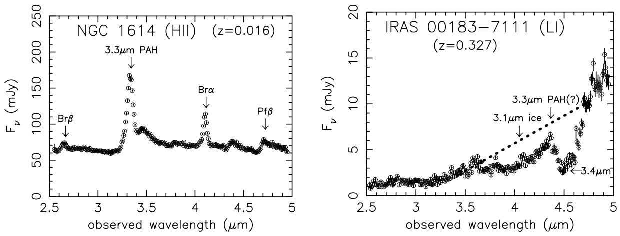


Figure 1: (Left): Infrared 2.5–5 μm spectrum of a starburst-dominated luminous infrared galaxy. PAH emission and hydrogen recombination lines (Brβ, Brα, Pfβ) are strong, and the continuum slope is flat. (Right): Spectrum of a buried AGN dominated galaxy. PAH emission is very weak, and strong dust absorption features are detected. The continuum is red, and steeply rising with increasing wavelength.

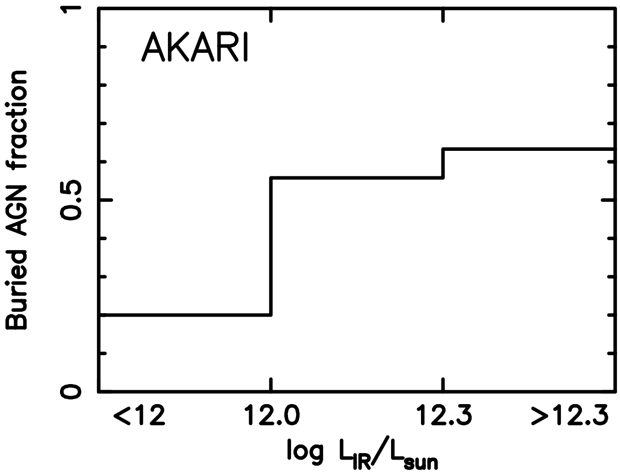


Figure 2: The abscissa and ordinate mean galaxy infrared luminosity and the detection rate of a luminous buried AGN, respectively. Buried AGNs become important with increasing galaxy infrared luminosity.

References

[1] Imanishi, M., et al.: 2008, *PASJ*, **60**, S489.
[2] Imanishi, M., et al.: 2010, *ApJ*, **721**, 1233.

The Central Mass Distribution of the Lensing Cluster SDSS J1004+4112

OGURI, Masamunee
(NAOJ)

The cluster SDSS J1004+4112 represents a rare example of a quasar lensed by a massive foreground cluster of galaxies, which was discovered in 2003 from the Sloan Digital Sky Survey data[1]. It consists of five images of a quasar at $z = 1.734$ produced by a cluster at $z = 0.68$. In addition, several background galaxies at $z = 2$–3 are also found to form multiple images (see Fig. 1).

Here we analyzed image configurations of many multiple images and time delays between quasar images to explore the central mass distribution of the cluster in details[2]. For this purpose, we developed a new lensing software called *glafic*, which implements the fast lens equation solver and several optimization methods to derive best-fit mass models.

Fig. 1 shows the best-fit mass model. The model successfully reproduces all the image configurations as well as time delays between quasar images. In the model the center of the dark matter distribution agrees well with the position of the central galaxy, in marked contrast to some of previous modeling of this system in which the offset between the dark matter center and central galaxy has been reported. Fig. 2 indicates that the radial mass distribution also shows an excellent agreement with the mass distribution inferred from *Chandra* X-ray observation[3].

The result suggests that the cluster is highly relaxed system which have formed in the early universe. In contrast, the standard structure formation model predicts that high-redshift clusters, as explored above, tend to be unrelaxed. The existence of such relaxed cluster already at $z = 0.68$ therefore should be confronted with numerical simulations.

Note that the lensing software *glafic* presented above is publicly available at
http://www.slac.stanford.edu/~oguri/glafic/

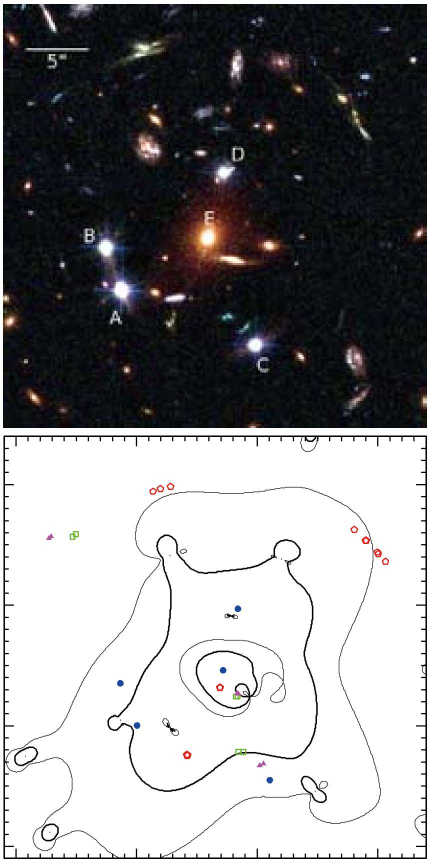


Figure 1: Top: *Hubble Space Telescope* image of SDSS J1004+4112, with quasar images indicated by A-E. Bottom: Critical curves for $z = 1.734$ (*thick*) and $z = 3.33$ (*thin*) obtained for the best-fit mass model.

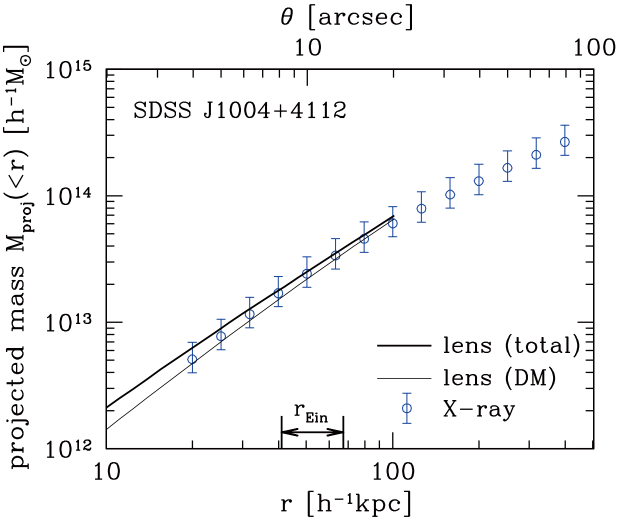


Figure 2: The radial mass distribution inferred from lensing analysis is compared with *Chandra* X-ray result.

References

[1] Inada, N., et al.: 2003, *Nature*, **426**, 810.
[2] Oguri, M.: 2010, *PASJ*, **62**, 1017.
[3] Ota, N., et al.: 2006, *ApJ*, **647**, 215.

Direct Measurement of Dark Halo Ellipticity with Weak Lensing

OGURI, Masamune (NAOJ)
TAKADA, Masahiro (University of Tokyo)
OKABE, Nobuhiro (ASIAA)
SMITH, Graham P. (University of Birmingham)

Clusters of galaxies are the system that galaxies are gravitationally bound thanks to the large amount of dark matter inside the clusters. Their density structure is determined mainly by the property of unknown dark matter particles as well as global history of the evolution of density fluctuations. Therefore, clusters of galaxies serve as an ideal laboratory to test the current standard structure formation scenario. The density structure has been well predicted by the so-called *N*-body simulation, which indicates that the dark matter distribution in clusters (dark halo) is highly flattened and deviates significantly from the simple spherical symmetric mass distribution[1]. Its observational test is very important, as the predicted shape reflects the cold and collisionless assumptions on dark matter particles, but the difficulty lies in the unseen nature of dark matter.

We conducted detailed analysis of *Subaru* Suprime-cam images[2] of 25 X-ray selected massive clusters to measure the ellipticity of projected dark matter distribution using weak lensing technique[3]. In particular we developed a method to analyze the two-dimensional shear map directly, without a priori assumption on the center of the dark matter distribution, which leads to reliable and robust measurements of the ellipticity (Fig. 1). A challenge lies in the weakness of the lensing signals which limits the detailed study. Here we adopt highquality wide-field *Subaru* images, and combine results for 25 clusters, to detect the deviation from spherical symmetry at 7σ level (Fig. 2). The measured mean ellipticity of $\langle e \rangle = 0.46 \pm 0.04$ is in excellent agreement with 0.42 predicted by *N*-body simulations, which represents the first direct confirmation of the flattened dark matter distribution, an important theoretical prediction of the current standard model. Our result also demonstrates the feasibility of exploring the nature of dark matter via flattening in the dark matter distribution.

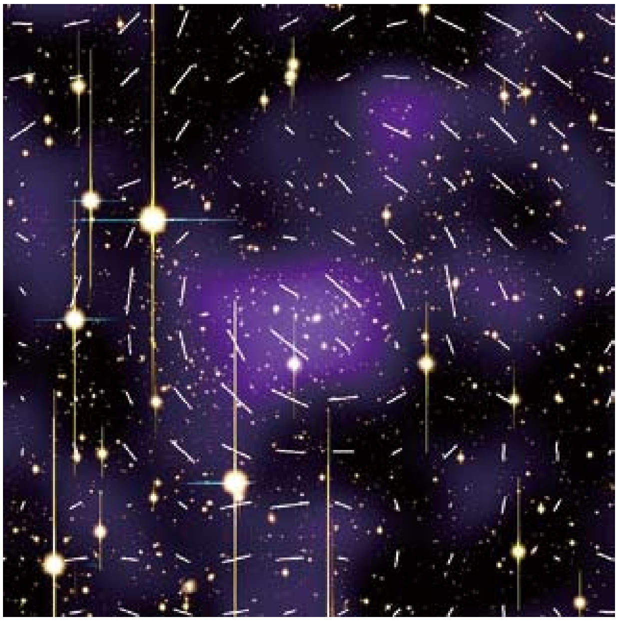


Figure 1: *Subaru* Suprime-cam image of Abell 2390, along with dark matter distribution inferred from weak lensing. Weak lensing distortions, which are obtained by averaging shapes of background galaxies, are shown by white bars. Dark matter densities measured by the weak lensing signal are indicated by purple hue.

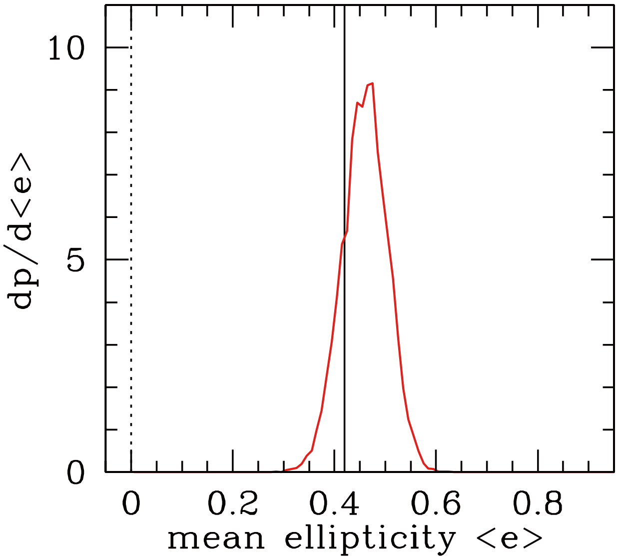


Figure 2: The likelihood distribution of average dark halo ellipticities among the cluster sample analyzed. The vertical solid line indicates the expected mean ellipticity from *N*-body simulation predictions.

References

[1] Jing, Y. P., Suto, Y.: 2002, *ApJ*, **574**, 538.
[2] Okabe, N., Takada, M., Umetsu, K., Futamase, T., Smith, G. P.: 2009, *PASJ*, **62**, 811.
[3] Oguri, M., Takada, M., Okabe, N., Smith, G. P.: 2010, *MNRAS*, **405**, 2215.

Formation of collapsing cores in subcritical magnetic clouds: three-dimensional MHD simulations with ambipolar diffusion

KUDOH, Takahiro
(NAOJ)

BASU, Shantanu
(University of Western Ontario)

We have performed fully three-dimensional magnetohydrodynamic simulations of collapsing core formation in molecular clouds with subcritical mass-to-flux ratio, including ambipolar diffusion[1]. Some of our major findings are as follows.

- Core formation in subcritical clouds is generally slow. The core develops gradually over an ambipolar diffusion time. When the initial mass-to-flux ratio is 0.5 times a critical value, the formation time is about 3×10^7 years for an initial midplane number density 10^4 cm^{-3}.
- The core formation time is shortened by strong velocity fluctuations. When the average strength of the velocity fluctuation is 3 times the sound speed, the formation time is about 5×10^6 years for the same cloud described above.
- The core formation time scales as $t_{core} \propto 1/\sqrt{\rho_{peak}}$, where ρ_{peak} is the value of the density peak during the first compression in the time evolution of the maximum density.
- In the case of a highly subcritical cloud, the core formation time does not strongly depend on the initial mass-to-flux ratio even when there is strong velocity fluctuation.
- Once a core forms, the density, velocity, and magnetic field structure of the core do not strongly depend on the initial strength of the velocity fluctuation. The infall velocities are subsonic and the magnetic field lines show weak hourglass shapes.

Figure 1 shows a close-up view of a core that is obtained in this simulation. The iso-surface contour shows the logarithmic density and the lines represent the magnetic field. The core is located in a filamentary structure that was induced by the initial velocity fluctuation. The magnetic field lines show an hourglass shaped structure because of the infall motion into the center of the core.

Figure 2 shows the core formation time as a function of ρ_{peak}, where ρ_{peak} is defined as the value of the density peak during the first compression in the time evolution of the maximum density on $z=0$. It shows that the core formation time is shorter when the density peak ρ_{peak} is greater, and indicates that it is nearly proportional to $1/\sqrt{\rho_{peak}}$. The density dependence is similar to that derived in quasistatically contracting magnetically supported cores, assuming a force balance of the magnetic force and gravity in the core.

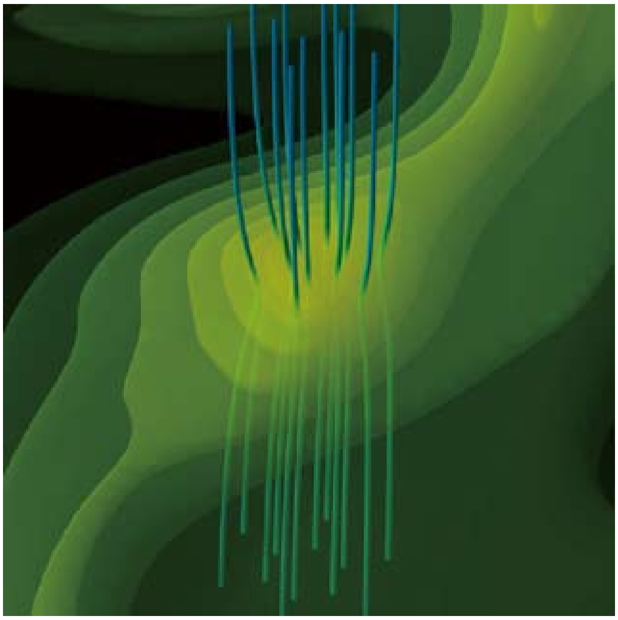


Figure 1: Isosurface of the logarithmic density, and the magnetic field lines near a core. The spatial scale is ~ 0.5pc.

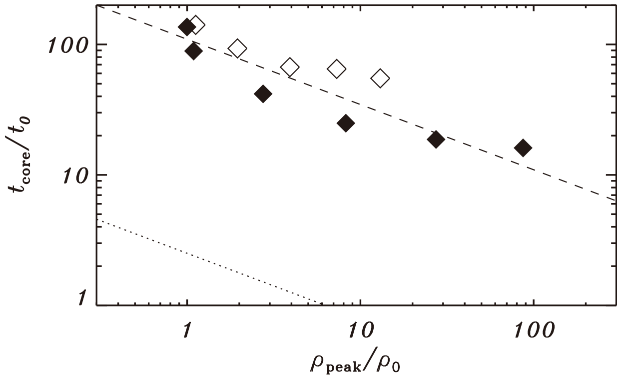


Figure 2: Core formation time as a function of the density peak during the first compression in its time evolution ($t_0 \simeq 2.5\times10^5$ year, $\rho_0 \simeq 4\times10^{20}$ g cm^{-3}). The filled and open squares represent the results for the initial k^{-4} and k^0 spectra, respectively. The dashed line shows that the core formation time is nearly proportional to $1/\sqrt{\rho_{peak}}$. The dotted line represents the free fall time of gas with density ρ_{peak} for comparison.

Reference

[1] Kudoh, T., Basu, S.: 2011, *ApJ*, **728**, 123.

The Primordial Origin Model of Magnetic Fields in Spiral Galaxies

SOFUE, Yoshiaki (Meisei University / University of Tokyo)
MACHIDA, Mami (Kyushu University)
KUDOH, Takahiro (NAOJ)

We propose a primordial-origin model for composite configurations of global magnetic fields in spiral galaxies (Figure 1)[1].

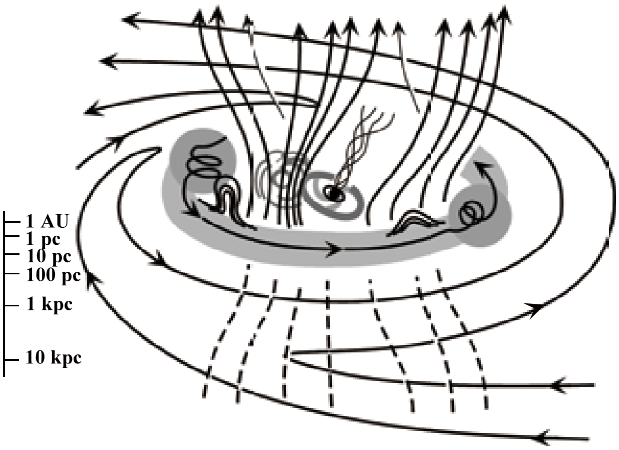


Figure 1: Schematic illustration of magnetic fields in spiral galaxies, including our Galaxy.

We show that a uniform tilted magnetic field wound up into a rotating disk galaxy can evolve into composite magnetic configurations comprising bisymmetric spiral (S=BSS), axisymmetric spiral (A=ASS), plane-reversed spiral (PR), and/or ring (R) fields in the disk, and vertical (V) fields in the center (Figure 2). By MHD simulations we show that these composite galactic fields are indeed created from a weak primordial uniform field, and that the different configurations can co-exist in the same galaxy (Figure 3). We show that spiral fields trigger the growth of two-armed gaseous arms. The centrally accumulated vertical fields are twisted and produce jets toward the halo. We find that the more vertical was the initial uniform field, the stronger is the formed magnetic field in the galactic disk.

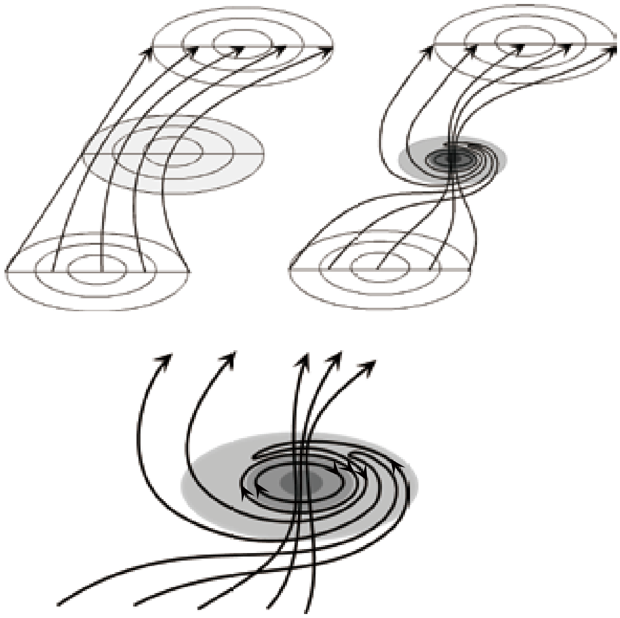


Figure 2: Origin of S, R and V fields from a tilted lopsided magnetic field in a rotating gaseous disk.

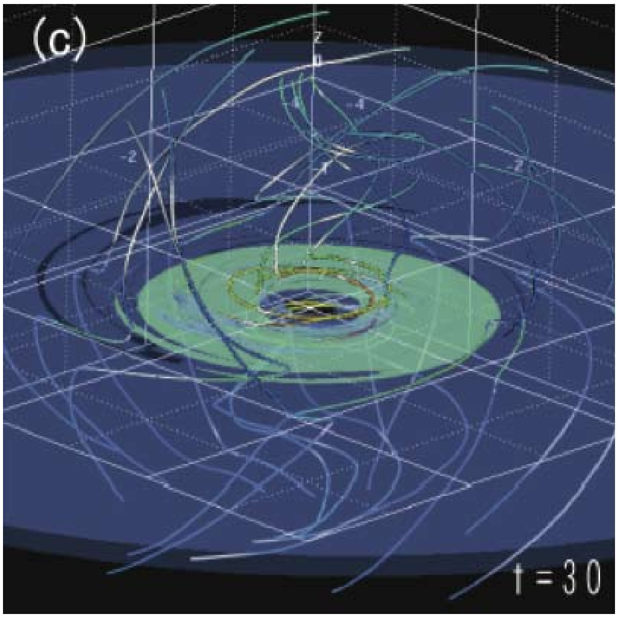


Figure 3: MHD simulation of the primordial origin model of magnetic field in a disk galaxy. The snap shot is taken at ~ 140 My. Curves show the magnetic lines of force. Blue and green surface show the iso-surface of the density. The initial magnetic field is uniform and its inclination to the rotation axis is 45°. The tilted field lines are wound up to create S configuration near the disk plane and V configuration in the central region.

Reference

[1] Sofue, Y., Machida, M., Kudoh, T.: 2010, *PASJ*, **62**, 1191.

Improvements in lunar gravity field modeling and orbit determination from SELENE multi-satellite tracking data types

GOOSSENS, Sander, MATSUMOTO, Koji, KIKUCHI, Fuyuhiko, SATO, Kaori
HANADA, Hideo, ISHIHARA, Yoshiaki, NODA, Hirotomo, ARAKI, Hiroshi
(NAOJ)

LIU, Qinghui, CHEN, Ming, HARADA, Yuji, KAWANO, Nobuyuki
(SHAO)

NAMIKI, Noriyuki
(Chiba Inst. Tech.)

IWATA, Takahiro
(JAXA/ISAS)

LEMOINE, Frank, ROWLANDS, David
(NASA GSFC)

The launch of SELENE, which acquired the first direct tracking data over the farside of the Moon by the use of 4-way Doppler data between a relay satellite and the main satellite, has resulted in a dramatic improvement of the knowledge of the global lunar gravity field[1,2]. In addition to the 4-way Doppler data, same-beam differential VLBI data between the two sub-satellites and two stations on Earth were also collected using the VERA network, and foreign stations in two international campaigns. The strength of differential VLBI data derives from the differencing out of common measurement errors, resulting in a precise measurement. Together with the SELENE 2-way and 4-way tracking data and historical tracking data, the VLBI data were processed into a new lunar gravity field model called SGM100i[3] (Fig. 1). The use of VLBI data allow longer arc lengths for the sub-satellites, increasing the sensitivity with respect to the lower degrees of the gravity field model. The resulting model shows a drastically improved performance in orbit determination, especially for edge-on geometries (where the satellite orbits over the deep farside). Correlations with topography also show an increase over the farside.

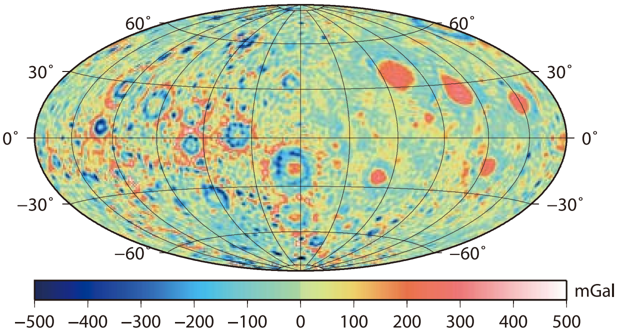


Figure 1: Free-air gravity anomalies at the lunar surface for the SGM100i model. The nearside is on the right.

SELENE was unique in the sense that it consisted of three satellites orbiting the Moon simultaneously, with a variety of terrestrial based tracking systems between all the satellites: 2-way tracking for each separate satellite, 4-way between one sub-satellite and the main satellite, and differential VLBI between the two sub-satellites. Using all these tracking data types, and data from the laser altimeter (at points where the ground tracks of different orbits intersect, the same topography should be measured), a comprehensive assessment of orbit precision was undertaken, and it was shown that the orbit precision of all satellites was improved when compared to the standard case using only 2-way data. The biggest improvements are for the main satellite during edge-on periods. Altimetry crossovers further help to obtain smooth orbit errors (computed from overlaps) at a level of 18 m throughout the mission[4] (Fig. 2).

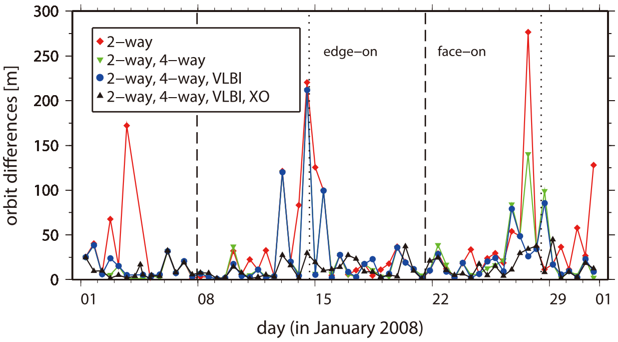


Figure 2: Orbit overlap results for the SELENE main orbiter using various tracking data types. The label “XO” stands for altimeter crossovers.

References

[1] Namiki, N., et al.: 2009, *Science*, **323**, 900.
[2] Matsumoto, K., et al.: 2010, *J. Geophys. Res.*, **115**, E06007.
[3] Goossens, S., et al.: 2011, *J. Geod.*, **85**, 205.
[4] Goossens, S., et al.: 2011, *J. Geod.*, in press.

Parent Galaxies of Extended Emission Line Regions in the Coma Cluster

YAGI, Masafumi, KOMIYAMA, Yutaka, KASHIKAWA, Nobunari, FURUSAWA, Hisanori
(NAOJ)

YOSHIDA, Michitoshi (University of Hiroshima)
OKAMURA, Sadanori (University of Tokyo)
GRAHAM, Alister W. (Swinburne University of Technology)
MILLER, Neal A. (University of Maryland)
CARTER, David (Liverpool John Moores University)
MOBASHER, Bahram (University of California, Riverside)
JOGEE, Shardha (University of Texas at Austin)

We constructed a special filter for Subaru/Suprime-Cam so that we can catch the Hα emission at the redshift of the Coma cluster, and conducted a survey of the Coma cluster. We discovered extended ionized hydrogen clouds out of galaxies, and reported[1,2]. In this year, we listed such clouds up, and investigate the statistical features of their parent galaxies[3]. Most of the parents are found to be starforming or post-starburst galaxies. Their velocity relative to the cluster is typically greater than 1000 km/s. We also compared the samples with galaxies with an UV asymmetry[4], which is a signature of a gas-stripping event, and found that the UV asymmetric galaxies are ALL included in the parent galaxies of the Hα clouds. These results suggest that the parent galaxies once lived out of the cluster and trapped by the gravity of the cluster. When they fell into the cluster, the gas was stripped by the interaction with the cluster hot gas and/or tidal force of the cluster. In this picture, we can imagine that if a parent galaxy is less massive with less gas they will soon lose all the gas to stop the starformation, while massive ones will hold gas to continue starformation. Such a correlation between the mass and the starformation is also confirmed. Previous studies show such extended ionized clouds in other clusters[5,6,7,8,9,10], but they are two in a cluster at most. In this study, we first reported many (14) parent galaxies in one cluster, and investigated the parents and their spatial and velocity distribution statistically.

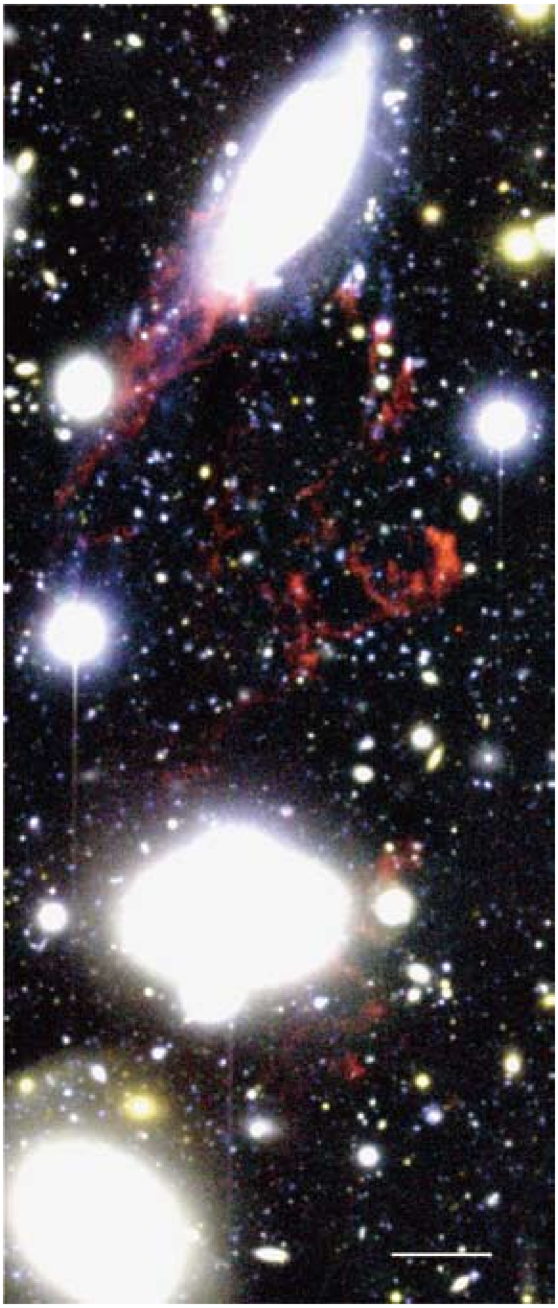


Figure 1: An example of the extended ionized clouds in the Coma cluster. B-band, R-band, and Coma Halpha clouds are shown as blue, green and red, respectively. The extended ionized clouds are seen as red. The bar at bottom right shows 10 kpc scale.

References

[1] Yagi, M., et al.: 2007, *AJ*, **660**, 1209.
[2] Yoshida, M., et al.: 2008, *ApJ*, **688**, 918.
[3] Yagi, M., et al.: 2010, *AJ*, **140**, 1814.
[4] Smith, R. J., et al.: 2010, *MNRAS*, **408**, 1417.
[5] Gavazzi, G., et al.: 2001, *ApJL*, **563**, L23.
[6] Yoshida, M., et al.: 2002, *ApJ*, **567**, 118.
[7] Cortese, L., et al.: 2007, *MNRAS*, **376**, 157.
[8] Sun, M., Donahue, M., Voit, M.: 2007, *ApJ*, **671**, 170.
[9] Kenney, J. D. P., et al.: 2008, *ApJL*, **687**, L69.
[10] Sun, M., et al.: 2010, *ApJ*, **708**, 964.

A New Hypothesis of Moscoviense Basin Formation: Double Impact Formation

ISHIHARA, Yoshiaki
(NAOJ)

MOROTA, Tomokatsu
(ISAS/JAXA)

NAKAMURA, Ryosuke
(AIST)

GOOSSENS, Sander, SASAKI, Sho
(NAOJ)

Selenodetic observations of the SELENE (Kaguya) mission provided us with globally accurate lunar gravity model[1] and high resolution lunar shape model[2]. Using those models, lunar crustal thickness model was also improved[3]. Recently, many studies, focused on interior structures of lunar impact basins, are conducted.

The Moscoviense basin is a mare-filled multi-ring basin located north-western lunar farside, and has the highest Bouguer gravity anomaly[1] and the thinnest crust on the Moon[3]. Because of ring offset and innermost partial ring (Figure 1), the Moscoviense basin formation was thought as an oblique impact. Comparing with the Freundlich-Sharonov basin (normal impact origin), the Moscoviense basin has a larger mantle plug than that of the Freundlich-Sharonov basin (Figure 1). Pre-impact depth of the Moho and outermost-ring size of both basins were almost the same (Figure 1), so the difference in mantle plug is probably due to the size of excavation. However, the excavation depth of an oblique impact is shallower than that of a normal impact. The large mantle plug of the Moscoviense basin is therefore hard to explain by a single oblique impact. We propose a new hypothesis for the Moscoviense basin formation, which is called “double-impact formation”[4]. This new hypothesis can explain offset of ring structures as difference of impact locations of first and second impact, and large mantle plug as a result of two-times of dynamic uplift process by first and second impact. The probability of occurence of double impact basin is about 50% for the Moscoviense basin case (Figure 2). This probability is not so small as to reject a double impact origin of the Moscoviense basin.

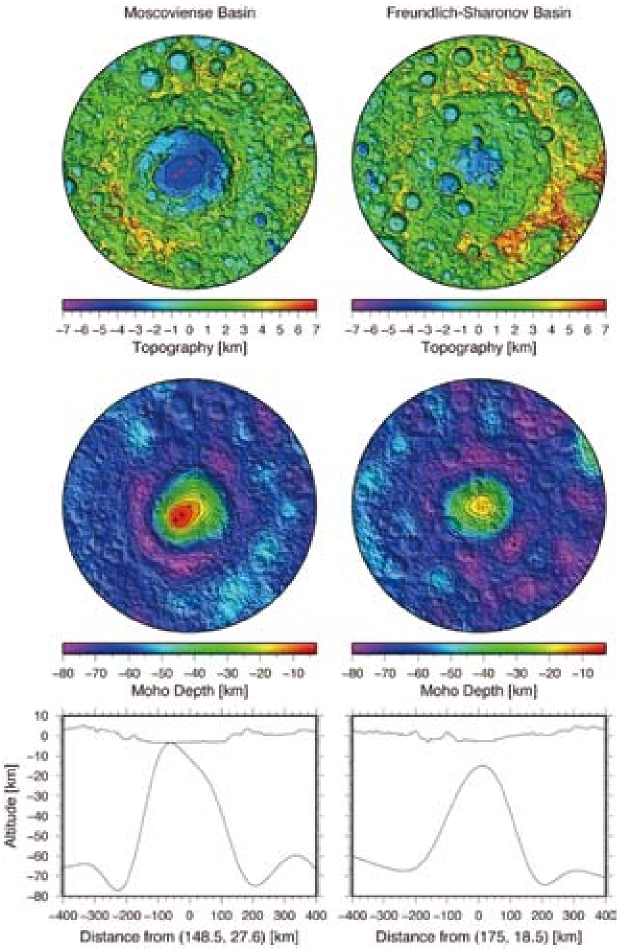


Figure 1: Topography (top), Moho structure (middle), and profiles (bottom) of the Moscoviense basin (left) and the Freundlich-Sharonov basin (right).

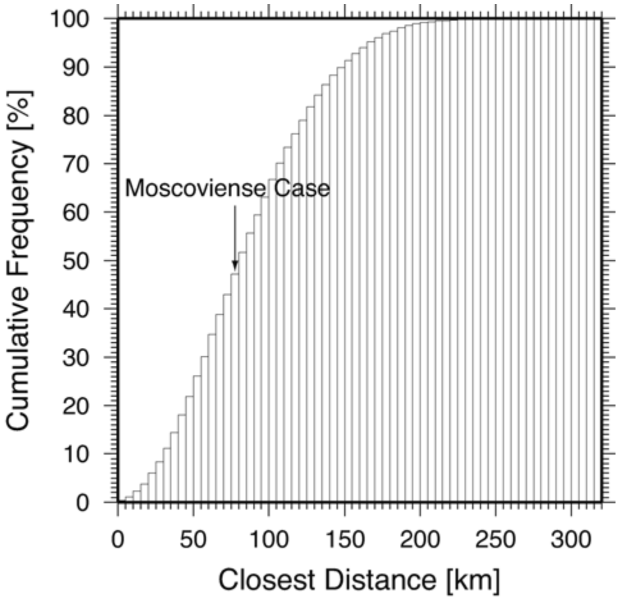


Figure 2: Cumulative frequency of the closest distance of impact locations for 50 random impact on the Moon. The arrow indicates the distance between the centers of the innermostand ourmost-ring features of the Moscoviense basin (80 km).

References

[1] Matsumoto, K., et al.: 2010, *JGR*, **115**, E06007.
[2] Araki, H., et al.: 2009, *Science*, **323**, 897.
[3] Ishihara, Y., et al.: 2009, *Geophys. Res. Lett.*, **36**, L19202.
[4] Ishihara, Y., et al.: 2011, *Geophys. Res. Lett.*, **38**, L03201.

Near-infrared Imaging Circular Polarimetry of the Orion Nebula using IRSF telescope with SIRPOL and Implications for the Origin of Homochirality

FUKUE, Tsubasa (NAOJ)
TAMURA, Motohide (NAOJ / Graduate University for Advanced Studies)
KANDORI, Ryo, KUSAKABE, Nobuhiko (NAOJ)
HOUGH, James H. (University of Hertfordshire)
BAILEY, Jeremy (University of New South Wales)
WHITTET, Douglas C. B. (Rensselaer Polytechnic Institute)
LUCAS, Philip W. (University of Hertfordshire)
NAKAJIMA, Yasushi, HASHIMOTO, Jun (NAOJ)

The origin of biomolecular homochirality is a longstanding mystery. The terrestrial living material consists almost exclusively of one enantiomer, L-amino acids. Amino acids in several meteorites have been found to have enantiomeric excesses of the same handedness as that seen in biological amino acids. Such detection of enantiomeric excesses in meteorites is consistent with the hypothesis that terrestrial life was seeded by the delivery of organics from outer space during the heavy bombardment phase of early Earth. Enantiomeric excesses can be produced by circularly polarized light through asymmetric photochemistry.

We report a wide-field and deep near-infrared (K_s band: 2.14 μm) circular polarization image in the Orion nebula, where massive stars and many low-mass stars are forming[1]. We use SIRPOL on the IRSF 1.4 m telescope in South Africa for the polarimetry.

Our results reveal that a high circular polarization region is spatially extended around the massive star-forming region, the BN/KL nebula (Fig. 1). Significant circular polarization extends over a region about 400 times the size of the solar system. However, other regions show no significant circular polarization. Most of the low-mass young stars do not show detectable extended structure in either linear or circular polarization, in contrast to the BN/KL nebula.

Our results and the feature of the Orion nebula implies as follows: If our solar system formed in a massive starforming region and was irradiated by net circularly polarized radiation, then enantiomeric excesses could have been induced, through asymmetric photochemistry, in the parent bodies of the meteorites and subsequently delivered to Earth. These could then have played a role in the development of biological homochirality on Earth.

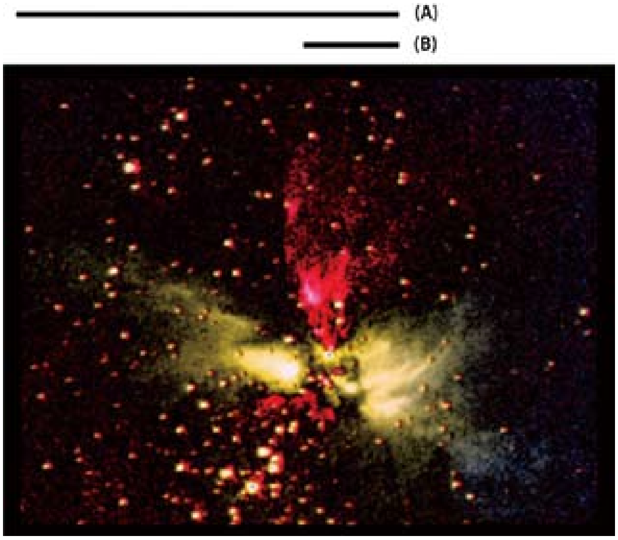


Figure 1: This image shows the degree of circular polarization of the Orion star-forming region. Yellow color expresses left-handed circular polarization, where the electric vector of light is rotated anticlockwise. Red color expresses righthanded circular polarization. The black bar denoted by (A) expresses about 400 times the size of the solar system, and the bar by (B) shows about 100 times the size of the Solar System.

Reference

[1] Fukue, T., Tamura, M., Kandori, R., Kusakabe, N., Hough, J. H., Bailey, J., Whittet, D. C. B., Lucas, P. W., Nakajima, Y., Hashimoto, J.: 2010, *Origins of Life and Evolution of Biospheres*, **40**, 335.

Origin of Molecular Outflow Determined from Thermal Dust Polarization

TOMISAKA, Kohji
(NAOJ)

As the origin of molecular outflows ejected from protostars, there are two major explanations: magnetic drive and entrainment. In the former, gas is magnetically driven and forms an outflow, In the latter, an optical jet which is ejected in the vicinity of a protostar entrains outer molecular gas and forms the outflow.

In order to conclude the problem, it is essential to observe the geometry of the magnetic field. We study the expected polarization for the thermal radiation from the magnetically aligned dust grains in the outflow[1]. Dust grains are aligned with their major axis being perpendicular to the magnetic field. Emission from such dust grains is polarized with the B-vector being perpendicular to the major axis. Figure 1 represents an outflow reproduced in the axisymmetric MHD simulation of the gravitational collapse of the molecular core[2]. This shows that a disk forms in the perpendicular direction to the magnetic field, which extends horizontally, and that an outflow is ejected in perpendicular direction to the disk.

Observing along the line-of-sight (los) specified with the angle from the z-axis θ, the Stokes' parameters q and u, which represent the polarization, are calculated with two angles, γ (the angle between the magnetic field and the celestial plane) and ψ (the position angle of the projected magnetic field) as $q = \int \rho \cos 2\psi \cos^2 \gamma ds$, $u = \int \rho \sin 2\psi \cos^2 \gamma ds$ where we perform the integration along the los.

Figure 2 indicates the expected polarization observation. This indicates (1) the pole-on (θ = 0º: top) view has an axisymmetric pattern. The molecular outflow is observed as a ring with a relatively high polarization degree whose B-vector is toward the azimuth direction. (2) Observing edge-on (θ = 90º: bottom), the pattern is mirror-symmetric and the disk has a higher polarization degree than the outflow. (3) Between these two (θ = 60º: middle), the pattern is 180º rotation-symmetry and both the disk and the outflow have lower polarization degree. These are characteristic for the configuration that the magnetic field has both poloidal and toroidal components.

The fact that the outflow has a toroidal magnetic field is a direct evidence of magnetic drive. When one of the patterns shown above is found, this indicates there exists the toroidal magnetic field and thus the outflow is magnetically driven.

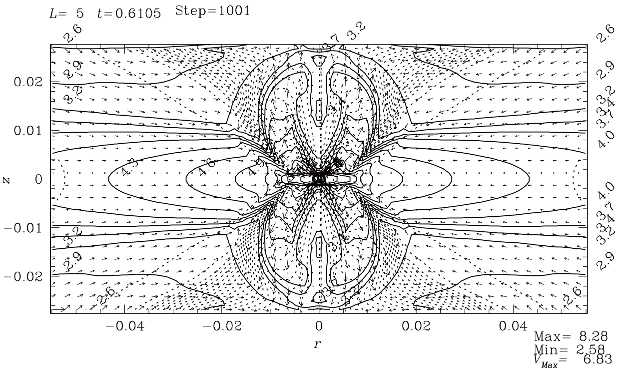


Figure 1: Simulation of molecular outflows. Solid and dashed lines represent, respectively, the isodensity contours and the poloidal magnetic field lines. Spatial extent is as large as 3000 AU × 6000 AU.

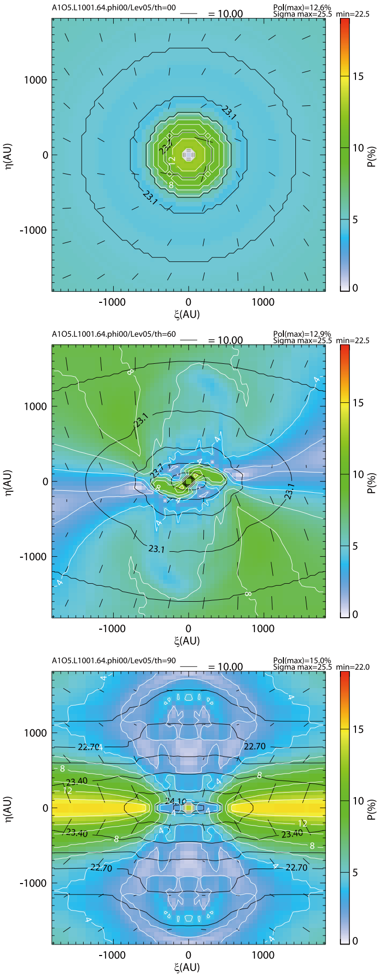


Figure 2: Expected distribution of the total intensity of the dust thermal emissions (black contour), polarization degree (white contour and color), and the directions of observed B-vector (black bar). (top) pole-on, (middle) θ = 60°, and (bottom) edge-on.

References

[1] Tomisaka, K.: 2002, *ApJ*, **575**, 306.
[2] Tomisaka, K.: 2011, *PASJ*, **63**, 147.

Second-order gauge-invariant cosmological perturbation theory

NAKAMURA, Kouji
(NAOJ)

Due to the precise measurement of the Cosmic Microwave Background (CMB) by WMAP, the “precision cosmology” has begun. The farthest region which we can observe by electromagnetic waves is the “last scattering surface” which corresponds to the epoch of the recombination of the hydrogen atom. This last scattering surface is observed as the CMB of 2.7 K by us. CMB is isotropic at the zeroth-order approximation, and its fluctuations (the first-order approximation) have the Gaussian property. Further, just now, Planck is trying to observe non- Gaussian nature (the second-order approximation).

Theory of cosmology should also be developed more precisely. Following to the above observations, it is necessary to construct the theory order by order. The second-order approximation is established by the general-relativistic second-order cosmological perturbation theory. Although the some issues of this theory was already completed in 2003[1], we have made great progress by the recent works.

In general relativity, gravity is represented by curved spacetimes and their metric g_{ab}. In its perturbation theories, we introduce two spacetime manifolds. One is the “physical spacetime” ($\mathcal{M}$, $\bar{g}_{ab}$). We want to clarify the properties of this manifold through perturbations. Another is the “background spacetime” ($\mathcal{M}_0$, g_{ab}) which have nothing to do with $\mathcal{M}$ but we introduce this as a reference of perturbations. We also write the relation between $\bar{g}_{ab}$ and g_{ab} by the perturbative expansion as

$$\bar{g}_{ab} = g_{ab} + \epsilon h_{ab} + \frac{1}{2}\epsilon^2 l_{ab} + O(\epsilon^3). \qquad (1)$$

Although $\mathcal{M}$ and $\mathcal{M}_0$ are distinct, through Eq. (1), we implicitly introduce the correspondence of points on these two manifold. This correspondence is called “gauge”. However, this correspondence is not unique but there is the degree of freedom in the choice of this correspondence due to the general covariance in the theory. This is called the “gauge degree of freedom”. This gauge degree of freedom arises from the relation between $\mathcal{M}$ and $\mathcal{M}_0$ and have nothing to do with the properties of $\mathcal{M}$ itself. Therefore, this gauge degree of freedom is unphysical. In general-relativistic perturbation theory, we have to exclude this gauge degree of freedom to obtain physical results. One of ways to do so is “gauge-invariant perturbation theories”. In these theories, we only treat “gauge-invariant perturbative variables” which are independent of the gauge degree of freedom. In linear theories, gauge-invariant formulations have been well-studied, however, in higher-order perturbation theories, it was non-trivial.

In Ref. [1], we assumed that the linear metric perturbation h_{ab} is decomposed as

$$h_{ab} = \mathcal{H}_{ab} + \pounds_X g_{ab}, \qquad (2)$$

where $\mathcal{H}_{ab}$ and X_a are gauge-invariant and gauge-dependent parts of h_{ab}, respectively. Based on this assumption, we showed that the second-order metric perturbation l_{ab}, the perturbation Q_1 of first order, and the perturbation Q_2 of the second order for an arbitrary tensor field Q are decomposed as

$$\begin{aligned} l_{ab} &= \mathcal{L}_{ab} + 2\pounds_X h_{ab} + \left(\pounds_Y - \pounds_X^2\right) g_{ab}, && (3) \\ {}^{(1)}Q &= {}^{(1)}\mathcal{Q} + \pounds_X Q_0, && (4) \\ {}^{(2)}Q &= {}^{(2)}\mathcal{Q} + 2\pounds_X {}^{(1)}Q + \left\{\pounds_Y - \pounds_X^2\right\} Q_0. && (5) \end{aligned}$$

Here, $\mathcal{L}_{ab}$, ${}^{(1)}\mathcal{Q}$, and ${}^{(2)}\mathcal{Q}$ are gauge-invariant part of l_{ab}, ${}^{(1)}Q$, and ${}^{(2)}Q$, respectively. We also showed that perturbations of the spacetime curvatures[2] and perturbations for matter fields[3] are also decomposed as Eqs. (4) and (5). Therefore, these formulae are universal.

In the above formulation, we assumed the decomposition (2) only. Then, we confirmed this assumption in the case of homogeneous isotropic background universe, derived the second-order field equations, and confirmed the consistency of these field equations[4,5.6]. Thus, we constructed the second-order gauge-invariant cosmological perturbation theory, successfully, and it is published as an invited review paper[7]. Finally, we can expect the further development of this second-order gauge-invariant perturbation thoery and comparison with observations.

References

[1] Nakamura, K.: 2003, *Prog. Theor. Phys.*, **110**, 723.
[2] Nakamura, K.: 2005, *Prog. Theor. Phys.*, **113**, 481.
[3] Nakamura, K.: 2009, *Phys. Rev. D*, **80**, 124021.
[4] Nakamura, K.: 2006, *Phys. Rev. D*, **74**, 101301(R).
[5] Nakamura, K.: 2007, *Prog. Theor. Phys.*, **117**, 17.
[6] Nakamura, K.: 2009, *Prog. Theor. Phys.*, **121**, 1321.
[7] Nakamura, K.: 2010, *Advances in Astronomy*, **2010**, 576273.

The origin and evolution of the halo PN BoBn1

OTSUKA, Masaaki (Space Telescope Science Insititute)
TAJITSU, Akito, IZUMIURA, Hideyuki (NAOJ)
HYUNG, Siek (Chungbuk National University)

Galactic halo planetary nebulae (PNe) are interesting objects as they provide direct insight into the final evolution of old, low-mass halo stars, and they are able to convey important information for the study of lowmass star evolution and the early chemical conditions of the Galaxy. About 14 objects have been identifend as halo members from their location and kinematics since the PN K 648 was discovered in the globular cluster M 15. However, in extremely metal-poor and C- and N-rich ([C, N/O]> 0, [Ar/H]< −2) halo PNe, there are unresolved issues on chemical abundances and evolution time scales. BoBn 1 (PN G108.4-76.1) is one of the C- and N-rich and extremely metal-poor halo PNe ([C, N/O]> 1, [Ar/H]= −2.22 ± 0.09, [Fe/H]= −2.39 ± 0.14; this work).

We have performed a comprehensive chemical abundance analysis of the extremely metal-poor halo PN BoBn 1 based on *IUE* archive data, Subaru/HDS spectra, VLT/UVES archive data, and *Spitzer*/IRS spectra[1]. We have detected over 600 lines in total and calculated ionic and elemental abundances of 13 elements using detected optical recombination lines and collisionally excited lines. In the optical high-dispersion spectra, we detected emission lines of fluorine and *s*-process elements such as rubidium, krypton, xenon, and barium. The amounts of [F/H], [Kr/H], and [Xe/H] suggest that BoBn 1 is the most F-rich among F-detected PNe and is a heavy *s*-process element rich PN. The enhancement of C, N, and heavy *s*-process element is comparable to carbon and *s*-process enhanced metal-poor (CEMP-*s*) stars with [Fe/H] > −2.5 [2]. This suggests that BoBn1 shares a similar origin an evolutionary history with CEMP-*s* stars.

We built photo-ionization model using non-LTE theoretical stellar atmosphere models to check consistency between elemental abundances derived by empirical methods and from the model and to investigate the properties of the central star, ionized nebula, and dust in a self-consistent way to fit the IR wavelength region. We compared the observed elemental abundances with theoretical nucleosynthesis model predictions for single stars and binaries with $Z = 10^{-4}$. The observed elemental abundances except for N could be explained either by a 1.5 $M_\odot$ single star model or a binary model composed of 0.75 $M_\odot$ + 1.5 $M_\odot$ stars. Using theoretical evolutionary tracks for post-AGB stars, we found that the progenitor of the central star was perhaps a 1–1.5 $M_\odot$ star and evolved into a system of a white dwarf with a core mass of ~0.62 $M_\odot$ and an ~0.09 $M_\odot$ ionized nebula. We estimated the dust mass of $5.8 \times 10^{-6} M_\odot$ in the nebula, which composes of amorphous carbon and PAHs. The presence of carbon dust indicates that BoBn 1 has experienced the third dredge up (TDU) during the thermal pulse AGB phase.

The progenitor might have been initially quite N-rich. The He-flash-driven deep mixing might be responsible for the over-abundance of N. From careful consideration of observational results and a comparison between BoBn 1 and K 648 in M 15, we propose that the progenitor was a binary and had experienced coalescence during its evolution to become a C- and N-rich PN. The similar evolutionary scenario would be also applicable to K 648 [3].

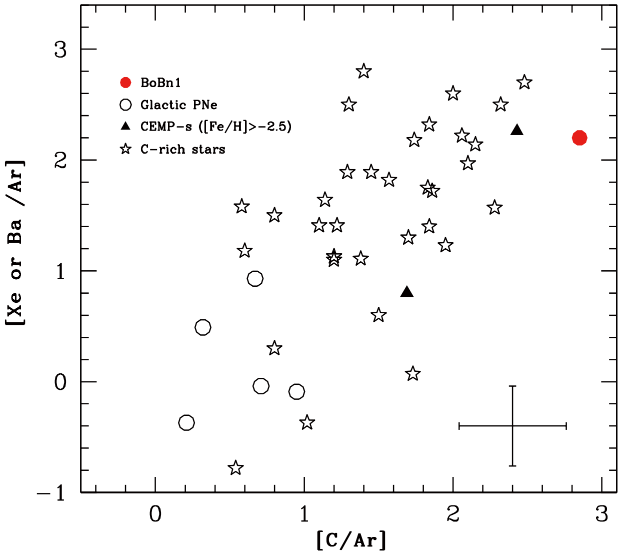


Figure 1: [Xe or Ba/Ar]-[C/Ar] diagram. The [Xe/Ar] value of BoBn 1 is upper limit. The diagram indicates that the C and *s*-process elements are certainly synthesized in the same layer and brought up to the stellar surface by the TDU.

References

[1] Otsuka, M., et al.: 2010, *ApJ*, **723**, 658.
[2] Aoki, W., et al.: 2007, *ApJ*, **655**, 492.
[3] Alves, D. R., et al.: 2000, *AJ*, **120**, 2044.

A large number of $z > 6$ galaxies around a QSO at $z = 6.43$: Evidence for a protocluster?

UTSUMI, Yousuke
(The Graduate University for Advanced Studies / NAOJ)

GOTO, Tomotsugu
(Institute for Astronomy, University of Hawaii / Subaru Telescope)

KASHIKAWA, Nobunari, MIYAZAKI, Satoshi, KOMIYAMA, Yutaka
(The Graduate University for Advanced Studies / NAOJ)

FURUSAWA, Hisanori
(NAOJ)

Roderik, Overzier
(Max-Planck Institut f¨ur Astrophysik)

QSOs have been thought to be important for tracing highly biased regions in the early universe, from which the present-day massive galaxies and galaxy clusters formed. While overdensities of star-forming galaxies have been found around QSOs at $2 < z < 5$[1,2,3], the case for excess galaxy clustering around QSOs at $z > 6$ is less clear. Previous studies with HST have reported the detection of small excesses of faint dropout galaxies in some QSO fields, but these surveys probed a relatively small region surrounding the QSOs[4]. To overcome this problem, we have observed the most distant QSO at $z = 6.4$ using the large field of view of the Suprime-Cam (34′ × 27′. Newly-installed red-sensitive fully depleted CCDs allowed us to select Lyman break galaxies (LBG) at $z \sim 6.4$ more efficiently. We found seven LBGs in the QSO field, whereas only one exists in a comparison field[5]. The significance of this apparent excess is difficult to quantify without spectroscopic confirmation and additional control fields. The Poisson probability to find seven objects when one expects four is ~10%, while the probability to find seven objects in one field and only one in the other is less than 0.4%, suggesting that the QSO field is significantly overdense relative to the control field. These conclusions are supported by a comparison with a cosmological SPH simulation which includes the higher order clustering of galaxies. We find some evidence that the LBGs are distributed in a ring-like shape centered on the QSO with a radius of ~3 M pc. There are no candidate LBGs within 2 Mpc from the QSO, i.e., galaxies are clustered around the QSO but appear to avoid the very center. These results suggest that the QSO is embedded in an overdense region when defined on a sufficiently large scale (i.e. larger than an HST/ACS pointing). This suggests that the QSO was indeed born in a massive halo. The central deficit of galaxies may indicate that (1) the strong UV radiation from the QSO suppressed galaxy formation in its vicinity, or (2) that star-formation closest to the QSO occurs mostly in an obscured mode that is missed by our UV selection.

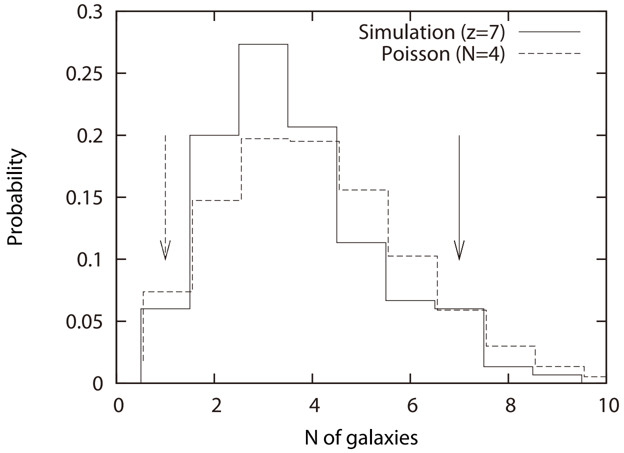


Figure 1: The probability distribution of how many galaxies would be found within the field of view of Suprime-Cam using our selection criteria. The solid histogram is based on the simulation of galaxy formation at $z = 7$ while the dashed histogram is the poisson distribution assuming the average value is $(7 + 1)/2 = 4$. The solid and the dashed arrows indicate the number of galaxies in the QSO field and the SDF comparison field, respectively.

References

[1] Djorgovski, S. G., et al.: 2003, *ApJ*, **596**, 67.
[2] Miley, G. K. et al.: 2004, *Nature*, **427**, 47.
[3] Kashikawa, N., et al.: 2007, *ApJ*, **663**, 765.
[4] Kim, S., et al.: 2009, *ApJ*, **695**, 809.
[5] Shimasaku, K., et al.: 2005, *PASJ*, **57**, 447.
[6] Utsumi, Y., et al.: 2010, *ApJ*, **721**, 1680.

Subaru Lightcurve Observations of Sub-km-sized Main-belt Asteroids

DERMAWAN, Budi (Bandung Institute of Technology)
NAKAMURA, Tsuko (Teikyo-Heisei University)
YOSHIDA, Fumi (NAOJ)

Investigations of the spin period and shape distributions for a certain asteroid group using their lightcurve observations are essential to understand collisional evolution of that group. We therefore conducted lightcurve observations of such asteroids with the Subaru telescope + Suprime-Cam, which can detect many asteroids in a single field of view at the same time. And from them we selected main belt asteroid (MBAs) and determined their spin periods and shapes. Although about 4000 asteroids are currently listed in the spin period catalogue, it includes a very small number of sub-km-sized MBAs which are considered to be outcomes from the collisional evolution in the main asteroid belt. Meanwhile, most asteroids detected by our Subaru observation are in the size range between 0.1–1 km in diameter. Hence we would say that our observation is the first dedicated lightcurve observation of sub-km-sized asteroids.

The observation was done in October 2001. We surveyed a sky field of 34′×27′ near opposition and the ecliptic, covering a time-span of 8.3 hours for a single night. As a result we detected 127 asteroids down to a limiting magnitude of $R \approx 24.6$ mag. Among them, we picked up 68 asteroids showing reliable spin periods. Out of 68 asteroids, it turned out that the spin periods of 33 asteroids are faster than 2.2 h, which are often called fast-rotator MBAs (FRAs). The fraction of fast-rotating asteroids is found to be about 48%. This is the first observational confirmation on the existence of FRAs among sub-km MBAs; those detected small MBAs fill up the region that used to be almost void of asteroids in the spin period vs size distribution (see Fig. 1)[1].

We calculated the shapes of 68 asteroids based on their lightcurve amplitudes and then found a tendency that FRAs are more spherical than non FRAs. This tendency was confirmed by rigorous statistical tests[2]. Our conclusion is that most of the fast-rotators show a strong trend that they are more spherical in shape than any other groups. Considering several timescales of the orbital and rotational evolution for small asteroids in the main asteroid belt, we showed that the above mentioned trend is not due to coincidence but primordial. Therefore, referring to shape distributions of impact fragments produced in laboratory experiments, our discovered sphericity preference of small fast-rotating asteroids probably requires some spin deceleration mechanisms, which selectively worked on all elongated objects during their impact formation and/or subsequent evolution.

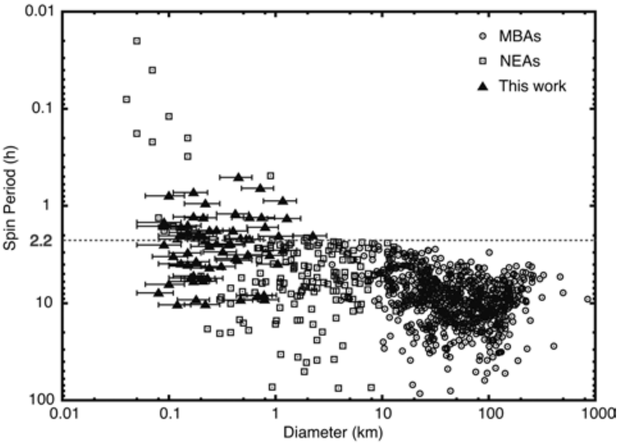


Figure 1: Distribution of size vs. spin period for know asteroids (open circles and open squares) and very small asteroids discovered (filled triangles) in this survey observation. Asteroids being above the horizontal line of 2.2 h are FRAs.

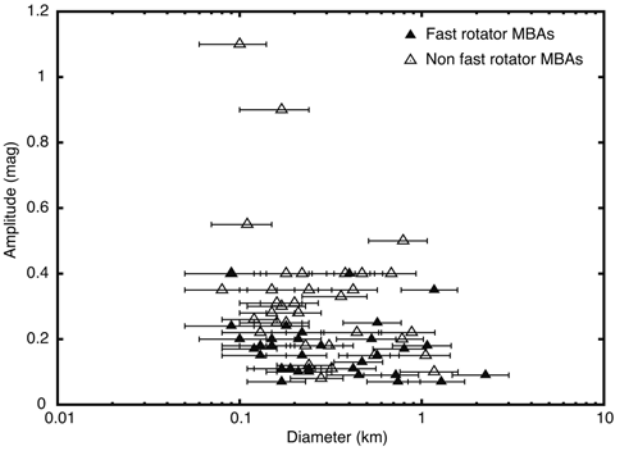


Figure 2: Diameter vs. lightcurve amplitude for 68 sub-kmsized MBAs.

References

[1] Dermawan, B., Nakamura, T., Yoshida, F.: 2011, *PASJ*, **63**, S555.
[2] Nakamura, T., Dermawan, B., Yoshida, F.: 2011, *PASJ*, **63**, S577.

Elliptically Weighted HOLICs for Weak-lensing Shear Measurement. I. Definitions and Isotropic Point-spread Function Correction

OKURA, Yuki
(NAOJ)

FUTAMASE, Toshifumi
(Tohoku University)

Restriction of cosmological parameters is most important study of Cosmology. These cosmological parameters can express behavior of the universe from early universe to future, and because these parameters contain the dark energy and the dark matter, this restriction is a one of chances to investigate them. One of methods of the restriction is to measure the power spectrum of mass of large scale structure which depends on cosmological parameters, and because gravitational lensing are made by mass distribution, cosmological paramters can be restricted by measuring cosmic shear which is made by mass distoributioin of large scale structure.

Shear is a component of distortion by gravitational lensing and is analyzed by weak lensing analysis method. One of the most widely used analysis is KSB method[1] which measures quadrupole moments, defines ellipticity by the moments and estimates shear from the ellipticity. KSB method can obtain shear easily, but precision is not high by rough correction and approximation. Because cosmic shear is especially weak, it is widely recognised that KSB method doesn't have enough precision. Therefore many new analysis methods and corrections have been developed.

Our studies HOLICs[2] also developed new analysis methods. HOLICs method series can obtain more precise results by using higher order moments. KSB method has a systematic error which is due to approximate a elliptical weight function by a circular weight function. E-HOLICs method can avoid the error by using the elliptical weight. This systematic error can be estimated in simple case. If image is simple elliptical Gaussian which has ellipticity δ_{true}, estimated ellipticity by KSB method $\delta_{\mathrm{estimate}}$ is obtained as

$$\delta_{estimate} = \delta_{true}\frac{1 - \delta_{true}^2/4}{1 - \delta_{true}^2} \qquad (1)$$

Therefore KSB method estimate ellipticity with over-estimation. However, E-HOLICs method can obtain δ_{true} without systematic error in this situation.

For verification, we tested E-HOLICs method with "Shear TEsting Programme 2" simulation data[3], and obtain the results that KSB method has a systematic error which depended on ellipticity and E-HOLICs method doesn't have the systematic error. Figure 1 shows the result, the horizontal axis means input shear and the vertical axis means difference between estimated shear and input shear, and left hand is plots of the result of KSB method and right hand is plots of the result of E-HOLICs method. We can see the dependencies on ellipticity of these methods.

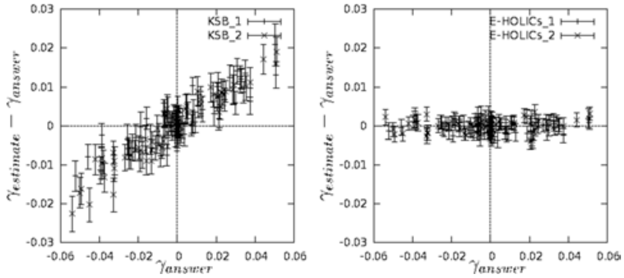


Figure 1: Plots of results of tests of STEP 2. The left side shows results of the KSB method and the right side shows results of the E-HOLICs method, with the selection rh > 3.3 (pixels), S/N > 20, and $|\delta$ intrinsic$| < 1.0$. The horizontal axis represents the value of inputted shear (answer), and the vertical axis represents the value of the difference between estimated shear and inputted shear. The subscripts 1 and 2 are components of directions.

We developed E-HOLICs method which can correct the systematic error which depends on ellipticity which KSB method has. However , there are other many systematic error, for example these depend on S/N. We still must correct much systematic error for analysing cosmic.

References

[1] Kaiser, N., Squires, G., Broadhurst, T.: 1995, *ApJ*, **449**, 460.
[2] Okura, Y., Futamase, T.: 2011, *ApJ*, **730**, 9.
[3] Massey, R., et al.: 2007, *MNRAS*, **376**, 13.

Forty seven new T dwarfs from the UKIDSS Large Area Survey

ISHII, Miki, TAMURA, Motohide
(NAOJ)
KUZUHARA, Masayuki
(University of Tokyo)
BURNINGHAM, Ben, PINFIELD, David
(University of Hertfordshire)
and the UKIDSS Cool Dwarf Science Working Group

Observations in the 1980–90s have established that the conventional spectral sequence from O to M stars is followed by even cooler dwarf stars—Some L dwarfs and all T dwarfs ($T_{\rm eff} \lesssim 1300$ K) correspond to "brown dwarf" whose mass is below 0.075 solar masses. Previous large area surveys (e.g., 2MASS, SDSS) have discovered about 600 L dwarfs and 100 T dwarfs so far. On the other hand, a deeper large area survey is necessary to detect more and cooler (i.e., intrinsically fainter) brown dwarfs, which will extend our understanding of star and planet formation, both through detailed study of individual systems and through statistical population studies. Ongoing UKIDSS Large Area Survey (LAS) meets the requirement. The UKIDSS/LAS will cover 4000 sq. degrees using the UKIRT Wide Field Camera (WFCAM), with 4 mag deeper detection limit than 2MASS. From the resultant data, the coolest T dwarfs and, further more, a new class of dwarfs cooler than T (Y dwarfs) are expected to be found.

The Cool Dwarf Science Working group, an international collaboration including UK and Japanese astronomers, has developed the selection method using UKIDSS *Y JHK* colors and the combination of SDSS *z-J*, *i-z* to select L/T and Y dwarf candidates. Followup spectroscopy using large telescopes such as Subaru and Gemini is adopted to determine their spectral types finally. As a result, (1) we have discovered 80 T dwarfs from 980 sq. degrees of sky, which means that the number of known T dwarfs have been almost doubled (as of 2010)[1]; (2) the coolest star ever known has been discovered by the UKIDSS[2] (Figure 1); (3) we have identified spectrally peculiar objects, which may represent hitherto unrecognised tracers of composition and/or gravity[1] (Figure 2). We have used our sample to estimate space densities for T6-T9 dwarfs. Our analysis suggests that the substellar mass function is declining at lower masses, which is at odds with results for young clusters.

After the completion of UUKIDSS/LAS, we expect to discover Y dwarfs together with hundreds of T dwarfs, which will shed light on the formation processes of substellar objects, the Initial Mass Function (IMF) and the formation history.

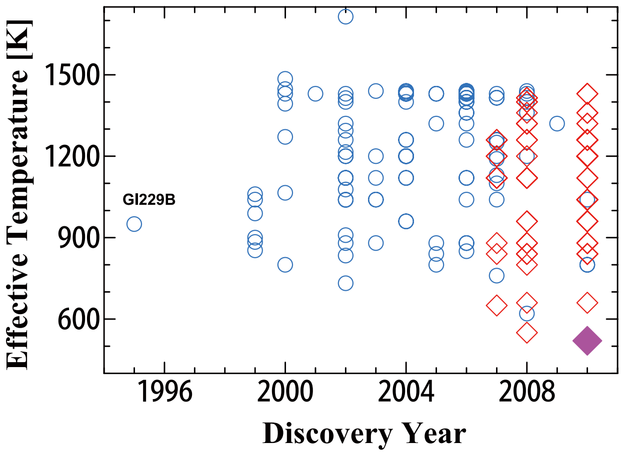


Figure 1: History of the coolest brown dwarf discovered: T dwarfs discovered by UKIDSS (◇) and previous surveys (○) are plotted against their discovery year.

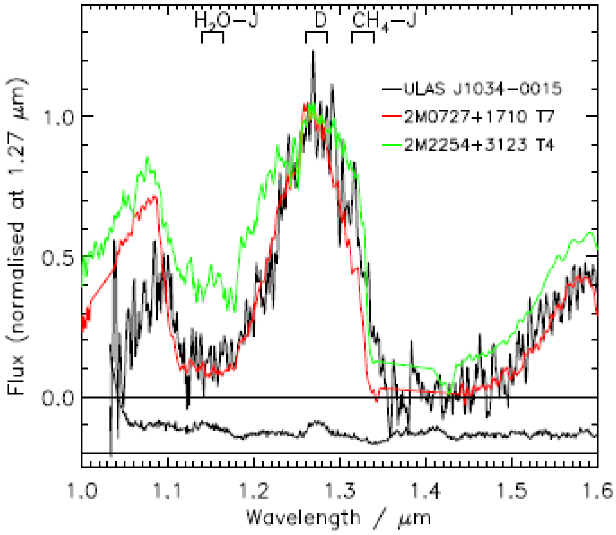


Figure 2: Example of a peculiar spectral type (ULAS J1034). CH_4-J index implies an earlier type than that suggested by the H_20-J index.

References

[1] Burningham, B., et al.: 2010, *MNRAS*, **406**, 1885.
[2] Lucas, P. W., et al.: 2010, *MNRAS*, **408**, 56.

Mass-Dependent Clustering History of K-selected Galaxies at $z < 4$ in SXDS/UDS Field

FURUSAWA, Junko, SEKIGUCHI, Kazuhiro, TAKATA Tadafumi, FURUSAWA, Hisanori
(NAOJ)

SHIMASAKU, Kazuhiro
(University of Tokyo)

SIMPSON, Chris
(Liverpool John Moores University)

AKIYAMA, Masayuki
(Tohoku University)

It has been a big challenge to study galaxy formation and evolution in an observational manner at the epochs above the redshift 2, by means of star formation rate, stellar masses, and spatial clustering of galaxies. However, those studies suffered from observational limits and have been performed only for paritcular galaxy populations which are selected based on galaxy colors. The discussions for each population were done separately and relation among them have been uncertain. Our study aimed at discussing the galaxy formation and evolution across the populations by using the whole galaxy populations which is selected by photometric redshift (photo-z).

The stellar mass of galaxies is a key parameter to describe galaxy formation and evolution, since it is relevant to the star formation history of galaxies. In various surveys on different patches of the sky have been undertaken for this scientific driver, reaching an interesting common view in which star formation rates of high-mass galaxies seem to get mild and stable earlier than those of lowmass galaxies. However, there still remain significant differences in the amplitudes and the epoch of the active star formation among the surveys in various mass ranges of galaxies, needing a more wide and deep observation to give a stringent clue to those questions.

We investigated mass-dependent galaxy evolution based on a large sample of (~50,000) *K*-band selected galaxies in a multi-wavelength catalog of the Subaru/XMM-Newton Deep Survey (SXDS) and the UKIRT Infrared Deep Sky Survey/Ultra Deep Survey (UDS). This unique dataset in a contiguous deep ($K_{\mathrm{AB}} \leq 23.5$) and wide field covering a 10 times larger area than those in other surveys with equivelent depths, allows us to discuss reliable stellar mass functions and clustering of galaxies up to $z = 4$ based on a photo-z technique. In addition, we obtained spectroscopic redshifts, especially for galaxies at $z > 2$ with Subaru/MOIRCS, confirming that the accuracy of our photo-z is sufficiently good to discuss the galaxy evolution.

Detailed discussions of the relation between stellar masses and evolution of clustering of galaxies is a unique and primary result of this study. The findings include the followings: (1) An increase of the stellar mass density in the universe is more rapid at $z > 2$ and gets relatively smaller at the below $z \sim 2$. (2) Evolution of the galaxy clustering depends on the stellar masses of galaxies, in which higher-mass galaxies tend to show stronger clustering. This trend seem to apply up to $z = 4$ (Figure 1). (3) Comparison between star-forming galaxy population (s*BzK*) and quiescent pupulation (p*BzK*) shows no clear correlation in redshift and clustering strength of the two pupulations. Post star-formation pupulations tend to have stronger clustering.

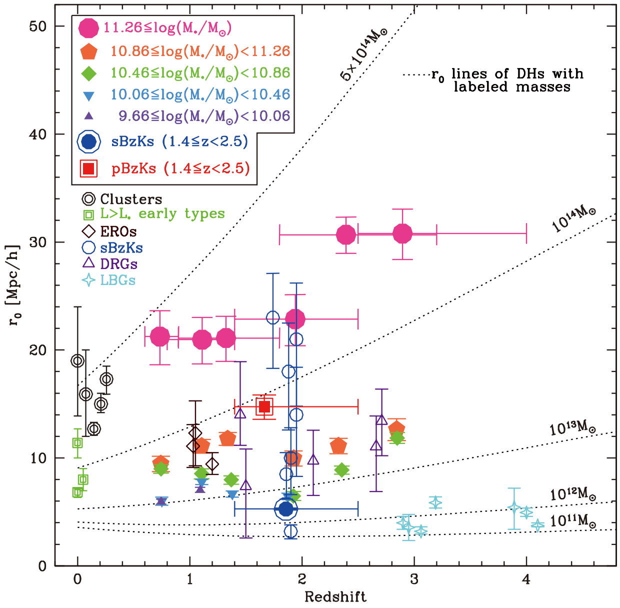


Figure 1: The redshift evolution of correlation lengths of various types of objects. Filled symbols show our result. Dotted lines show the correlation lengths of dark haloes with four different typical masses. Hollow symbols show correlation lengths of the different populations of objects (Double black circles: present-day clusters of galaxies [1]. Double light green squares: present-day luminous early-type galaxies and Brown diamonds: EROs[2]. Purple triangles: DRGs, Blue circles: s*BzK*s with various K magnitude range and Cyan crosses: LBGs[3]).

References

[1] Bahcall, N. A., et al.: 2003, *ApJ*, **599**, 814.
[2] Overzier, R.A., et al.: 2003, *A&A*, **405**, 53.
[3] Hayashi, M., et al.: 2007, *ApJ*, **660**, 72.

Development of On-site Data Analysis System for Suprime-Cam

FURUSAWA, Hisanori, OKURA, Yuki (NAOJ)
MINEO, Sogo (University of Tokyo)
TAKATA, Tadafumi, NAKATA, Fumiaki (NAOJ)
TANAKA, Manobu, KATAYAMA, Nobuhiko, ITOH, Ryosuke (KEK)
YASUDA, Naoki (University of Tokyo)
MIYAZAKI, Satoshi, KOMIYAMA, Yutaka (NAOJ)
UTSUMI, Yousuke (Graduate University for Advanced Studies / NAOJ)
UCHIDA, Tomohisa (KEK)
AIHARA, Hiroaki (University of Tokyo)

We develop on-site quick data analysis system for the prime-focus camera Suprime-Cam at Subaru Telescope [1]. This system is designed to assist observation with Suprime-Cam and to improve productivity of scientific outcomes[2], by considering the following subjects:

(1) Automated evaluation of data quality: In order to assist observations, we target automation of data evaluation during the night. In typical observations with Suprime-Cam, data check is a burdensome task for observers, and it was difficult to conduct sufficient data evaluation. We consider assisting the qualitative data evaluation at the observing site is a key to improve the productivity of the observation. The new on-site data analysis system performs automated data check for every data frame, deriving qualitative information of data quality, including seeing, median ellipticity of stellar sources, sky-background level, and read noise level estimated from the overscan regions. Variation of those values againt time are shown on a web browser within a couple of minutes after the data acquisition. Coarse astrometric calibration and determination of photometric zeropoint for reference fields are also performed. The obserevers can grasp the achievement of their observation at some point and plan the next exposures.

(2) Management of data evaluation results in database: We also aim at efficient recording and making use of the derived data evaluation results. This system employs database (DB) to register all the derived information and analysis history in the data check processes. Data frames are tagged based on thresholding values for quality information of seeing, sky-background level, and the number of detected sources. The observers can easily choose data frames which satisfy requirements by clicking a web browser only several times. Mosaic-stacking analysis to check depths of data or creation of flat frames can also be applied to those particular range of frames upon request. The evaluation results in DB has an advantage of making it easier to pick up necessary data frame only in the final analysis after the observation, which may be more useful in a large and long-term survey programs. As a future prospect, the DB information could contribute to construct useful data archive by adding extra-information of the observing situation such as weather conditions, status of the instrument etc.

This system uses paralellized processing on multiple PC nodes, in order to facilitate data evaluation exposure to exposure. Analysis applications are made of in-house C/C+/Python codes, open sources, and a commercialbased middleware on a 64-bit Linux OS. This system has been operated since March 2010 in Suprime-Cam observations (Figure 1). In prospective large imaging surveys with the next-generation instrument HSC, experience in this study will play an important role for making efficient execution of the survey and constructing a useful data archive[3].

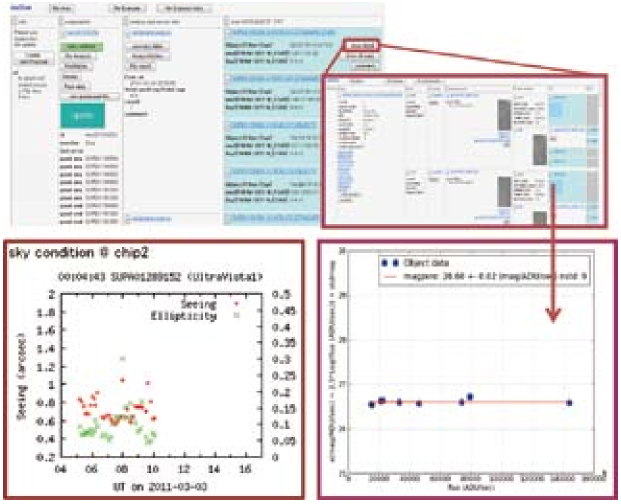


Figure 1: A snapshot of the on-site data analysis system, which shows a summary window for the automated data check, web-basis result monitor, and a result of flux calibration.

References

[1] Miyazaki, S., et al.: 2002, *PASJ*, **54**, 833.
[2] Furusawa, H., et al.: 2011, *PASJ*, **63**, S585.
[3] Furusawa, H., et al.: 2010, *Proc. SPIE*, **7740**, 83.

RMHD Simulations of Low-Mass Star Formation Processes

TOMIDA, Kengo, TOMISAKA, Kohji
(The Graduate University for Advanced Studies / NAOJ)

MACHIDA, Masahiro N., SAIGO, Kazuya
(NAOJ)

MATSUMOTO, Tomoaki
(Hosei University)

A first core is a transient object formed in the early phase of star formation. It mainly consists of molecular hydrogen and is in quasi-hydrostatic equiribrium by gas pressure and rotation. This object evolves under the accretion from the envelope, and it begins dynamical collapse due to H_2 dissociation when the central temperature exceeds about 2000 K (the second collapse). The lifetime of a first core is short, about several thousand yrs, but it plays a critical role in star formation processes because it is related to important phenomena such as circumstellar disk formation, binary fragmentation, bipolar molecular outflow, and so on. First cores have not been observed yet since it was theoretically predicted by Larson (1969), but recently several candidates are reported. Now, it is expected that we can observe first cores directly by ALMA.

We performed radiation magnetohydrodynamic simulations of star formation in a rotating magnetized cloud core using our newly developed code[1]. We found that the mass, size and lifetime of the first core are 1.5–2 times larger compared to previous simulations without radiation transfer, due to shock and radiation heating. On the other hand, the structure and velocity of the outflow driven by magnetic fields do not differ significantly. Incorporating radiation transfer is crucial to discuss the stability and observational properties of first cores.

Formation of ~1 $M_\odot$ stars is well studied so far, but, it is well known that there are rather larger number of smaller molecular cloud cores and stars. Some of first core candidates recently reported are also suggested to be less massive, ~0.1 $M_\odot$. Motivated by these facts, we investigated the evolution of the first core in a very lowmass molecular cloud core whose mass is 0.1 $M_\odot$ using RHD simulations[2]. We found that the first core in the very low-mass molecular cloud core evolves slowly under the influence of radiation cooling, and lives significantly longer compared to fiducial 1 $M_\odot$ cases, at least more than 14,000 yrs. This evolution is qualitatively different from that of typical 1 $M_\odot$ models. This result suggests that first cores may be more common than previous predictions. We calculated the observational properties of this model, and showed that it is faint but observable with ALMA and Herschel. We also presented a strategy to observe such a first core and distinguish it from other evolutionary phases.

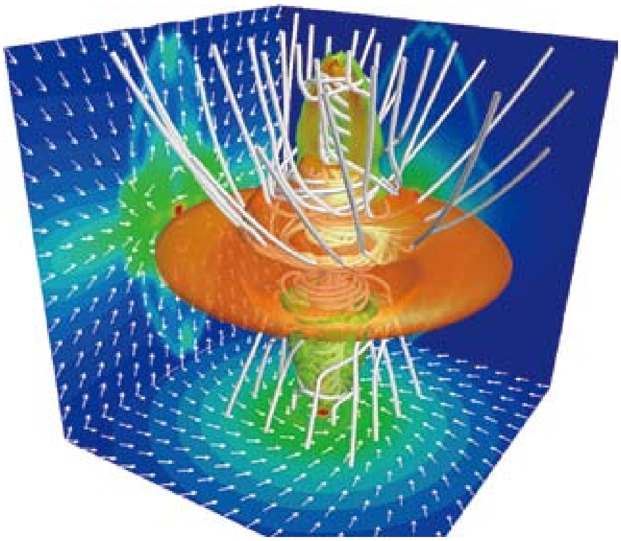


Figure 1: A bipolar outflow is launched from the first core. White lines are magnetic field lines.

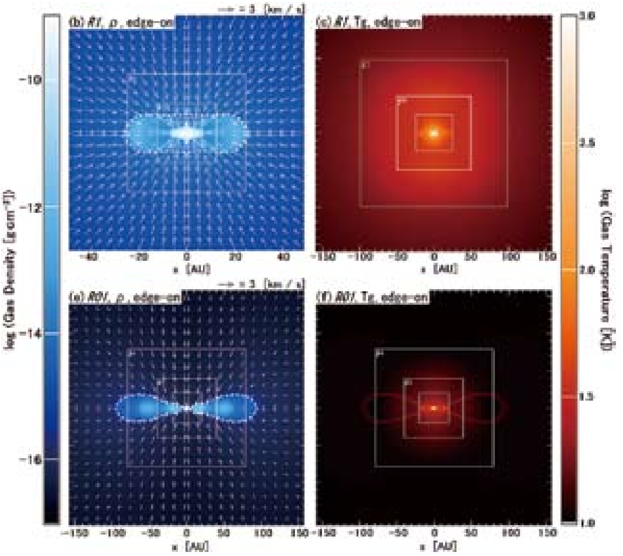


Figure 2: Cross-sections of first cores in 1 $M_\odot$(top) and 0.1 $M_\odot$ (bottom) molecular cloud cores (left: density, right: temperature). In the low-mass model, almost all the gas in the cloud core quickly accretes onto the first core and the envelope becomes very thin. The low-mass model is significantly colder than 1 $M_\odot$ model because of weak accretion and efficient radiative cooling.

References

[1] Tomida, K., et al.: 2010, *ApJ*, **714**, L58.
[2] Tomida, K., et al.: 2010, *ApJ*, **725**, L239.

Transition from a Toroidal to a Poloidal Magnetic Field in the Galactic Center

NISHIYAMA, Shogo, NAGATA, Tetsuya, YISHIKAWA, Tatsuhito
(Kyoto University)

TAMURA, Motohide, SUENAGA, Takuya
(NAOJ)

HATANO, Hirofumi, NAGAYAMA, Takahiro
(Nagoya University)

MATSUNAGA, Noriyuki, KATO, Daisuke
(University of Tokyo)

HOUGH, James, H.
(University of Hertfordshire)

SUGITANI, Koji
(Nagoya City University)

The detailed nature and origin of the very strong magnetic field (MF) in the central few-hundred pc of the Galaxy has been a subject of controversy for nearly a quarter of century, and is important in understanding many phenomena in this region. Previous observations have been mainly based on sub-millimeter polarimetric observations of dense molecular clouds, or radio observations of non-thermal radio filaments. The former show that the MFs in dense molecular clouds runs almost parallel to the Galactic plane, indicating a *toroidal* MF[1]. By contrast, the radio filaments are aligned nearly perpendicular to the Galactic plane, and are highly polarized along the filaments' long axes, suggesting a large-scale, pervasive *poloidal* MF in the intercloud medium[2].

We report observations of the Galactic center (GC) region with a wide-field near-infrared polarimeter SIRPOL on IRSF. Near-infrared polarimetry enables us to probe the direction of the MFs not only in the dense molecular clouds, but in the intercloud regions toward the GC. Fig. 1 shows the MF direction (*E*-vectors of polarization in the K_S band) in the GC. The MF direction has strong dependence on the Galactic latitude. The histogram of the MF direction at $|b| \leq 0.^\circ4$ has a clear peak of ~90° (the direction parallel to the plane), suggesting a toroidal MF configuration in this region. At higher Galactic latitude ($|b| > 0.^\circ4$), the mean MF direction appears to swing to the direction nearly perpendicular to the Galactic plane. These results suggest a transition of the large-scale MF configuration from toroidal to poloidal in the GC region, at $|b| \sim 0.^\circ4$[3,4].

Previously, the MF configuration of the GC has been viewd as poloidal in the diffuse, interstellar (intercloud) medium, and approximately parallel to the Galactic plane only in the dense molecular clouds. The new data presented here shows a toroidal MF prevails at $|b| < 0.^\circ4$, even outside dense molecular clouds, which radio and sub-mm surveys show are mostly confined to within ~$0.^\circ2$ of the Galactic plane. Toward higher Galactic latitudes ($|b| > 0.^\circ4$), the field changes from toroidal to poloidal configuration.

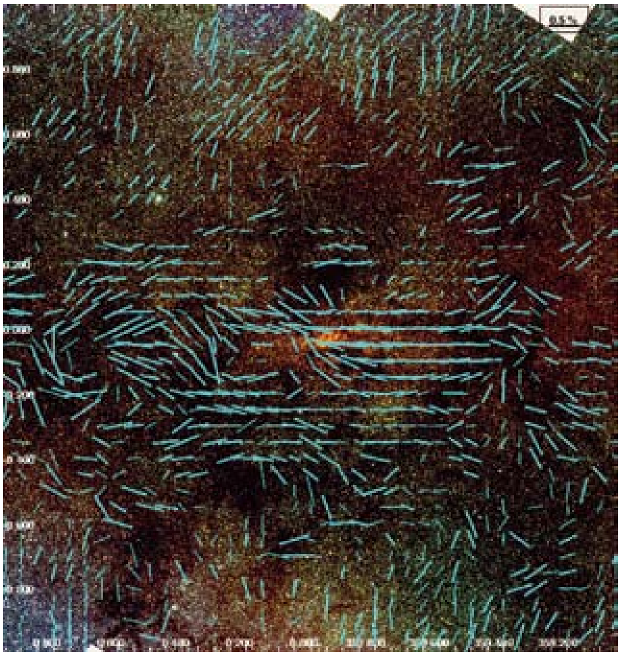


Figure 1: NIR mosaic image of the Galactic center (GC) region covering $2.^\circ0 \times 2.^\circ0$ in the Galactic coordinate, taken with the IRSF telescope and NIR camera SIRPOL. The three NIR bands are *J* (blue, 1.25 μm), *H* (green, 1.63 μm), and K_S (red, 2.14 μm). The central-parsec star cluster of the GC is the bright yellow blob in the center of the image. Observed *E*-vectors of polarization are also plotted with cyan bars whose length indicates the degree of polarization. The vectors are averaged in a circle of $2.'4$ radius with a $3.'0$ grid, and plotted with thick bars (detected with more than 3σ) and thin bars (detected with 2–3σ).

References

[1] Novak, G., et al.: 2003, *ApJ*, **583**, L83.
[2] Yusef-Zadeh, F., et al.: 2004, *ApJS*, **155**, 421.
[3] Nishiyama, S., et al.: 2009, *ApJ*, **690**, 1648.
[4] Nishiyama, S., et al.: 2010, *ApJ*, **722**, L23.

An achromatic eight-octant phase-mask coronagraph using photonic crystal

MURAKAMI, Naoshi (Hokkaido University)
NISHIKAWA, Jun (NAOJ)
YOKOCHI Kaito (Tokyo University / NAOJ)
TAMURA, Motohide (NAOJ)
BABA, Naoshi (Hokkaido University)
ABE, Lyu (Université de Nice-Sophia Antipolis)

For direct detection of faint exoplanets, high-contrast imagers would be indispensable for strongly suppressing central bright stars. In particular, extremely high contrast of 10^{-10} will be needed for detecting Earth-like planets. An eight-octant phase-mask (EOPM) coronagraph is one of promising concepts because of its high-contrast performance, small inner working angle, and simple optical configuration[1]. The EOPM divides a stellar image into eight-octant sectors and provides π-phase difference between adjacent sectors. Then a destructive interference occurs inside pupil area on a reimaged pupil plane, and the stellar light is totally diffracted outside the pupil area. The diffracted stellar light is blocked by a diaphragm called Lyot stop. On the other hand, a planetary image, formed at an off-axis position on the EOPM, will not be totally blocked by the Lyot stop and can be detected at a final focal plane. For detecting extremely faint planetary signal and carrying out spectroscopic characterizations, achromatic high-contrast imagers will be required.

We manufactured a coronagraphic mask based on photonic-crystal technology for realizing a fully achromatic EOPM[2]. The photonic crystal holds periodic nanostructure of refractive indices, and exhibits anisotropic properties of effective dielectric constants. The manufactured photonic-crystal mask consists of an eight-octant half-wave plates with fast axes of $\pm 45°$. As shown in figure 1, extremely small central defect, an order of submicron, was realized by the photonic-crystal technology. The photonic-crystal mask operates as an fully-achromatic EOPM when the mask is placed between two crossed polarizers with axes of 0° and 90°.

We carried out laboratory demonstration of the EOPM coronagraph using two laser light sources with different wavelengths as a simulated star (DPSS laser with $\lambda = 532$ nm, and He-Ne laser with $\lambda = 633$ nm). Figure 2 shows the experimental results. The light from the simulated star was strongly suppressed, and peak-to-peak contrasts of 7×10^{-6} and 3×10^{-6} were obtained for the DPSS and the He-Ne lasers, respectively. In a halo region, contrasts of about 10^{-6} and 10^{-7} were obtained for the both lasers at 3 and $13\,\lambda/D$, respectively. We expect improved coronagraphic performance with a use of extreme adaptive optics systems, because we assume that the residual speckle noise mainly comes from phase aberrations of the optical components.

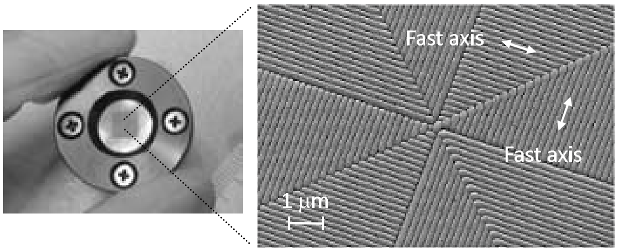


Figure 1: A picture and a scanning electron microscope image of a photonic-crystal coronagraphic mask. (manufactured by the Photonic Lattice, Inc.)

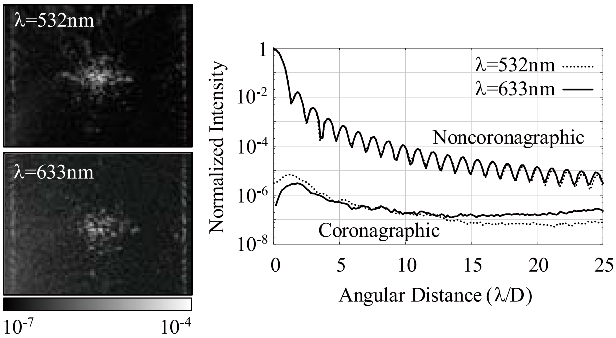


Figure 2: Experimental results of laboratory demonstration: (*left*) acquired coronagraphic images and (*right*) radial profiles of noncoronagraphic and coronagraphic images.

References

[1] Murakami, N., et al.: 2008, *PASP*, **120**, 1112.
[2] Murakami, N., et al.: 2010, *ApJ*, **714**, 772.

Environment of supermassive black holes observed with Virtual Observatory

SHIRASAKI, Yuji, OHISHI, Masatoshi, MIZUMOTO, Yoshihiko, TAKATA, Tadafumi
(NAOJ)

TANAKA, Masahiro
(University of Tsukuba)

YASUDA, Naoki
(IPMU)

It is believed from observational evidences that most galaxies have a supermassive black hole at their centers. A lot of theoretical models for the formation of the supermassive black holes have been proposed. According to the one of the most promising models, at first, a lot of massive stars are formed as a result of a galaxy merger, then intermediate-mass black holes are formed by the collisions of these massive stars. Then the intermediate-mass black holes move to the center of the galaxy, merge with the other intermediate-mass black holes, and then produce a supermassive black hole. Thus it is expected that supermassive black holes are mostly produced at environment of high galaxy density. The supermassive black hole accretes the surrounding matter and emit strong radiation, which can be observed as an active galactic nucleus (AGN). It is observationally found that the number density of AGN peaks at around redshift two, which corresponds to the universe of ten billions years ago, and is thought that the supermassive black holes were produced mostly at this epoch. Thus it is expected that the AGNs produced in this epoch are found in the environment of high galaxy density. Studies of AGN environment have been conducted by many authors by using data obtained from large surveys such as the SDSS, however, the redshift of observable galaxies is limited to 0.6. To extend the study toward higher redshift use of a large telescope is inevitable, however, it is difficult to obtain enough observation time for measuring the AGN environment with good enough statistics.

We decided to use archive data of the Suprime-Cam attached on the Subaru telescope to conduct the study of AGN environment at higher redshift. Japanese Virtual Observatory (JVO)[1] provides reduced Suprime- Cam data and enables correlation search among dataset provided at any VO of the world. We retrieved cutout images of the Suprime-Cam around AGNs, measured number of galaxies as a function projected distance from the AGNs, and derived cross correlation function between AGNs and galaxies[1]. We also used UKIDSS catalog, which is data obtained by the UKIRT infrared telescope. In this study, about two thousands of AGNs at redshift from 0.3 to 3.0 were analyzed (Figure 1). As a result, we found that the high redshift AGNs reside at environment of higher galaxy density, where it is expected that galaxy merger happened more frequently (Figure 2).

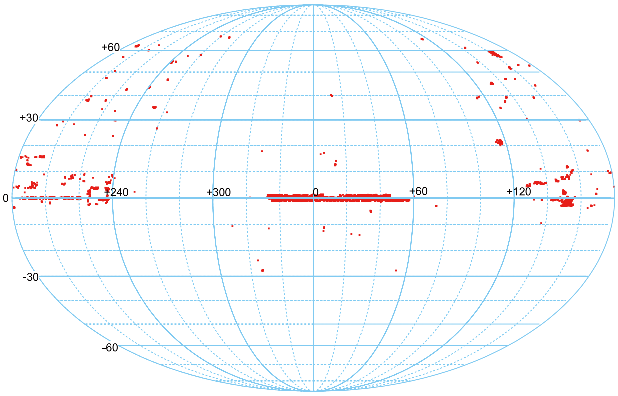


Figure 1: Sky distribution of AGNs analyzed in this work in equatorial coordinate.

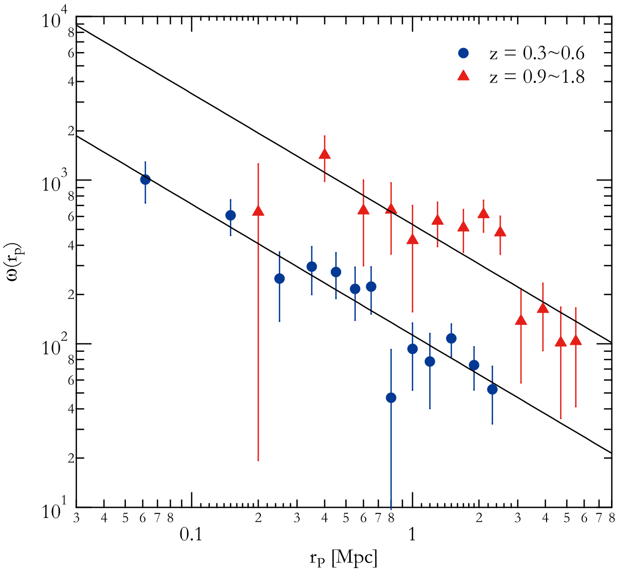


Figure 2: Projected cross correlation function between AGNs and galaxies.

Reference

[1] Shirasaki, Y., et al.: 2011, *PASJ*, **63**, S469.

---

[1] http://jvo.nao.ac.jp

MOIRCS Narrow-Band Survey for Distant Clusters of Galaxies

KOYAMA, Yusei (University of Tokyo)
KODAMA, Tadayuki (NAOJ)
SHIMASAKU, Kazuhiro (University of Tokyo)
HAYASHI, Masao (NAOJ)
OKAMURA, Sadanori (University of Tokyo)
TANAKA, Ichi (NAOJ)
TOKOKU, Chihiro (Tohoku University)

It is well established that properties of galaxies, such as colors and morphologies, are strongly correlated with environment where they reside. For example, high-density regions such as clusters of galaxies are filled with ellipticals or lenticulars(S0s), with little on-going star-formation activity[1]. However, it is still unclear when and how this strong environmental dependence is established. To understand what happens on galaxies during the hierarchical assembly in the past Universe, studying distant clusters of galaxies is critically important since they are in the younger stages of the present-day clusters.

Targeting the large-scale structure around a distant galaxy cluster, RXJ1716+6708 at $z = 0.81$ (hereafter RXJ1716), identified in our previous study[2], we performed a wide-field Hα emitter survey for this field using a narrow-band filter (NB119; $\lambda_c = 1.19\,\mu$m) installed on MOIRCS/Subaru, which perfectly matches to the Hα line at $z = 0.81$. The Hα line ($\lambda_{\rm rest} = 6563$ Å) is one of the best indicators of star formation activity in galaxies. However, it shifts to near-infrared regime at $z > 0.4$, so that it has been quite difficult to conduct an intensive Hα-based study for the distant Universe. We note that this study is the first wide-field Hα line survey for distant ($z > 0.5$) clusters, and revealed the Hα-based star forming activity along the filamentary large-scale structures for the first time.

Our survey shows that the Hα emitters are distributed clearly along the large-scale structure (Fig. 1). On the other hand, we also find that the Hα emitters avoid the very central cluster region. This suggests that the star forming activity in the cluster core has already been completely quenched at $z \sim 0.8$, while in the cluster surrounding region, a large fraction of galaxies are still actively forming stars. This result is also consistent with that obtained through our wide-field 15 μm imaging campaign[3] with AKARI (see red circles in Fig. 1).

We measured star formation rates (SFR) independently from the Hα and mid-infrared (rest-frame 8 μm) luminosities, and find that the extinction at Hα is ~1 mag for moderately star forming galaxies, which is consistent with local spirals. However, in the extremely dusty cases, this value exceeds ~3 mag. These very dusty galaxies show red colors, and some of them are on the red sequence whose colors are consistent with those expected for "non-star-forming" galaxies. More impor-tantly, we find that such very dusty galaxies (probably in the transitional phase under some environmental effects) are most commonly seen in the cluster surrounding groups or filaments, strongly supporting the importance of the cluster surrounding environment as a key place for shaping the environmentally-driven galaxy evolution. Thus, taking a great advantage of the widefield capability of Subaru Telescope, we revealed the evidence that the dust-obscured activities of galaxies (dusty starbursts and/or AGNs) are indeed taking place in the cluster in-fall regions, suggesting a strong link between these hidden activity and environmental effects.

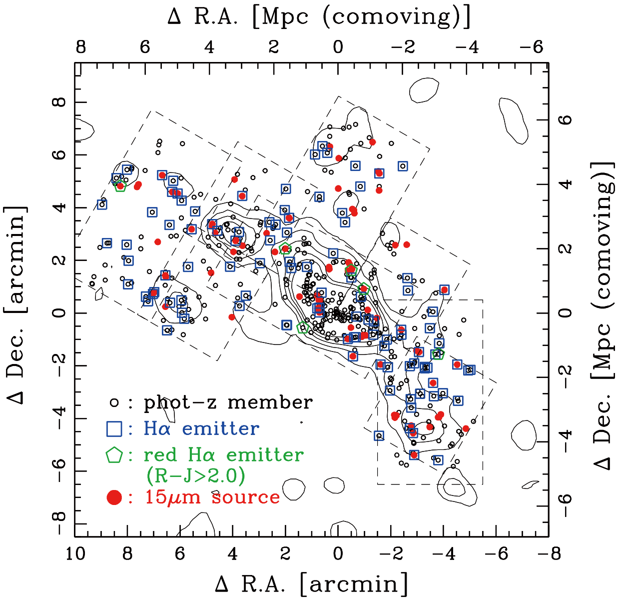


Figure 1: Spatial distribution of the cluster member galaxies around the RXJ1716 cluster at $z = 0.81$. The dashed-line rectangles show our 8 FoVs of MOIRCS. Black dots represent all the phot-z selected galaxies within our observed field. Blue squares, green pentagons, and filled red circles indicate the Hα emitters, the red Hα emitters, and the mid-infrared sources detected in our AKARI 15 μm imaging. Contours are drawn based on surface number density of cluster member galaxies.

References

[1] Dressler, A.: 1980, *ApJ*, **236**, 351.
[2] Koyama, Y., et al.: 2007, *MNRAS*, **382**, 1719.
[3] Koyama, Y., et al.: 2008, *MNRAS*, **391**, 1758.

Production of High Temperature Plasmas During the Early Phases of a C9.7 Flare

WATANABE, Tetsuya, HARA, Hirohisa (NAOJ)
STERLING, A. C. (MSFC/NASA)
Harra, L. K. (MSSL/UCL)

The early phases of a C9.7 flare on 2007 June 6 were observed by the EIS instrument on board the *Hinode* mission with an EIS study that enabled a high-cadence raster observation over an area of 240 arcsec × 240 arcsec, by rastering of the 1 arcsec slit utilizing scan jumps of 10 arcsecs in the heliocentric E-W direction. The time cadence of rastering was about 160 seconds[1].

Sections of raster images obtained between 17:20:09 and 17:20:29 (UT) show a few bright patches of emission from Fe xxiii/Fe xxxiv lines at the footpoints of flaring loops and these footpoints show dominating blue-shifted components of $-(300\text{–}400)\,\mathrm{km\,s^{-1}}$ while Fe xv/xiv lines are nearly stationary, Fe xii lines and/or lowertemperature lines show slightly red-shifted features, and Fe viii, Si vii to He ii lines show $\sim +50\,\mathrm{km\,s^{-1}}$ redshifted components. The density of the 1.5–2 MK plasma at these footpoints is estimated to to be $3 \times 10^{10}\,\mathrm{cm^{-3}}$ by Fe xiii/xiv line pairs around the maximum of the flare.

High-temperature loops connecting the footpoints appear in the Fe xxiii/xxiv images taken over 17:22:49–17:23:08 (UT) which is near the flare peak. Line profiles of these high-temperature lines at this flare peak time show only slowly-moving components. The concurrent cooler Fe xvii line at 254.8 Å is relatively weak, indicating the predominance of high-temperature plasma ($> 10^7$ K) in these loops.

The rapid appearance of flaring loops in the flareline raster images can be explained by high-speed chromospheric evaporation of $\sim 400\,\mathrm{km\,s^{-1}}$. However, this plasma might not be in ionization equilibrium, because the relaxation time scale to reach ionization equilibrium is estimated to require more than 300 seconds, if the density is assumed to be that in preflare; $(3\text{–}4) \times 10^9\,\mathrm{cm^{-3}}$ which is the situation expected in the scenario of explosive evaporation[2].

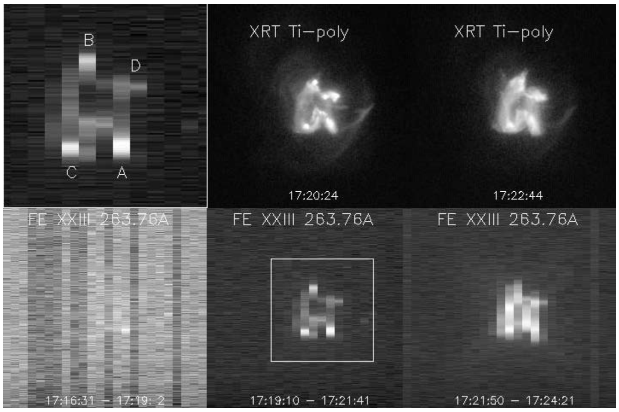


Figure 1: Monochromatic raster images of EIS emission lines of Fe xxiii λ263.76 (bottom panels). The EIS raster images are constructed by using 10 arcsec jumps in the E-W direction. The top-left panel shows a twice-expanded image of white-square area in the Fe xxiii image (middle panel) obtained over 17:19:10–17:21:41 (UT), in which prominent flaring loop footpoints are denoted as A, B, C, and D. The X-Ray Telescope (XRT) observed the flare with Ti-poly filter at the times of 17:20:24 and 17:22:44 (UT).

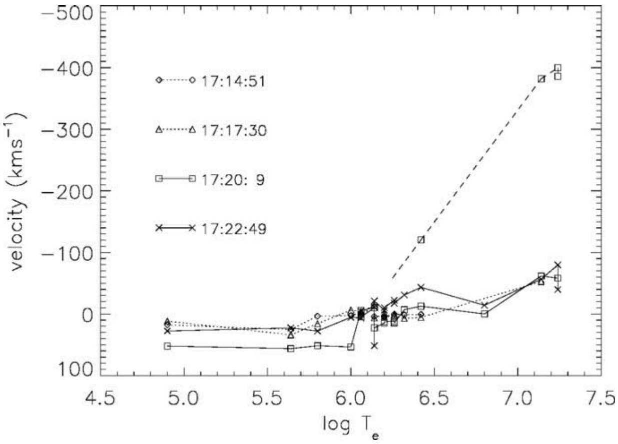


Figure 2: Temperature dependence of plasma motions in the initial phases of the flare at Footpoint A of Figure 1: Negative (positive) velocities represent blue (red) line shifts in the ordinate, and they are plotted against their line formation temperatures. Line-center positions of high-speed components are connected by dashed line.

References

[1] Watanabe, T., Hara, H., Sterling, A. C., Harra, L. K.: 2010, *ApJ*, **719**, 213.
[2] Fisher, G. H. Canfield, C. C., McClymont, A. N.: 1985, *ApJ*, **289**, 434.

A Deep Survey of $z = 7$ Lyα Emitters and Reionization with the Red-sensitive CCDs on the Subaru Telescope Suprime-Cam

OTA, Kazuaki (Kyoto University)
IYE, Masanori, KASHIKAWA, Nobunari (NAOJ)
SHIMASAKU, Kazuhiro, OUCHI, Masami (University of Tokyo)
TOTANI, Tomonori (Kyoto University)
KOBAYASHI, Masakazu A. R. (NAOJ)
NAGASHIMA, Masahiro (Nagasaki University)
HARAYAMA, Atsushi, KODAKA, Natsuki (Saitama University)
MOROKUMA, Tomoki (University of Tokyo)
FURUSAWA, Hisanori, TAJITSU, Akito, HATTORI, Takashi (NAOJ)

We conducted a deep narrowband NB973 (FWHM = 200 Å centered at 9755 Å) survey of $z = 7$ Lyα emitters (LAEs) in the Subaru/*XMM-Newton* Deep Survey Field, using the fully depleted CCDs newly installed on the Subaru Telescope Suprime-Cam, which is twice more sensitive to $z = 7$ Lyα at ~1 μm than the previous CCDs[1] (Figure 1). Reaching the depth 0.5 magnitude deeper than our previous survey in the Subaru Deep Field that led to the discovery of a $z = 6.96$ LAE[2,3], we detected three probable $z = 7$ LAE candidates (Figure 2).

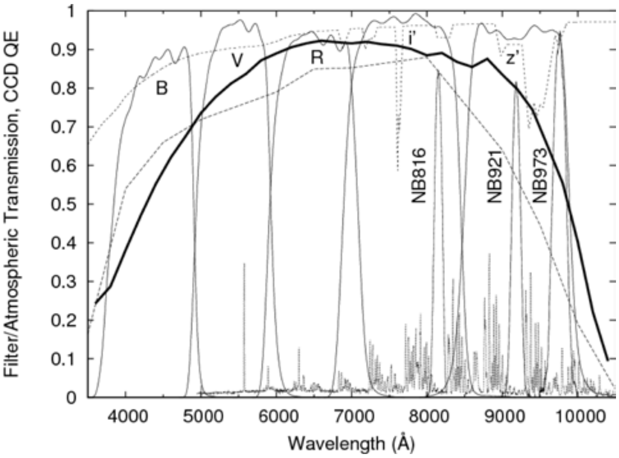


Figure 1: Suprime-Cam filter transmission, skylines, atmospheric transmission and quantum efficiencies of old CCDs and new fully depleted CCDs (thin-solid, thin-dotted, shortdashed, long-dashed and thick-solid curves, respectively). New CCDs are twice more sensitive to $z = 7$ Lyα at ~9730 Å.

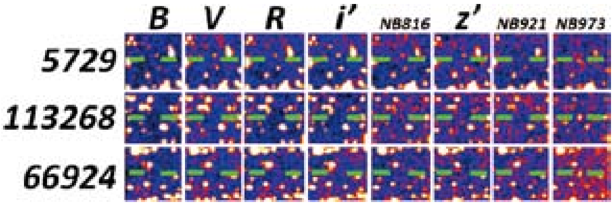


Figure 2: The multi-waveband images of the three candidate $z = 7$ LAEs. They are detected only in NB973.

Even if all the candidates are real, the LAE number density $n_{\mathrm{Ly}\alpha}$ and Lyα luminosity density $\rho_{\mathrm{Ly}\alpha}$ at $z = 7$ are ~7.7–54% and ~5.5–39% of those at $z = 5.7$ to the Lyα line luminosity limit of $L(\mathrm{Ly}\alpha) \sim 9.2 \times 10^{42}$ erg s^{-1} (Figure 3). This could be due to evolution of the LAE population at these epochs as a recent galaxy evolution model predicts that the LAE modestly evolves from $z = 5.7$ to 7[4]. However, even after correcting for this effect of galaxy evolution, $n_{\mathrm{Ly}\alpha}$ and $\rho_{\mathrm{Ly}\alpha}$ still show deficits from $z = 5.7$. This might reflect the attenuation of Lyα emission by neutral hydrogen remaining at the epoch of reionization and suggests that reionization of the universe might not be complete yet at $z = 7$, supporting the possible higher neutral fraction at the earlier epochs at $z > 6$ suggested by the previous surveys of $z = 5.7$–7 LAEs, $z \sim 6$ quasars and $z > 6$ γ-ray bursts.

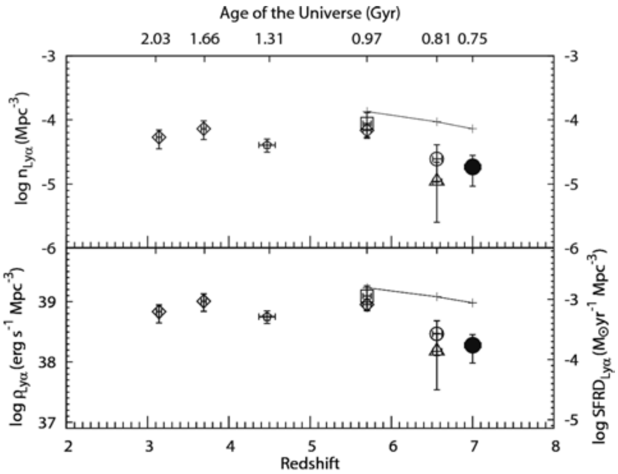


Figure 3: Number density $n_{\mathrm{Ly}\alpha}$, Lyα luminosity density $\rho_{\mathrm{Ly}\alpha}$ and star formation rate density SFRD$_{\mathrm{Ly}\alpha}$ of LAEs at $z = 3.1$, 3.7, 4.5, 5.7, 6.6, 7 to Lyα luminosity limit 9.2×10^{42} erg s^{-1} (See [1] for details). Horizontal errors are the redshift range of each survey. The vertical errors include both cosmic variance and Poisson errors. The plus symbols with solid lines show the expected densities, when the universe is fully reionized, calculated by using a LAE evolution model[4].

References

[1] Ota, K., et al.: 2010, *ApJ*, **722**, 803.
[2] Iye, M. N., et al.: 2006, *Nature*, **443**, 186.
[3] Ota, K., et al.: 2008, *ApJ*, **677**, 12.
[4] Kobayashi, M. A. R., et al.: 2010, *ApJ*, **708**, 1119.

Temporal Relation between the Disappearance of Penumbral Fine-Scale Structure and Evershed Flow

KUBO, Masahito
(NAOJ)
ICHIMOTO, Kiyoshi
(Kyoto University)
LITES, Bruce W.
(High Altitude Observatory)
SHINE, Richard A.
(Lockheed Martin Solar and Astrophysics Laboratory)

Sunspot penumbrae consist of many fine-scale radial filaments. Their fine-scale structures reflect complex magnetic field structures in penumbrae: azimuthal fluctuations of the penumbral magnetic field inclination and field strength are well observed at the scale of the intensity fluctuations. A systematic outward flow called Evershed flow is closely related to the formation of penumbral fine-scale magnetic field structures. Evershed flows are radial outward flows propagating along the penumbral horizontal magnetic fields, and their origin is rising hot gas well observed in the inner penumbra.

We investigate the temporal relation between the Evershed flow, dot-like bright features (penumbral grain), the complex magnetic field structure, and dark cores along bright filaments in a sunspot penumbra. We use the dark core in order to trace the center of the bright filament (Figure 1). It is believed that a pile-up of hot plasma along the center of the bright penumbral filament pushes up the $\tau = 1$ surface into the upper layer, where the temperature is lower. As a result, a dark lane (dark core) is observed along the top of the cusp of the $\tau = 1$ surface.

This study confirms that the appearance and disappearance of the Evershed flow and penumbra grains occur at nearly the same time and are associated with changes of the inclination angle of the magnetic field from vertical to more horizontal (Figure 2)[1]. This suggests that both convection (penumbral grains) and horizontal fields in the penumbra are necessary for (or caused by) the formation of the Evershed flow. The close correlation between the Evershed flow, convection, and more horizontal fields supports recent models wherein the Evershed flows are convective flows in the inclined magnetic field lines in the penumbra.

The dark core of the bright filament also appears coincidental with the Evershed flow. However, we find that the dark-cored bright filament survives at least for 10–20 minutes after the disappearance of the Evershed flow. If the Evershed flow only caused a pile-up of hot plasma along the bright filament, the dark core should disappear within a cooling timescale after the end of the Evershed flow. However, the dark core is continuously observed without the Evershed flow for a period much longer than a cooling timescale in the photosphere. This suggests that local heating along the bright filament of the penumbra is important for maintaining its brightness, in addition to heat transfer by the Evershed flow.

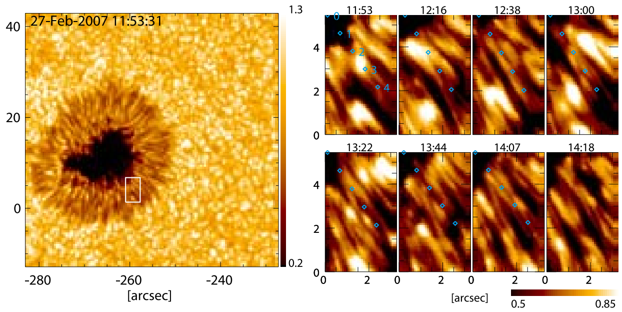


Figure 1: *left*: G-band intensity image obtained with the Solar Optical Telescope aboard *Hinode*. The intensity is normalized to the mean intensity of the quiet area outside the sunspot. The axes represent the positions with respect to the disk center. *right*: Time series of G-band images in the white box of the left panel. The dots with intervals of 1″ are linearly aligned on a dark core in the bright penumbral filament. Note that the dark core disappears at 14:18 UT.

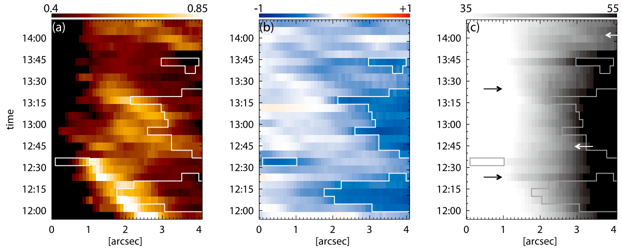


Figure 2: Space vs. time plots along the dotted lines in Figure 1 for (a) G-band intensity, (b) Doppler velocity, and (c) magnetic field inclination. The contours represent the Doppler velocity of $-0.4\,\mathrm{km\,s^{-1}}$. The positive (negative) Doppler velocities indicate a redshift (blueshift) in units of $\mathrm{km\,s^{-1}}$. The magnetic field with the line-of-sight direction is represented by the inclination angle of 0 degree.

Reference

[1] Kubo, M., et al.: 2011, *ApJ*, **731**, 84.

Discovery of an Excess of Hα Emitters around 4C+23.56 at $z = 2.49$

TANAKA, Ichi, KODAMA, Tadayuki
(NAOJ)
BREUCK, Carlos De, VENEMANS, Bram, VERNET, Joël
(European Southern Observatory)
KURK, Jaron D.
(Max-Planck-Institut für extraterrestrische Physik)
TANIGUCHI, Yoshiaki
(Ehime University)
KAJISAWA, Masaru
(Tohoku University / Ehime University)
ICHIKAWA, Takashi
(Tohoku University)
MATSUDA, Yuichi
(University of Durham)
PACKHAM, Chris
(University of Florida)
ZIRM, Andrew
(University of Copenhagen)
SEYMOUR, Nick
(UCL)
STERN, Daniel
(Jet Propulsion Laboratory)
STOCKTON, Alan
(University of Hawaii)

1 Aim and Method

Most of massive galaxies in clusters generally show no structure with homogeneously red color. It has been shown from the studies of stellar populations that they are formed through the intense star-formation that happened at $z > 2$, then evolved passively until today. Therefore, we may be able to observe the site of major star-formation on the progenitors of such massive cluster galaxies directly if we go and find protoclusters lying at the redshifts of 2 to 4.

However, the number of known protoclusters are still small. Especially, the number of those lying at $2 < z < 2.7$ where we can observe their Hα emission from the ground is only a few. Availability of Hα emission is important because it is the best tracer of the star-formation activity. Hα emission is one of the most familiar lines for astronomy and so it is well-calibrated through a large number of histric studies. It is much less affected by dust extinction compared to the UV continuum or Lyα emission which we use to explore the very distant universe.

In order to find the formation site of cluster galaxies in the act, we embarked a survey of massive star-forming galaxies in the putative protocluster lying around the radio galaxy 4C+23.56 at $z = 2.5$, one of the most distant object which we can observe the redshifted Hα from the ground. We choose the field because 4C+23.56 was once suggested to have a possible protocluster[2,3]. To enable detecting the redshifted Hα emission at $z = 2.48$, we employed a custom-made narrowband filter and installed it into MOIRCS instrument on Subaru Telescope. The observation was carried out making use of the observatory time. The field had a deep *Spitzer* MIPS mid-infrated data in the archive. We used the MIPS 24 μm photometry data for supplementary purpose, because it is the independent probe of the star-formation and works even under extreme dust extinction.

2 Results

We have found 11 candidate Hα emission-line galaxies (hereafter HAEs) to a flux limit of ~7.5×10^{-17} erg s^{-1} cm^{-2}[1]. This is about 5 times more than expected from the field counts. The distribution of HAEs on the sky is tightly confined to a 1.2-Mpc-radius area at $z = 2.49$. Contrary to the usual assumption, 4C+23.56 is situated at the western edge of the emitter distribution and not at the center. Analysis of the MIPS 24 μm imaging also shows that there is about 2.5 times more faint sources. All but two of the 11 HAEs are also found in the MIPS data. The inferred star-formation activity in the proto-cluster from those dataset is very high, with the median SFR a few 100 $M_\odot$ yr^{-1}. What is more, most of those extreme star-forming galaxies are quite massive ($> 10^{11} M_\odot$). It is quite rare that we observe such intense star-formation on a number of massive galaxies in cluster core region at $z < 1.5$. This suggests that we may be witnessing the very end stage of massive cluster galaxy formation. The area will serve the ideal targets for science with ALMA.

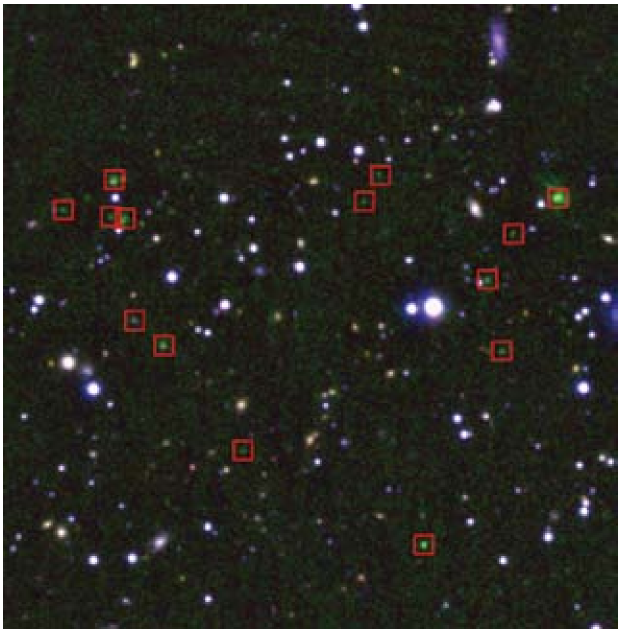


Figure 1: The Hα emitters discovered around 4C+23.56 (green objects with red open boxes). A part of the MOIRCS FOV is shown. Reproduced from our press release at http://subarutelescope.org (Feb 1, 2011).

References

[1] Tanaka, I., et al.: 2011, *PASJ*, **63S**, 415.
[2] Knopp, P., Chambers, C.: 1997, *ApJS*, **109**, 367.
[3] Kajisawa, M., et al.: 2006, *MNRAS*, **371**, 577.

Extremely metal poor stars and Chemical Evolution in the Early Universe

KOMIYA, Yutaka
(NAOJ)

SUDA, Takuma, HABE, Asao, FUJIMOTO, Masayuki
(Hokkaido University)

Extremely metal-poor (EMP, [Fe/H] < −2.5 in this paper) stars are stars formed in the early universe in terms of chemical evolution. They are formed at high redshift but are still shining with the glow of nuclear burning in the Local Group. Hundreds of the EMP stars has been identified in the Milky Way halo and element abundances of these stars are revealed by follow-up spectroscopic observations. They provide a means of probing the earliest phases of the evolution of the Milky Way and supernovae in the early universe. Among them, two hyper metal-poor (HMP) stars with [Fe/H] < −5 are the most metal deficient objects observed yet.

In our previous study[1], we give constraint on the initial mass function (IMF) of the EMP stars and argue that typical mass of EMP stars is ~$10M_{\odot}$. Changeover of the IMF affects the chemical evolution of the Milky Way.

We investigate early phases of the chemical evolution of the Galaxy and formation history of EMP stars using hierarchical chemical evolution models. We build a merger tree of the Galaxy according to the extended Press-Schechter theory. We follow the chemical evolution along the tree, and compare the model results to the metallicity distribution function (MDF) and the abundance ratio distribution of EMP stars. We also study the feedback effect from the very massive population III stars.

The MDF predicted by the hierarchical model with the high mass IMF consistent with observations[2]. Second and later generations of stars in each dwarf primordial galaxies distribute at [Fe/H] > −4 and stars with [Fe/H] < −4 are the first stars in mini-halos. Observational scarcity of HMP stars indicate that the IMF of first stars are shifted to higher mass than EMP stars. Abundance ratio distributions predicted by the high mass IMF is also consistent with observations[3].

We further study the effects of the surface pollution through the accretion of interstellar matter (ISM) onto stars along the chemical and dynamical evolution of the Galaxy. Because of shallower potential of smaller minihalos, the accretion of ISM in the mini-halos in which these stars were born is dominant. It can account for the surface iron abundances as observed for the HMP stars if the cooling and concentration of gas in their birth minihalos is taken into account.

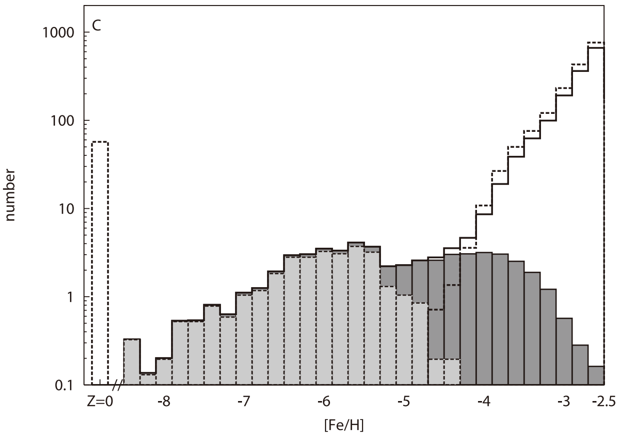


Figure 1: Dashed and solid lines shows predicted MDF before and after surface pollution, respectively. Dark and light shaded histograms denote distributions of Pop. III dwarf and giant, respectively. (This figure is reprinted from[2])

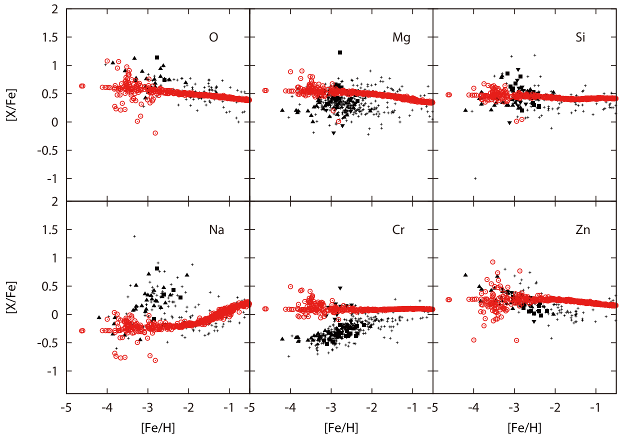


Figure 2: Abundance distributions of metal poor stars. *Red*: Model results. *black*: Observations. (This figure is reprinted from [3])

References

[1] Komiya, Y., et al.: 2007, *ApJ*, **658**, 367.
[2] Komiya, Y., et al.: 2010, *ApJ*, **717**, 542.
[3] Komiya, Y.: 2011, *ApJ*, **736**, 73.

Cosmic Star Formation Activity at $z = 2.2$ Probed by Hα Emission Line Galaxies

TADAKI, Ken-ichi
(University of Tokyo)
KODAMA, Tadayuki, HAYASHI, Masao
(NAOJ)
KOYAMA, Yusei
(University of Tokyo)
TANAKA, Ichi
(NAOJ)
TOKOKU, Chihiro
(Tohoku University)

Since recent observations in optical and near-infrared wavelength indicate that the volume-averaged star formation rate (SFR) increases from $z = 0$ to $z \sim 1$ and plateaus at $z \sim 2$, it is likely that a large fraction of stars in galaxies at present-day formed at $z > 1$. The AGN activity and the redshift distribution of submm galaxies (SMG) also peak at this epoch. Therefore the redshift range of z = 2–3 is the epoch when galaxies have the most intensive evolution. It is absolutely imperative to build a statistical sample of star forming galaxies at z = 2–3 in order to understand the cosmic star formation history and the early evolution of galaxies.

Taking the advantage that Hα line at $z = 2.19$ is free from any strong OH sky emission line, we have made a custom-made narrow-band filter, namely, NB209 filter. This narrow-band filter captures Hα emission from the galaxies at $z = 2.19 \pm 0.02$. The imaging survey has been carried out with MOIRCS on the Subaru telescope with the NB209 filter in GOODS-N field. The survey reached a 3σ limiting magnitude of 23.6 (NB209) which corresponds to a 3σ limiting line flux of 2.5×10^{-17} erg s^{-1} cm^{-2} over a 56 arcmnin^2 contiguous area. Also, we used the MORICS Deep Survey (MODS) photometric catalog[1], which contains optical ($UBVi'z'$, near-infrared (JHK_s), mid-infrared and X-ray data. Using these dataset, we have identified 12 Hα emitters at $z = 2.2$ on the basis of narrow-band excesses and photometric redshifts. One of them is likely to be a AGN because a Xray emission is detected from this object. For the seven new emitters out of 12, including the AGN candidate, we obtained near-infrared spectra with MOIRCS on multiobject spectroscopy (MOS) mode. Because an emission line, whose flux is above 3σ, is detected from all of them, it is confirmed that our criteria is effective and robust in selecting genuine Hα emitters at $z = 2.2$.

The Hα line, a hydrogen's Balmer series line emitted from ionized gas (i.e., HII region) around hot young stars, is one of the best SFR indicators. It has many great advantages; being less affected by dust extinction, providing a survey with high sensitivity, and having been well calibrated in the local Universe. We have estimated star formation rates (SFR) and stellar masses ($M_{\rm star}$) for individual galaxies from Hα flux and K_s-band magnitude. The average SFR and $M_{\rm star}$ is 27.8 $M_\odot$ yr^{-1} and 4.0×10^{10} $M_\odot$, respectively.

The evolution of galaxies depends strongly on the environment. Because field galaxies are antithetical to cluster galaxies in terms of environment, we can directly examine the environmental dependence of star formation activity by comparing the properties of emitters among different environments. In addition to the present general field survey, we have estimated SFRs and stellar masses for a large sample of star forming galaxies both in clusters and in the other general field at various redshifts. Figure 1 indicates that the evolution of star formation activities both in the fields and in the clusters. We find that the star formation activity is reduced rapidly from $z = 2.5$ to $z = 0.8$ in the cluster environment, while it is only moderately changed in the field environment. This result suggests that the timescale of galaxy formation is different among different environments, and the star forming activities in high density regions eventually overtake those in lower density regions as a consequence of "galaxy formation bias" at high redshifts.

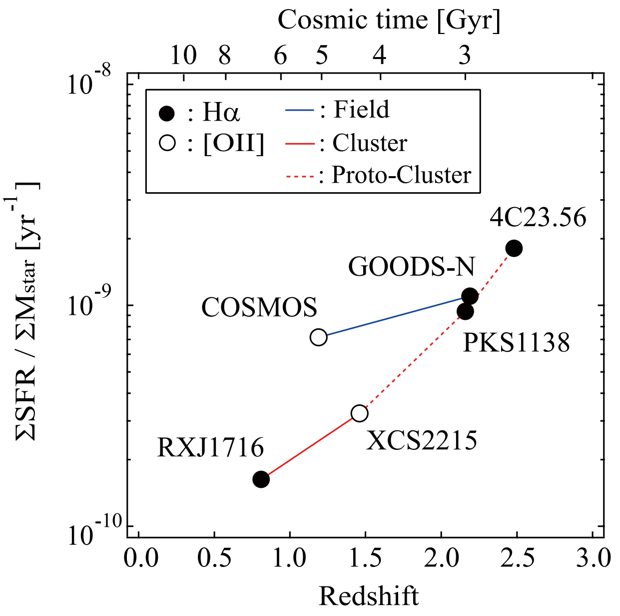


Figure 1: The evolution of star formation activities of the line emitting galaxies. Filled circles and open circles indicate Hα emitters and [OII] emitters, respectively.

Reference

[1] Kajisawa, M., et al.: 2011, *PASJ*, **63S**, 379.

Neutrino-heated gamma-ray bursts

KOTAKE, Kei, HARIKAE, Seiji, TAKIWAKI, Tomoya
(NAOJ)

Gamma-ray bursts (GRBs) have long attracted the attention of astrophysicists since their accidental discovery in 1970s. Regarding the long-duration GRBs, there have been accumulating observations identifying a massive stellar collapse as their origin. For their central engines, the so-called collapsar has received quite some interest for more than decade.

In the collapsar scenario, the central cores with significant angular momentum collapse into a black hole. Neutrinos emitted from the accretion disk heat matter in the polar funnel region to launch the GRB outflows. Paczynski (1990) pioneerlingly proposed that the energy deposition proceeds predominantly via neutrino and antineutrino annihilation into electron and positron (e.g., $\nu+\bar{\nu} \rightarrow e^- + e^+$, hereafter "neutrino pair annihilation"). There have been only a few studies pursuing the possibility of generating jets by the energy deposition via neutrino pair annihilation. This is mainly because the neutrino emission from the accretion disk generally becomes highly aspherical, thus demanding us to solve a multidimensional neutrino transfer problem.

We have presented a numerical code and scheme for calculating the deposition of energy and momentum via neutrino pair annihilation in a Kerr spacetime, in which we solve the general relativistic radiative equation along the null geodesics[1]. The charged-current β-processes are taken into account, which are dominant in the vicinity of the accretion tori. With these improvements, the newly developed code would provide a more realistic estimation of the annihilation rates than before.

As for the hydrodynamic data (such as density, electron fraction, and entropy), we take the ones at 9.1 s after the onset of gravitational collapse for model J0.8 (Figure 1, left panel), which show a clear accretion-disk and BH system with the polar funnel regions along the spin axis of the disk. The position of the inner boundary of the computational domain is set to be $4\,M_\odot$, which mimics the event horizon of the BH. We set the Kerr parameter $a^* = 0.999$ to mimick the extreme Kerr geometry.

To trigger the neutrino-heating explosion, the neutrino-heating timescale should be smaller than the advection timescale, which is characterised by the freefall timescale in the polar funnel regions (e.g., [2]). This condition is akin to the condition of the successful neutrino-driven explosion in the case of core-collapse supernovae.

The right panel of Figure 1 depicts the ratio of the dynamical τ_{dyn} to the heating timescales τ_{heat} for an extreme Kerr geometry, showing that the ratio becomes greater than unity in the polar funnel regions. This indicates the possible formation of the neutrino-driven outflows there, if coupled to the collapsar's hydrodynamics. Our obtained results here suggest the neutrino pair annihilation has a potential importance equal to the conventional magnetohydrodynamic mechanism for igniting the GRB fireballs.

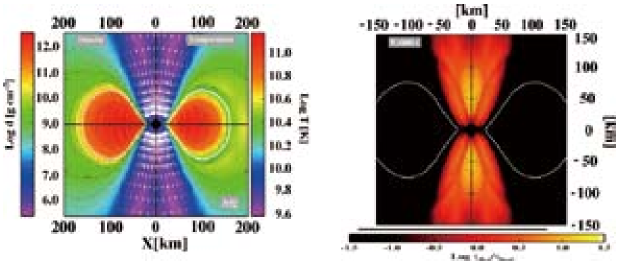


Figure 1: Left panel shows hydrodynamic configuration employed in the ray-tracing calculation. This is the snapshot at 9.1 s after the onset of gravitational collapse for model J0.8 when the accretion disk is in a stationary state (see [3] for more detail). The logarithmic density (in $\mathrm{g\,cm^{-3}}$, left-half) and temperature (in K, right-half) are shown. The white solid line denotes the area where the density is equal to $10^{11}\,\mathrm{g\,cm^{-3}}$, representing the surface of the accretion disk. The central black circle ($\approx 4\,M_\odot$) represents the inner boundary of our computations Right panel is $\tau_{\mathrm{dyn}}/\tau_{\mathrm{heat}}$ (:the dynamical timescale τ_{dyn} versus the heating timescale τ_{heat}) in an extreme Kerr geometry (left).

References

[1] Harikae, S., Kotake, K., Takiwaki, T., Sekiguchi, Y.-i.: 2010, *ApJ*, **720**, 614.
[2] Kotake, K., Sato, K., Takahashi, K.: 2006, *Reports of Progress in Physics*, **69**, 971.
[3] Harikae, S., Kotake, K., Takiwaki, T.: 2010, *ApJ*, **713**, 304.

Small-JASMINE: Current Status

YANO, Taihei, GOUDA, Naoteru, KOBAYASHI, Yukiyasu, TSUJIMOTO, Takuji
HASTUTORI, Yoichi, TAMURA, Tomonori
(NAOJ)

YAMADA, Yoshiyuki
(Kyoto University)

FUJIWARA, Ken, KOYANAGI, Jun
(ISAS/JAXA)

YASUDA, Susumu, UTSUNOMIYA, Shin
(JAXA)

NIWA, Yoshito
(University of Tokyo)

JASMINE-WG

We have been investigating the validity of satellite system of Small-JASMINE. There is no fatal problem in the system at this present stage. We have changed the observational wave-length from K-band to H-band in 2010 in order to remove the refrigerator because it is too expensive. Accordingly we now investigate mainly the following points for the system.

- ◦ Cooling system using Peltier device
- ◦ Attitude of the satellite
- ◦ Baffle of the telescope

In addition to the above issues, we have picked up the following three important issues in order to achieve the aim of Small-JASMINE project[1]. (A) Small-JASMINE is required to measure the positions of stars with high accuracy from the huge amount of data during the observational period. (B) The high stabilization of the thermal environment in the telescope is required. (C) The attitude-pointing stability of these satellites with subpixel accuracy is also required. Here we concentrate on these three issues.

1 Measuring the positions of stars with high accuracy

Determination of positions of star images on a detector with high precision is very important. We will show the laboratory experiment that we can determine the positions of star images on the detector with high precision.

In order to accomplish such a precision, we take the following two procedures. (1) We determine the positions of star images on the detector with the precision of about 0.01 pixel for one measurement, using an algorithm for estimating them from photon weighted means of the star images. (2) We determine the positions of star images with the precision of about 0.0001–0.00001 pixel, which corresponds to that of 10 micro-arcsec, using a large amount of data over 100000 measurements. We have already shown the validity of the procedure (1). For the procedure (2), we have shown the expected accuracy of positions of stars using 100000 data by now.

2 The high stabilization of the thermal environment

Image on a detector is distorted if the telescope expands or shrinks by the variation of the thermal environment.

In order to accomplish a measurement of positions of stars with high accuracy, we must make a model of the distortion of the image on the focal plane with the accuracy of less than 0.1nm. We have investigated numerically that the above requirement is achieved if the thermal variation is within about 1 K /0.75h. We have investigated the validity of the following algorithm in order to determine the positions of stars.

- ◦ Distortions of the image of the first and second order are solved from the observational data of adjacent images.
- ◦ The displacement of higher order (higher than third order) is small enough to neglect.

We examine the thermal structure analysis and obtain the distortion of images on the focal plane. Then we calculate the displacement of each order.

We have ascertained that more than third order displacement is less than the required value of 0.1 nm. Then, our algorithm will work well.

3 The attitude-pointing stability of the satellite

We need high precision attitude-pointing stability with sub-pixel accuracy. Then, we develop a Tip-tilt mirror (TTM) servo system in order to achieve a pointing stability with an accuracy of 190 mas/7 sec. We use star images for correction of pointing error. Now we prepare for experiment of TTM servo system.

Reference

[1] Yano, T., et al.: 2011, *EAS Publications Series*, **45**, 449-452.

Observation of a Binary Black Hole just before its Merger

IGUCHI, Satoru (NAOJ)
OKUDA, Takeshi (Nagoya University)
SUDOU, Hiroshi (Gifu University)

In the galaxy formation process, galaxy clusters are believed to evolve into a giant elliptical galaxy through numerous galaxy mergers. Recent observational results show possible evidence that BBHs exist in the center of giant galaxies and may merge to form a supermassive black hole in the process of their evolution. Clarifying the BBH formation mechanism is essential for the study of galaxy mergers in galaxy formation, as well as for the understanding of the role of black hole mergers in the evolution of supermassive black holes and the detection of gravitational waves at the phase of BBH orbital decay.

We first detected a periodic flux variation on a cycle of 93 ± 1 days (Fig. 1) from the 3-mm monitoring observations of a giant elliptical galaxy 3C 66B[1], with which an orbital motion with a period of 1.05 ± 0.03 years had been observed[2]. The detected signal period is shorter than the orbital period; however it can be explained by the Doppler-shifted modulation associated with the orbital motion of a BBH. Assuming that the BBH has a circular orbit and that the jet axis is parallel to the binary angular momentum (Fig. 2), our observational results demonstrate the presence of a very close BBH that has a binary orbit with an orbital period of 1.05 ± 0.03 years, an orbital radius of $(3.9 \pm 1.0) \times 10^{-3}$ pc, an orbital separation of $(6.1^{+1.0}_{-0.9}) \times 10^{-3}$ pc, the larger black hole mass of $(1.2^{+0.5}_{-0.2}) \times 10^{9} M_{\odot}$, and the smaller black hole mass of $(7.0^{+4.7}_{-6.4}) \times 10^{8} M_{\odot}$. Since it is supposed that a black hole emits strong gravitational waves in the final stage of merger, the decay time of a BBH estimated from the gravitational radiation is $(5.1^{+60.5}_{-2.5}) \times 10^{2}$ years. The black hole merger is one of the most spectacular natural phenomena in the universe and our observational results show that the black hole collisions may have important implications for the formation of a supermassive black hole in the evolution process.

References

[1] Iguchi, S., Okuda, T., Sudou, H.: 2010, *ApJ*, **724**, 166.
[2] Sudou, H., Iguchi, S., Murata, Y., Taniguchi, Y.: 2003, *Science*, **300**, 1263.

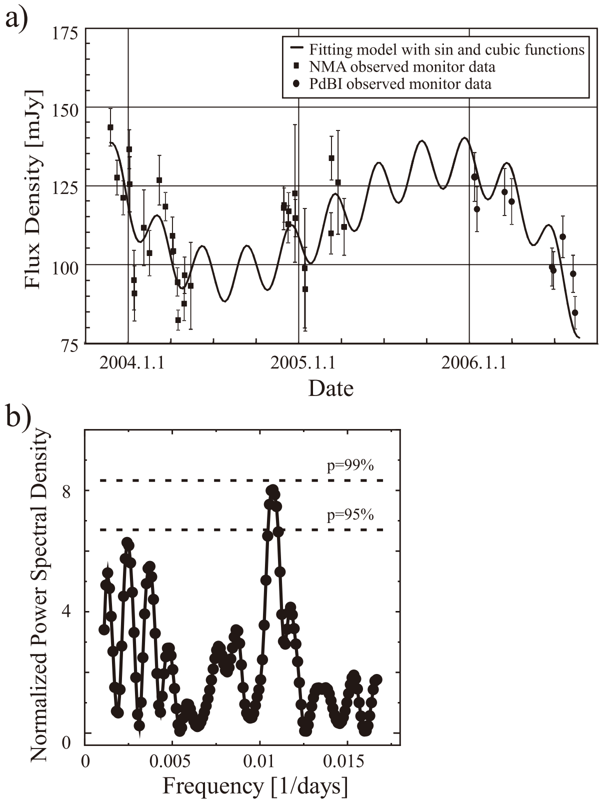


Figure 1: (a) Peak flux monitoring data of the core of 3C 66B at millimeter wavelength, observed with NMA (filled squares; 93.716 GHz) and PdBI (filled circles; 86.2 GHz). (b) Lomb- Scargle periodogram of the flux monitoring data above. The data shows the periodicity of 93 ± 1 days with a 98 % probability.

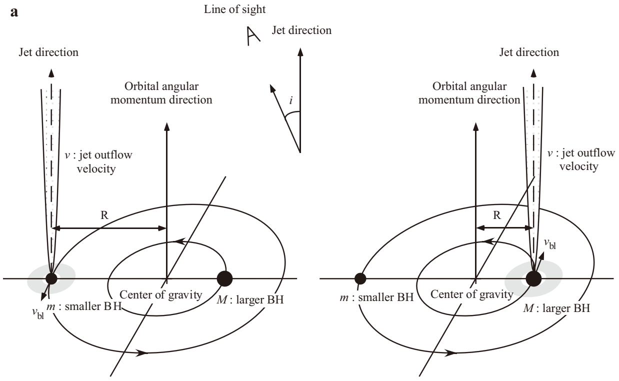


Figure 2: Two schematic geometries of a BBH. We assume that the BBH in 3C 66B has a circular orbit, that the jet is linked to the accretion disk around one of the two black holes, and that the jet axis is parallel to the total angular momentum of the binary. The observed jet is formed by either (a) the smaller massive black hole (with a mass of *m*) or by (b) the larger massive black hole (with a mass of *M*).

Photospheric Magnetic Activities triggering X-ray Microflares around a Well-developed Sunspot

KANO, Ryouhei (NAOJ)
SHIMIZU, Toshifumi (JAXA/ISAS)
TARBELL, Theodore D. (LMSAL)

Microflares, which are small energetic events in the solar corona, are an example of dynamical phenomena suitable for understanding energy release processes in the solar corona. We identified 55 microflares around a well-developed sunspot surrounded by a moat with high-cadence X-ray images from the Hinode X-Ray Telescope (Figure 1), and searched for their photospheric counterparts in line-of-sight magnetograms taken with the Hinode Solar Optical Telescope. We found opposite magnetic polarities encountering each other around the footpoints of 28 microflares, while we could not find such encounters around the footpoints of the other 27 microflares. Emerging magnetic fluxes in the moat were the dominant origin for causing the encounters of opposite polarities (21 of 28 events; Figure 2 left). Unipolar moving magnetic features with the negative polarity same as the sunspot definitely caused the encounters of opposite polarities for 5 microflares (Figure 2 right). The decrease of magnetic flux, i.e., magnetic flux cancellation, was confirmed at the encountering site in typical examples of microflares. Microflares were not isotropically distributed around the spot; the microflares with emerging magnetic fluxes were observed in the direction where magnetic islands with the same polarity as the spot were located at the outer boundary of the moat, while the microflares with negative moving magnetic features were observed in the direction where magnetic islands with the polarity opposite to the spot were located at the outer boundary of the moat. We also found that emerging magnetic fluxes in the moat had a unique orientation in which the same polarity as the spot is closer to the spot than the other. These observational results lead to two magnetic configurations including magnetic reconnection for triggering energy release at least in a half of microflares around the spot, and suggest that the global magnetic structures around the spot strongly affect what kinds of polarity encounters are formed in the sunspot moat[1].

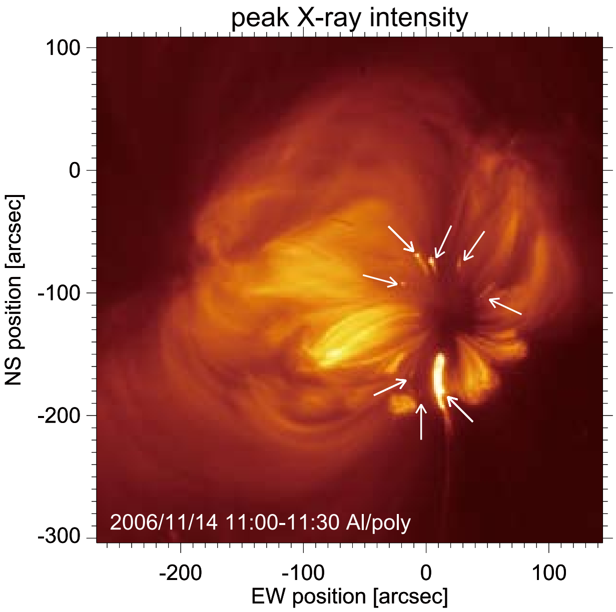


Figure 1: X-ray image taken with the Hinode/XRT. Some microflares used in the paper are shown by arrows.

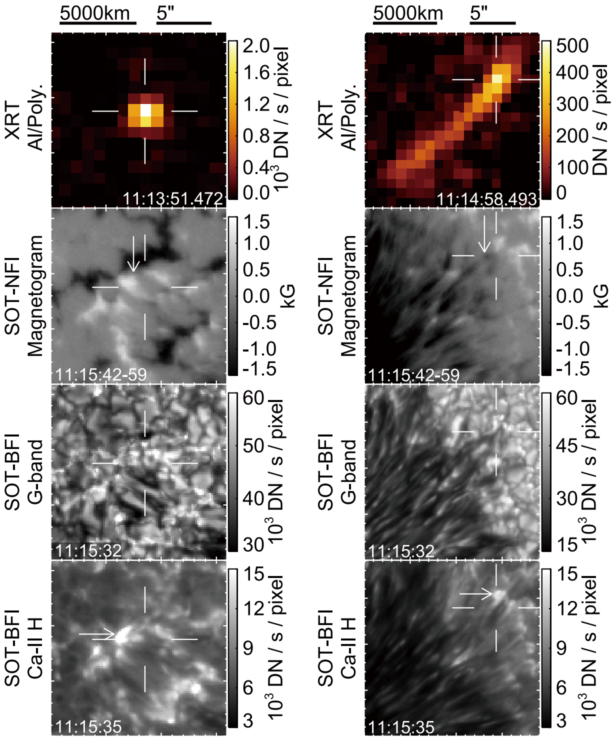


Figure 2: Microflares triggered by a emergning magnetic flux (left) and a moving magnetic feature (right). They are shown by arrows on the magnetograms. Brightening in Ca II H line were also observed.

Reference

[1] Kano, R., Shimizu, T., Tarbell, T. D.: 2010, *ApJ*, **720**, 1136.

Evolution of a Nuclear Gas Disk and Gas Supply to the Galactic Center

NAMEKATA, Daisuke
(Univeristy of Tsukuba)

Gas supply to galactic centers is important for activities in galactic centers and growth of super-massive black holes (SMBHs). To elucidate relation between gas supply processes to galactic centers and activities in galactic centers is also important for understanding the evolution of galaxies. We have studied the relation between gas supply from the Galactic disk to the central 60 pc region in our Galaxy and stellar and gas distribution in this region. A part of our study[1] was published by support of NAOJ. Here, we report the results of [1].

In the central 60 pc, there are three young massive star clusters (Central cluster, Arches cluster, and Quintuplet cluster). Each of the clusters contains a hundred of massive stars and masses of the clusters is estimated to be $\sim 10^4 M_\odot$, if we assume the Salpeter-type IMF[2]. The Central cluster exists within the central 1 pc and the other clusters exist at the projection distance of 30 pc from the Galactic center. How these clusters are formed remains unclear. At the radius of 2–5 pc, there is also a massive molecular gas ring called the circumnuclear disk (CND). Its mass is estimated to be $\leq 10^6 M_\odot$[3]. How the CND is formed and how the CND is related with the Central cluster are uncertain. The clusters have similar ages, indicating that the clusters are formed simultaneously by the same process. In [1], we consider the possibility that the CND and the star clusters are formed simultaneously by the evolution of a self-gravitationally unstable gas disk (hereafter, the nuclear gas disk) whose radius is much larger than the radius of the CND. We assume that gas is supplied from the Galactic disk to the nuclear gas disk continuously.

In order to investigate this possibility, we performed high resolution two-dimensional hydrodynamic simulations of the nuclear gas disk taking into account selfgravity and radiative cooling. All the simulations are carried out on Cray XT4 af CfCA of NAOJ.

The evolution of the nuclear gas disk is as follows. The outer part of the nuclear gas disk frist becomes self-gravitationally unstable by the gas supply from the Galactic disk. By self-gravitational instability, small gas clumps with the mass of $\approx 10^3 M_\odot$ are formed in the outer part of the nuclear gas disk. These gas clumps coalescences into more massive gas clumps. These massive gas clumps gravitationally interacts with each other and exchange their angular momentum. By this, angular momentum transfer is induced in the nuclear gas disk and gas is supplied to smaller radii. The typical mass of massive gas clumps are 10^4–$10^5 M_\odot$. We found that these massive gas clumps can reach the Galactic center without being destroyed by strong tidal force produced by the SMBH and the nuclear star cluster. Figure 1 shows the migration of a massive gas clump to the Galactic center.

Recently, low angular momentum cloud capture by the SMBH is proposed as the formation mechanism of the Central cluster[4]. They showed that in order to reproduce the observations, the mass of the gas clump must be comparable to 10^4–$10^5 M_\odot$. These masses are consistent with the mass of the gas clumps that migrate to the Galactic center in our simulations. Thus, the selfgravitational instability of the nuclear gas disk may explain the origin of gas clump assumed in[4].

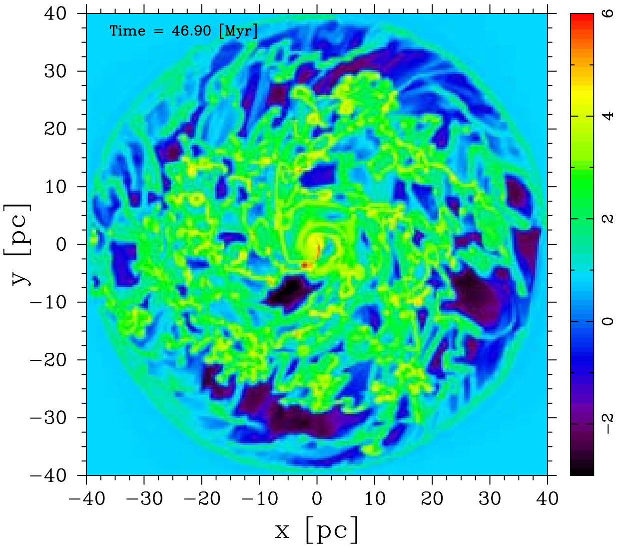


Figure 1: Migration of a massive gas clump to the Galactic center.

References

[1] Namekata, D., Habe,A.: 2011, *ApJ*, **731**, 57.
[2] Figer, D., et al.: 1999, *ApJ*, **525**, 750.
[3] Montero-Castaño, M., Herrnstein, R. M., Ho, P. T.: 2009, *ApJ*, **695**, 1477.
[4] Bonnell, I., Rice, W.: 2008, *Science*, **321**, 1060.

Subaru Telescope Detects Clues for Understanding the Origin of Mysterious Dark Gamma-Ray Bursts

HASHIMOTO, Tetsuya (NAOJ)
OHTA, Kouji (Kyoto University)
Aoki, Kentaro, TANAKA, Ichi (NAOJ)
YABE, Kiyoto (Kyoto University)
KAWAI, Nobuyuki (Tokyo Institute of Technology)
Subaru GRB Team

Gamma-ray bursts (GRBs) are one of the most profound mysteries in current astronomy. A low-metallicity single-star explosion scenario is generally being accepted as a explanation of the origin of GRBs in theory[1] and observation[2]. However adding to the complexity of understanding GRBs are “dark GRBs”, which have extremely faint afterglows and/or cannot be detected in the optical band, are particularly elusive and have rarely been investigated, even though they may make up close to half of all GRBs.

The opportunity to know more about dark GRBs came on March 25, 2008 when a dark GRB without its optical afterglow. Only 9 hours after the burst, we used the Subaru Telescope, mounted with its Multi-Object Infrared Camera and Spectrograph (MOIRCS), to obtain nearinfrared images of the field around the GRB and unveil its mysterious nature, the only detection of a GRB host galaxy and its afterglow in the near-infrared (Figure 1). The rapid observational system of the Subaru Telescope, its strong light-gathering power, and near-infrared observations with its wide-field instrument facilitated this successful discovery. Theoretical models predict much brighter GRB afterglows than the relatively faint afterglow that our images detected in the near-infrared wavelength. We propose that our findings demonstrate that a large amount of dust around the GRB strongly suppressed the brightness of the afterglow in the optical and near-infrared wavelengths. A high-metallicity environment typically produces a very dusty environment like this. Did it do so in this case?

To explore this question, we followed-up our research about a year after our initial observation. We used the Subaru Prime Focus Camera (Suprime-Cam) to obtain optical images of the GRB’s field that could be used to investigate the properties of the host galaxy. We successfully detected the host galaxy, this time in the optical band. This allowed us to examine various properties of the host galaxy by comparing the observed brightness of the GRB host in various wavelengths with model spectra of the galaxy. We found that this host galaxy has a stellar mass comparable to that of the Milky Way and is one of the most massive GRB host galaxies. More massive galaxies generally tend to show higher metallicity[3]. We calculated the expected metallicity of the host galaxy by relating its stellar mass to metallicity and found that its expected metallicity is by far the highest among metallicities previously confirmed for GRB host galaxies[4].

How, then, could we explain our findings? A lowmetallicity single-star explosion scenario does not align with the current our findings that the host galaxy of this dark GRB has high metallicity. Our findings open the possibility that dark GRBs may originate from a type of explosion process other than that of the more wellinvestigated GRBs. A binary-star merger scenario [5] has been proposed in the past as another possible explanation for the origin of GRBs. Since this scenario can account for the occurrence of GRBs in high-metallicity environment, we point out the possibility that this dark GRB originated in a binary-star system. Our results demonstrate that research on dark GRBs is an important key to revealing the origin of the whole population of GRBs.

We may even throw light on the hypothesis[6] that a GRB within the Milky Way may be responsible for the mass extinction that occurred on Earth about 435 million years ago during the Ordovician Period. Until now, this explanation was deemed unlikely because of the high-metallicity environment of the Milky Way[7].

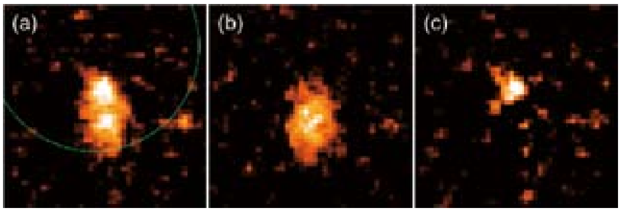


Figure 1: Afterglow of the dark GRB and its host galaxy taken with the Subaru Telescope’s MOIRCS. Image (a) was taken 9 hours after the burst. Image (b) was taken 34 hours after the burst. Image (c) shows the afterglow after image (b) is subtracted from image (a). A green circle in (a) shows the uncertainty of the position of the X-ray afterglow.

References

[1] Woosley, S. E., Bloom, J. S.: 2006, *ARA&A*, **44**, 507.
[2] Modjaz, M., et al.: 2008, *AJ*, **135**, 1136.
[3] Erb, D. K., et al.: 2006, *ApJ*, **644**, 813.
[4] Hashimoto, T., et al.: 2010, *ApJ*, **719**, 378.
[5] Nomoto, K. I., et al.: 1995, *Phys. Rep.*, **256**, 173.
[6] Melott, A. L., et al.: 2004, *IJAsB*, **3**, 55.
[7] Stanek, K. Z., et al.: 2006, *AcA*, **56**, 333.

Near-infrared spectroscopy of massive star-forming galaxies at $z \simeq 2$

ONODERA, Masato (ETH Zürich)
ARIMOTO, Nobuo (NAOJ/GUAS)
DADDI, Emanuele (CEA-Saclay)
RENZINI, Alvio (INAF-Padova)
KONG, Xu (USTC, China)
CIMATTI, Andrea (Università di Bologna)
BROADHURST, Tom (University of Basque Country)
ALEXANDER, Dave M. (Durham University)

We have obtained near-infrared (near-IR) spectra of a sample of *BzK*-selected, massive star-forming galaxies (*sBzK*s; [1]) at $1.5 < z < 2.3$ that were obtained with OHS/CISCO at the Subaru telescope and with SINFONI at the VLT[2]. Among the 28 *sBzK*s observed, Hα emission was detected in 14 objects, and for 11 of them the [N II] λ6583 flux was also measured. Multiwavelength photometry[3] was also used to derive stellar masses and extinction parameters, whereas Hα and [N II] emissions have allowed us to estimate star-formation rates (SFR), metallicities, ionization mechanisms, and dynamical masses.

In order to enforce agreement between SFRs from Hα with those derived from rest-frame UV and mid-infrared, additional obscuration for the emission lines (that originate in H II regions) was required compared to the extinction derived from the slope of the UV continuum.

We have also investigated the stellar mass-metallicity relation (Figure 1), as well as the relation between stellar mass and specific SFR (SSFR), and compared them to the results in other studies. At a given stellar mass, the *sBzK*s appear to have been already enriched to metallicities close to those of local star-forming galaxies of similar mass. At the similar redshift range, the *sBzK*s presented here tend to have higher metallicities compared to those of UV-selected galaxies, indicating that near-infrared selected galaxies tend to be a chemically more evolved population.

The *sBzK*s show SSFRs that are systematically higher, by up to ~ 2 orders of magnitude, compared to those of local galaxies of the same mass. The relation between SSFR and stellar mass of Hα detected sample is consistent with that for so-called main-sequence star-forming galaxies at $z \simeq 2$ derived through multiwavelength SED modeling[4] and radio stacking analysis[5] with a couple of outliers reaching very high SSFRs similar to those of submillimeter selected galaxies which are thought to be in violent star-forming phases driven by stochastic events like major merger.

The empirical correlations between stellar mass and metallicity, and stellar mass and SSFR are then compared with those of evolutionary population synthesis models[6] constructed either with the simple closed-box assumption, or within an infall scenario. Within the assumptions that are built-in such models, it appears that a short timescale for the star-formation ($\simeq$100 Myr) and large initial gas mass appear to be required if one wants to reproduce both relations simultaneously.

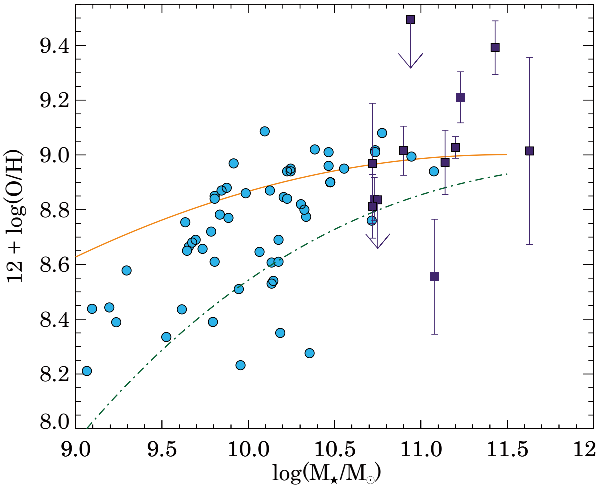


Figure 1: Mass-metallicity relation for sBzK galaxies in this study (filled square) compared with UV-selected $z \simeq 2$ galaxies (green dot-dashed line; [7]), $z \simeq 0.7$ galaxies (cyan circles; [8]), and local galaxies from SDSS (orange solid line; [9]).

References

[1] Daddi, E., et al.: 2004, *ApJ*, **617**, 746.
[2] Onodera, M., et al.: 2010, *ApJ*, **715**, 385.
[3] Kong, X., et al.: 2006, *ApJ*, **638**, 72.
[4] Daddi, E., et al.: 2007, *ApJ*, **670**, 156.
[5] Pannella, M., et al.: 2009, *ApJ*, **698**, L116.
[6] Fioc, M., Rocca-Volmerange, B.: 1997, *A&A*, **326**, 950.
[7] Erb, D. K., et al.: 2006, *ApJ*, **644**, 813.
[8] Savaglio, S., et al.: 2005, *ApJ*, **635**, 260.
[9] Tremonti, C. A., et al.: 2004, *ApJ*, **613**, 898.

Distance Measurement of Star-Forming Region IRAS 05137+3919 in Far Outer Galaxy

HONMA, Mareki, HIROTA Tomoya, KAN-YA, Yukitoshi, KAWAGUCHI, Noriyuki
KOBAYASHI, Hideyuki, KURAYAMA, Tomoharu, SATO, Katsuhisa
(NAOJ)

Star forming regions in far outer Galaxy are interesting targets because they can be used to trace extent of the Galaxy disk and also because they provide a laboratory to study how star formation occurs in an extreme environment with less metallicity and without presence of spiral arm. So far several star-forming regions are expected to exist in the far outer Galaxy with a Galacto-centric distance larger than 15 kpc[1], and extensive studies have been conducted for some of these potential star-forming regions in the far outer Galaxy[2]. However, their distance estimates were based on kinematic distances and/or assumed luminosities of young stars. Therefore, it is still highly uncertain whether these star-forming regions are indeed located in such a distant area, and hence astrometric confirmations are definitely required.

As an astrometric observation of such a star-forming region in the far outer Galaxy, we have monitored an H_2O maser source associated with star forming region IRAS 05137+3919, which is located toward the anti-center direction ($l = 168°$) with its kinematic distance of 12 kpc. Although H_2O maser spots in IRAS 05137+3919 are relatively variable in flux, we have determined a parallax of $\pi = 0.086 \pm 0.027$ mas (see Figure 1), corresponding to a source distance of $D = 11.6^{+5.3}_{-2.8}$ kpc[3]. The parallax detection is only 3-σ level and thus the uncertainty is fairly large. Nevertheless, from this result we can strongly constrain on the minimum distance of IRAS 05137+3919, which is 8.3 kpc at 90% confidence level. This can be seen from the bottom panel of figure 1, where a parallax significantly larger than 0.1 mas is inconsistent with observations. The parallax obtained in this study is basically consistent with the previous distance estimate of 12 kpc based on kinematic distance. Assuming the Galaxy center's distance of $R_0 = 8.5$ kpc, the minimum distance of 8.3 kpc is converted to a minimum Galacto-centric distance of 16.7 kpc (again at 90% confidence level). Therefore, the present study provides the first astrometric confirmation that there indeed exists a star-forming region in the far outer Galaxy.

The minimum distance obtained in this study is beyond the distance of spiral arm that is measured based on astrometry (such as Outer arm, corresponding to ~13 kpc toward the direction of IRAS 05137+3919). This result indicates that star formation process there is triggered by other mechanism rather than spiral shocks, imposing an interesting question on how stars form in the outer region of the Galaxy.

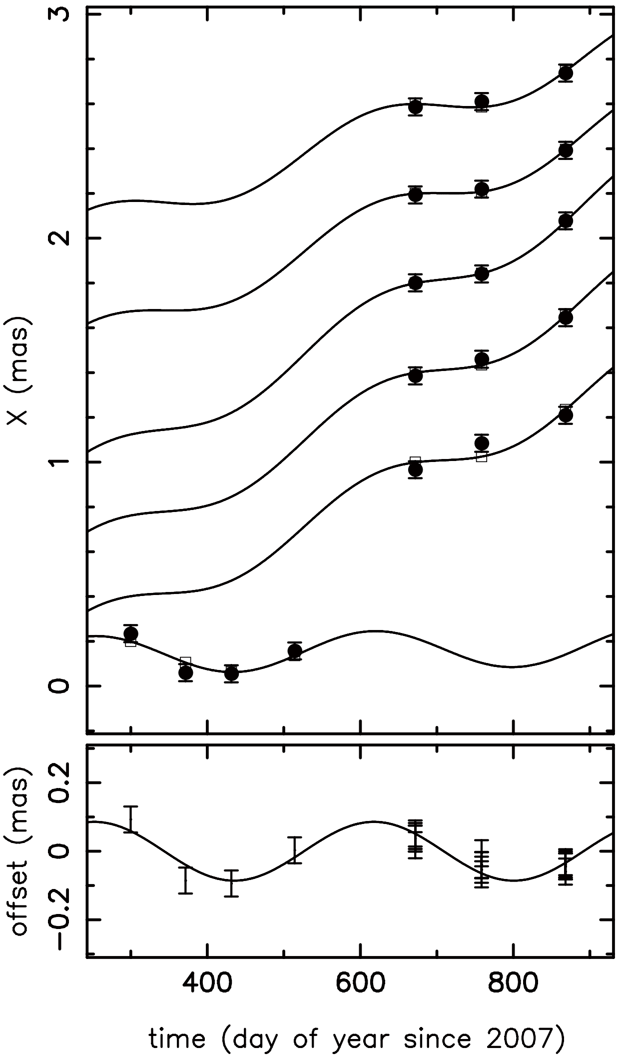


Figure 1: Maser spot motions in IRAS 05137+3919 along the East-West direction. Top panel shows the observed motions of 6 spots (sum of parallax and proper motion), and bottom panel is the parallax components after removing the proper motions. Curves show the best-fit results.

References

[1] Diegel, S., et al.: 1994, *ApJ*, **422**, 92.
[2] Kobayashi, N., et al.: 2008, *ApJ*, **683**, 178.
[3] Honma, M., et al.: 2011, *PASJ*, **63**, 17.

Connection of SuperMassive Black Hole and galaxy in Active galaxy

OI, Nagisa, IMANISHI, Masatoshi, IMASE, Keisuke
(The Graduate University for Advanced Studies/NAOJ)

Active Galactic Nuclei (AGNs) emit the bulk of their large luminosity ($>10^{10} L_\odot$). An engine of AGN is believed the release of gravitational energy generated by a mass-accreting onto SuperMassive Black Hole (SMBH) and conversion to radiative energy. Recent observations have revealed that formation of galaxies and SMBHs are related to each other. Since a tight correlation between masses of bulges (stellar masses) and SMBHs has been found, understanding the mechanism of connection between AGN and host galaxy is important to uncover the histories of SMBH and galaxy formations. However since size of host galaxy is more than 1000 times larger than that of AGN, it is difficult to connect them directly. It is more likely that kinematics and/or energy is interact with each material locally, then the relationship between AGN and galaxy might be made, so that understanding of relationship of them at a galaxy center continues to play an important role. Some theories of the physical mechanism at a galaxy center predict different relationships between AGN and nuclear starburst activities. To distinguish these theories, it is necessary to study AGNs over a wide AGN luminosity range including lowluminosity AGNs.

Infrared (IR) spectroscopy at $\lambda = 2$–$4\,\mu$m is effective to investigate the nuclear starbursts, because effects of dust extinction are small. Furthermore, Polycyclic Aromatic Hydrocarbons (PAH) emission feature, found in this IR wavelength range, can be used to distinguish between an emission of starbursts and AGN, because the feature are seen only in a starburst, but not in an AGN (due to PAH destruction by AGN's strong X-ray radiation). Moreover, the CO absorption features in this IR wavelength range can be used to estimate contributions an emission of stellar and AGN. These features enable us to discriminate an emission of starbursts and of AGN spectroscopically in an unresolved central region with spatially existing observing facilities.

Narrow slit spectroscopy using IR spectrographs attached to ground-based telescopes has applied to prevent an emission of galaxy central from an contamination by stars in an extended galaxy, and to investigate activities of nuclear starbursts. We have performed IR 2–4 μm spectroscopy of 22 low-luminosity nearby AGNs using the SpeX IR instrument attached to the IRTF telescope, and estimated nuclear starburst activities quantitatively (Fig. 1). We combined our sample with previous highluminosity AGNs[1], and then compared the activities of nuclear starbursts with those of AGN. As a result, we found the positive correlation between them over a wide AGN luminosity range (Fig. 2). The result strongly supports the theory that nuclear starbursts remove much more angular momentum from materials and encourage an AGN activity, that is "nuclear starbursts control the activity of AGN"[2].

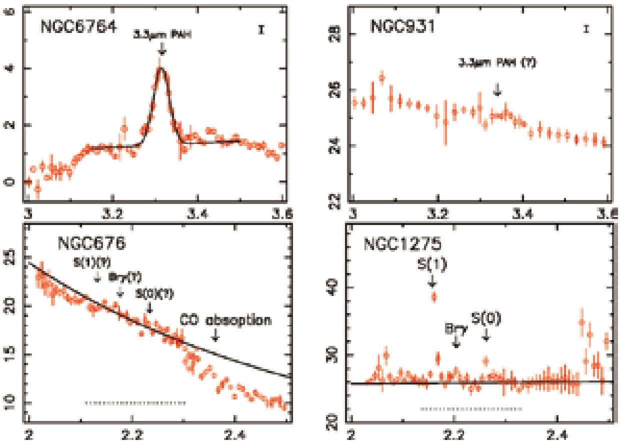


Figure 1: (left): Near infrared spectrum of a starburst dominated active galaxy. PAH emission (top) and CO absorption (bottom) features are strong. (right): Spectrum of an AGN dominated galaxy. Both of PAH emission and CO absorption features are very weak.

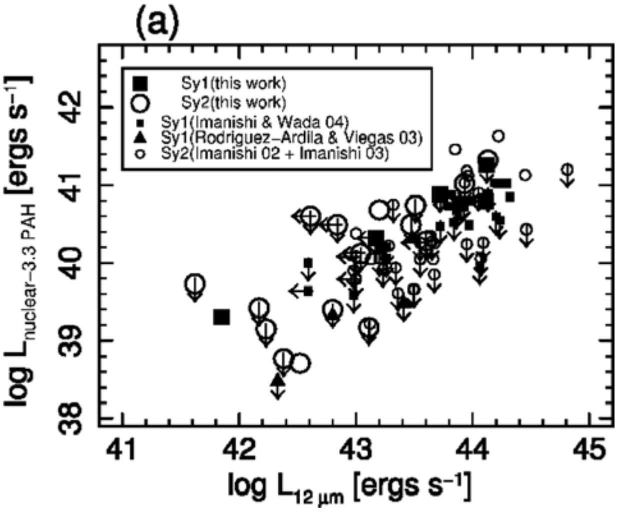


Figure 2: Nuclear starburst activities (ordinate) versus AGN activities (abscissa). The more active the nuclear starbursts activities are, the more active the AGN activities are.

References

[1] Imanishi, M., Wada, K.: 2004, *ApJ*, **617**, 214.
[2] Oi, N., et al.: 2010, *PASJ*, **62**, 1509.

Neutrino oscillation and expected event rate of supernova neutrinos in adiabatic explosion model

KAWAGOE, Shio, YOSHIDA, Takashi (University of Tokyo)
KAJINO, Toshitaka (NAOJ/University of Tokyo)
SUZUKI, Hideyuki (Tokyo University of Science)
SUMIYOSHI, Kohsuke (Numazu College of Tschnology)
YAMADA, Shoichi (Waseda University)

There are a lot of problems concerning to the mechanism of core-collapsed supernova explosions and supernova neutrinos[1]. Since 99% of the gravitational energy of the collapsed core is released as neutrinos. Most of neutrino oscillation parameters have been determined by the various neutrino experiments. However, it is still very difficult to determine three neutrino oscillation parameters of the mass difference between 1–3 mass eigenstates Δm^2_{13}, the mixing angle θ_{13}, and the CP violation phase δ[2]. It is one of the most important research topics of particle physics to determine these parameter values, and it is expected that the neutrinos are important keys to solve how supernova explosions succeed.

We calculate the supernova in adiabatic explosion model using an implicit Lagrangian code for general relativistic spherical hydrodynamics[3,4]. The numerical tables of Shen's equation of state (EOS) and Timmes's EOS are adopted for the high and low density matters in this code, respectively. We solve the time evolution of the neutrino wave function along the density profile of our result, and we obtains survival probabilities of the neutrinos. The neutrinos change their flavors at resonance of neutrino oscillations, and the shock propagation influences the resonance. In the case of the normal hierarchy (the inverted hierarchy), the survival probabilities of ν_e ($\bar{\nu}_e$) are influenced by the shock wave[5]. Using these survival probabilities, we obtain the energy spectra of the neutrinos passed through the exploding supernova. We calculate expected event rates of the supernova neutrinos with Super-Kamiokande (SK) and SNO [4].

The expected event rates depend on θ_{13}, and the influence of the shock wave appears when $\sin^2 2\theta_{13}$ is larger than 10^{-3}. The neutrino signals for the shock propagation is decreased compared with the case without shock. We define time-dependent ratio of the events of high-energy to low-energy neutrinos,

$$\mathrm{Rx} = \frac{\text{the number of high-energy neutrinos}}{\text{the number of low-energy neutrinos}} \tag{1}$$

where x refers to SK or SNO. The time-dependent ratio shows clearer signal of the shock propagation that exhibits remarkable decrease by at most factor ~2 for $\bar{\nu}_e$ in inverted hierarchy, whereas it exhibits smaller change by ~10% for ν_e in normal hierarchy (Figure 1). Both ratios $\mathrm{R_{SK}}$ and $\mathrm{R_{SNO}}$ increase with $\sin^2 2\theta_{13}$. For a given θ_{13}, the ratios with shock are smaller than the ratios without the shock. Therefore, observing time-dependent ratio of the neutrino events thus would provide a piece of very useful information to constrain θ_{13} and the mass hierarchy, and eventually help understanding the propagation how the shock propagates inside the star.

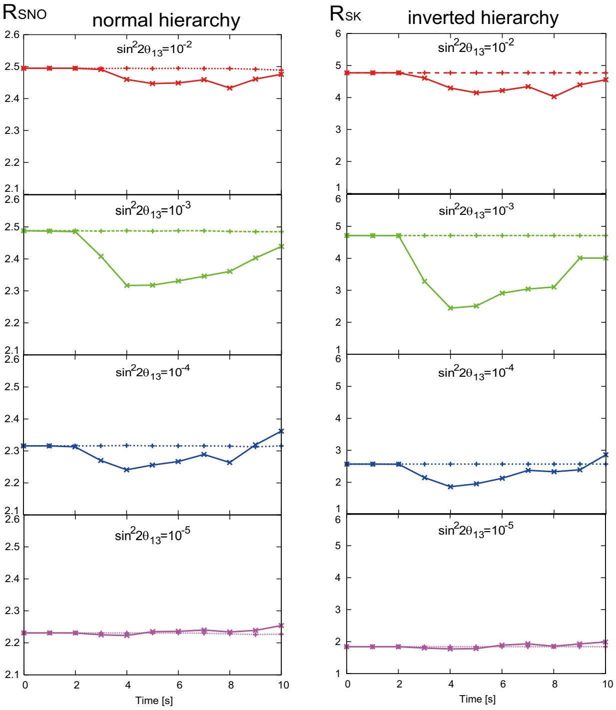


Figure 1: Left panels are $\mathrm{R_{SNO}}$ in the normal hierarchy, and right panels are $\mathrm{R_{SK}}$ in the inverted hierarchy for $\sin^2 2\theta_{13} = 10^{-2}$, 10^{-3}, 10^{-4} and 10^{-5} from top to bottom. Solid and dashed lines are the calculated results with and without shock wave, respectively.

References

[1] Woosley, S. E., et al.: 1986, *ApJ*, **24**, 205.
[2] Apollonio, M., et al.: 2003, *PRD*, **68**, 093003.
[3] Yamada, S.: 1997, *ApJ*, **475**, 720.
[4] Kawagoe S., et al.: 2010, *PRD*, **81**, 123014.
[5] Kawagoe S., et al.: 2009, *JCAP*, **9**, 033.

Origin of rare isotope Ta-180 in supernova-neutrino nucleosynthesis

HAYAKAWA, Takehito, CHIBA, Satoshi
(JAEA)
KAJINO, Toshitaka
(NAOJ/University of Tokyo)
MOHR, Peter
(Diakoniekrankenhaus Schw¨abisch Hall)
MATHEWS, Grant J.
(University of Notre Dame)

The astrophysical origin of an isotope, $^{180}\text{Ta}^m$, has remained an unsolved problem. This isotope has two unique features. First this is the rarest isotope in the solar system. Second the ground state decays by β decay with a half-life of 8.15 hr, whereas an excited state is a long-lived isomer with a half-life of $\geq 10^{15}$ yr. This nucleus is bypassed by the major nucleosynthesis mechanisms of the *s* and *r* processes. Thus exotic processes have been proposed but they have only underproduced the abundance of the rarest isotope ^{180}Ta[1,2]. The most popular scenario in recent times is the production in the ν process via the $^{181}\text{Ta}(\nu, \nu'n)^{180}\text{Ta}$ and $^{180}\text{Hf}(\nu_e, e)^{180}\text{Ta}$ neutrino reactions in core-collapse supernovae[3,4]. However, they overproduce the ^{180}Ta solar abundance. They noted that the observed ^{180m}Ta abundance can not be inferred from their calculations until the branching between the long-lived isomer and the ground state is known.

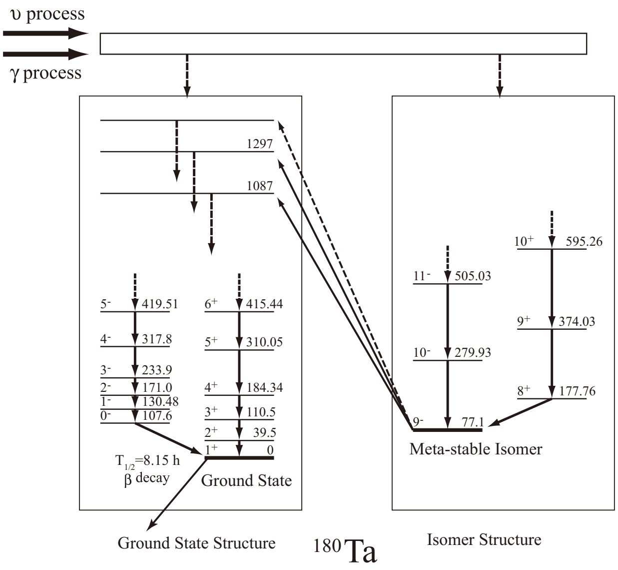


Figure 1: Schematic view of nucleosynthesis of ^{180}Ta.

In the ν process, low-spin excited states in ^{180}Ta are predominantly populated from ^{180}Hf by Gamow-Teller transitions and subsequently decay preferentially to the 1^+ ground state. However, in a high temperature photon bath of supernovae, the meta-stable isomer is excited from the ground state by (γ, γ') reactions through highly excited states. Moreover, the transition rate between the ground state and the isomer is affected by the changing temperature. Therefore, the final isomeric branching ratio should be evaluated by a time-dependent calculation.

We have proposed a model that the excited states of ^{180}Ta as consisting of two sets of nuclear states: 1) the ground state structure, which consists of the ground state plus the excited states with strong transitions to the ground state; and 2) the analogous isomeric structure (see Fig. 1). For $T_9 = 0.1$–1.0 all excited states lower than a few hundred keV are populated. After the freezeout each excited state decays to either the ground state or the isomer. In the transitional region, strongly connected states are only partly thermalized and two structures are linked between the weak γ transitions. We calculate the time-dependent calculation based on the two structure model taking into account previously measured linking transitions.

We finally obtain the isomer residual ratio of 0.39 at the freeze-out. It should be noted that this ratio is almost independent of the astrophysical parameters such as the supernova neutrino energy spectrum, the explosion energy, the temperature time constant, and the peak temperature in the ν process layers. With this ratio we can reproduce the solar abundance of ^{180}Ta by neutrino nucleosynthesis and an electron neutrino temperature of $kT \approx 4$ MeV[5,6].

References

[1] Beer, H., Ward, R. A.: 1981, *Nature*, **291**, 308.
[2] Yokoi, K., Takahashi, K.: 1983, *Nature*, **305**, 198.
[3] Woosley, S. E., et al.: 1990, *ApJ*, **356**, 272.
[4] Byelikov, A., et al.: 2007, *Phys. Rev. Lett.*, **98**, 082501.
[5] Hayakawa, T., et al.: 2010, *Phys. Rev. C*, **81**, 052801(R).
[6] Hayakawa, T., et al.: 2010, *Phys. Rev. C*, **82**, 058801.

A New Type of Small-Scale Downflow Patches in Sunspot Penumbrae

KATSUKAWA, Yukio (NAOJ)
JURČÁK, Jan (Academy of Sciences of the Czech Republic)

It has been known that high-speed outward flows, called Evershed flows, take place along magnetic field lines in a sunspot penumbra. High resolution and high precision spectro-polarimetric observations with Hinode have provided lots of knowledge on relationship between filamental magnetic structures and the Evershed flows in penumbrae, which helps to understand how the highspeed flows are driven by strong interaction between inclined fields and convection. In contrast, Hinode has revealed that there are small-scale flows in and around a sunspot that cannot be explained by the Evershed flows and has not been realized before.

The penumbral flow studied in this paper is one of the flow structures newly discovered with Hinode. Observations with the Spectro-Polarimeter (SP) aboard the Solar Optical Telescope (SOT) clearly show existence of patchy downflow structures in a penumbra which are different from the Evershed flows[1]. Sunspot magnetic fields consist of vertical and horizontal magnetic components with respect to the solar surface, and they form interlaced magnetic field configuration. The patchy structures associated with the downflow have a size of 300–400 km, and are located within the vertical magnetic component. While the flow structures associated with the Evershed flow typically have duration of tens of minutes to one hour, the newly discovered downflows are relatively transient phenomena and have duration of only a few minutes. The small size and short duration probably made it difficult to find the downflow patches in previous observations. Analysis of polarized spectrum line profiles reveals that the velocity of the downflow is about 1 km/s in the lower photospheric layer, and is almost zero in the upper photosphere.

The penumbral downflows have importance because some of the downflows are temporally and spatially coincident with the chromospheric brightenings above the penumbra. It is expected that magnetic reconnection between the vertical and horizontal magnetic fields generates bi-directional jets; the downward flow is observed in the photosphere, and the upward flow is observed in the chromosphere as a transient brightening. In this case, the finding of the downflows strongly supports that magnetic reconnection takes place in the photosphere. On the other hand, no counterpart is detected in the chromosphere for some of the downflows. One reason is that the observation does not have enough temporal resolution to detect temporal coincidence of the transient downflows and the brightenings. Some of the downflows are observed to appear after disappearance of the Evershed flows, which suggests that cooled materials drain down along magnetic fields after interruption of heat transport by the Evershed flow. The process is possibly related with the disappearance of the filamental magnetic fields[2]. It is required to acquire a simultaneous observation of the photosphere and the chromosphere with high temporal resolution to get a better grasp on the cause of the downflows.

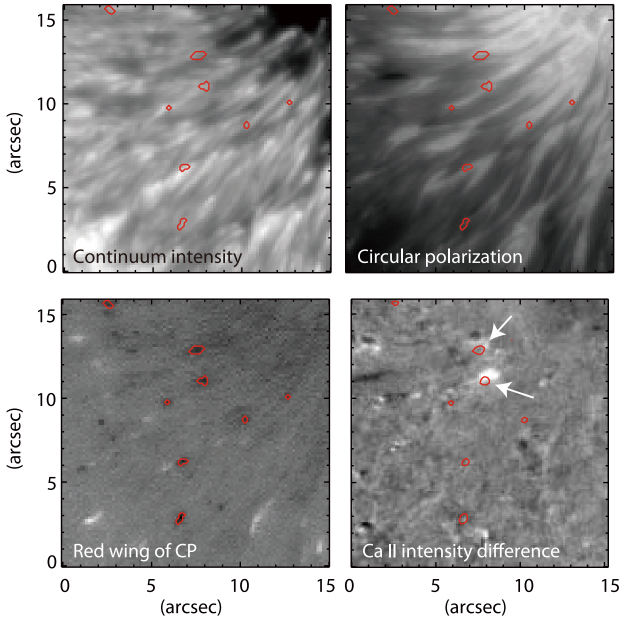


Figure 1: Sunspot penumbra observed with the Hinode Spectro-Polarimeter (SP). Here are shown maps of contin- uum intensities (*left top*), intensities of circular polarization (*right top*), red shifts of the circular polarization (*left bottom*), and chromospheric brightenings seen in Ca II H filtergrams (*right bottom*). The red contours indicate downflow patches, and the arrows indicate the chromospheric brightenings coin- cident with the downflows.

References

[1] Katsukawa, Y., Jurčák, J.: 2010, *A&A*, **524**, A20.
[2] Jurčák, J., Katsukawa, Y.: 2010, *A&A*, **524**, A21.

Latest model calculation of big bang nucleosynthesis catalyzed by a long-lived massive particle

KUSAKABE, Motohiko
(University of Tokyo)

KAJINO, Toshitaka
(NAOJ/University of Tokyo)

YOSHIDA, Takashi
(University of Tokyo)

MATHEWS, Grant J.
(University of Notre Dame)

In standard big bang nucleosynthesis (BBN) with the baryon-to-photon ratio inferred from WMAP, ^{7}Li is produced mostly as ^{7}Be (Fig. 1a, dashed lines). Subsequently, ^{7}Be is transformed into ^{7}Li by electron capture. A problem of standard BBN is a discrepancy between the predicted and observed abundances of $^{(6\text{ and})\,7}$Li[1]. One of solutions is catalysis reactions by negatively charged massive particles X^-s[2]. We solve numerically the nonequilibrium nuclear and chemical reaction network for this X^--catalyzed BBN[2] with improved reaction rates derived from rigorous quantum many-body calculations[3]. We adopt all of their rates, and choose their $^7\text{Be}_X(p,\gamma)^8\text{B}_X$ rate for an infinite X^- mass case.

Figure 1 shows a result of BBN calculation[4]. The X^- particles recombine with ^{7}Be at $T_9 \sim 0.5$. The $^7\text{Be}_X$ (Fig. 1b) is then destroyed by the $^7\text{Be}_X(p,\gamma)^8\text{B}_X$ reaction, primarily through the atomic excited state of $^8\text{B}_X$[5], and secondarily through the atomic ground state $^8\text{B}^*(1^+, 0.770\text{ MeV})_X$ composed of the $^8\text{B}^*(1^+, 0.770\text{ MeV})$ nuclear excited state and an X^-[6]. At $T_9 \sim 0.1$, the X^-particles bind to ^{4}He. Then, the reaction $^4\text{He}_X(d,X^-)^6\text{Li}$ operates, and ^{6}Li and $^6\text{Li}_X$ (after the recombination) are produced. Neutral X-nuclei, i.e., p_X, d_X, and t_X, mainly react with ^{4}He nuclei to lose their X^-s leaving $^4\text{He}_X$. The abundances are, therefore, kept low. Their nuclear reactions are thus not important.

The $^8\text{Be}_X(p,\gamma)^9\text{B}_X$ reaction through the $^9\text{B}^{*a}_X$ atomic excited state is weak because its resonance energy is large [3]. The resonant $^8\text{Be}_X(n,X^-)^9\text{Be}_X$ reaction through the state $^9\text{Be}^*(1/2^+, 1.684\text{ MeV})_X$ is not likely to operate since the state is estimated to be not a resonance but a bound state located below the $^8\text{Be}_X+n$ threshold[3].

We assume that the present cold dark matter (DM) was partly produced by the decay of $X^{\pm}$ particles, i.e., $Y_{\text{DM}} \geq Y_X$. Using the WMAP-CMB constraint on the cold DM density and the X^- abundance needed for a solution to the Li problems, a limit on the mass m_{DM} is derived. Comparing this mass to the suggested allowed region, e.g., $40\text{ GeV} < m_{\text{DM}} < 200\text{ GeV}$ from the CDMS experiment, implies that only an X^- particle which decays via the weak interaction can have existed with sufficient abundance to reduce the ^{7}Li produced in BBN (see Fig. 6 of [2] for this case).

In this revised model there is no signature in the abundances of nuclei heavier than Be. We predict that the primordial ^{9}Be abundance in the allowed parameter region is negligible, $^9\text{Be/H} < O(10^{-25})$, and far less than the most stringent upper limit of $^9\text{Be/H} < 10^{-14}$[7]. $^9\text{Be}_X$ is destroyed through the process $^9\text{Be}_X(p,{}^6\text{Li})^4\text{He}_X$ [2]. Another isobar, i.e., $^9\text{B}_X$ can be produced without experiencing the decays. The decay of the X^-, however, induces reactions $^9\text{B}_X \rightarrow p + {}^8\text{Be}$ + (decay products) since the ^{9}B is unstable to the proton decay. The ^{9}Be production through $^9\text{B}_X$ is, thus, not possible

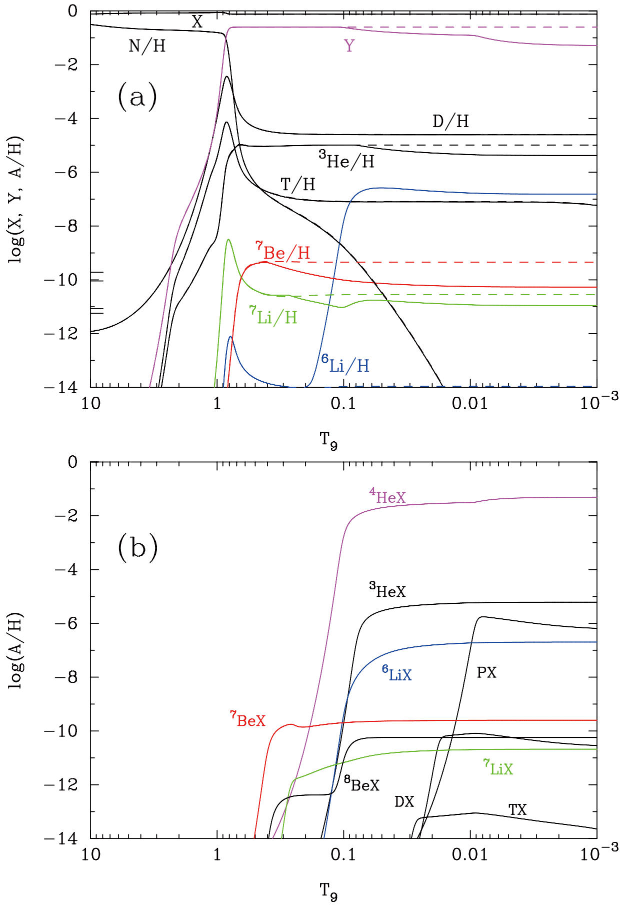


Figure 1: Abundances of normal (a) and X-nuclides (b) as a function of temperature $T_9 \equiv T/(10^9\text{ K})$. The parameters are the abundance ratio of X to baryon $Y_X \equiv n_X/n_b = 0.05$ and the lifetime $\tau_X = \infty$. This is reprinted from[1].

References

[1] Aoki, W., et al.: 2009, *ApJ*, **698**, 1803.
[2] Kusakabe, M., et al.: 2008, *ApJ*, **680**, 846.
[3] Kamimura, M., et al.: 2009, *Prog. Theor. Phys.*, **121**, 1059.
[4] Kusakabe, M., et al.: 2010, *Phys. Rev. D*, **81**, 083521.
[5] Bird, C., et al.: 2008, *Phys. Rev. D*, **78**, 083010.
[6] Kusakabe, M., et al.: 2007, *Phys. Rev. D*, **76**, 121302.
[7] Ito, H., et al.: 2009, *ApJ*, **698**, L37.

Discriminating Planetary Migration Mechanisms by the SEEDS Project

NARITA, Norio[1], KUDO, Tomoyuki[1], BERGFORS, Carolina[2], NAGASAWA, Makiko[3]
THALMANN, Christian[2], SATO, Bun'ei[3], SUZUKI, Ryuji[1], KANDORI, Ryo[1], JANSON, Markus[4]
GOTO, Miwa[2], BRANDNER, Wolfgang[2], IDA, Shigeru[3], ABE, Lyu[5], CARSON, Joseph[2/6]
EGNER, Sebastian, E.[1], FELDT, Markus[2], GOLOTA, Taras[1], GUYON, Olivier[1/7], HASHIMOTO, Jun[1]
HAYANO, Yutaka[1], HAYASHI, Masahiko[1], HAYASHI, Saeko[1], HENNING, Thomas[2], HODAPP, Klaus, W.[8]
ISHII, Miki[1], KNAPP, Gillian, R.[9], KUSAKABE, Nobuhiko[1], KUZUHARA, Masayuki[1/10], MATSUO, Taro[11]
McELWAIN, Michael, W.[9], MIYAMA, Shoken[1], MORINO Jun-Ichi[1], MORO-MARTIN, Amaya[2]
NISHIMURA, Tetsuro[1], TAE-SOO, Pyo[1], SERABYN, Eugene[11], SUENAGA, Takuya[1/12], SUTO, Hiroshi[1]
TAKAHASHI, Yasuhiro, H.[1/12], TAKAMI, Michihiro[13], TAKATO, Naruhisa[1], TERADA, Hiroshi[1]
TOMONO, Daigo[1], TURNER, Edwin, L.[9/10], WATANABE, Makoto[14], YAMADA, Toru[15]
TAKAMI, Hideki[1], USUDA, Tomonori[1], TAMURA, Motohide[1]

1: NAOJ, 2: Max Planck Institute for Astronomy, 3: Tokyo Institute of Technology, 4: University of Toronto, 5: Universite de Nice Sophia-Antipolis, 6: College of Charleston, 7: University of Arizona, 8: University of Hawaii, 9: Princeton University, 10: University of Tokyo, 11: Jet Propulsion Laboratory, California Institute of Technology, 12: Graduate University for Advanced Studies, 13: Academia Sinica, 14: Hokkaido University, 15: Tohoku University

Planetary orbits reflect their migration history. It is now known that there are many exoplanets with eccentric and/or highly tilted orbits. Those exoplanets are considered to migrated through planet-planet scattering or the Kozai migration. It is difficult, however, to discriminate these two migration mechanisms, since the both mechanisms predict eccentric and/or highly tilted orbits. To discriminate the two migration mechanisms, it it necessary to search for counterparts of their migration (e.g., giant planets for planet-planet scattering or a distant companion for the Kozai migration). We thus started high-contrast direct imaging observations for eccentric or tilted planetary systems in the SEEDS (Strategic Explorations of Exoplanets and Disks with Subaru) project.

We first observed a retrograde planetary system HAT-P-7, for which the Subaru telescope found the retrograde orbit of HAT-P-7b in 2009[1], with the HiCIAO (High Contrast Instrument for the Subaru Next Generation Adaptive Optics) onboard the Subaru. We found that there are two companion candidates around the HAT-P-7 system (see Figure 1)[2]. Although it is not yet known whether those candidates are physically associated with HAT-P-7 or not, if associated, those companions are M stars and separated by at least 1000 AU. We then calculated whether those companion candidates can cause the Kozai migration for the inner retrograde planet. We found that it is impossible for the companion candidates to cause the Kozai migration in the presence of an outer planet around the retrograde planet (reported by [3]). As a result, we conclude that it is the most plausible that the retrograde planet HAT-P-7b has migrated through planet-planet scattering. The SEEDS project will conduct this kind of observations for dozens of planetary systems to discriminate planetary migration mechanisms.

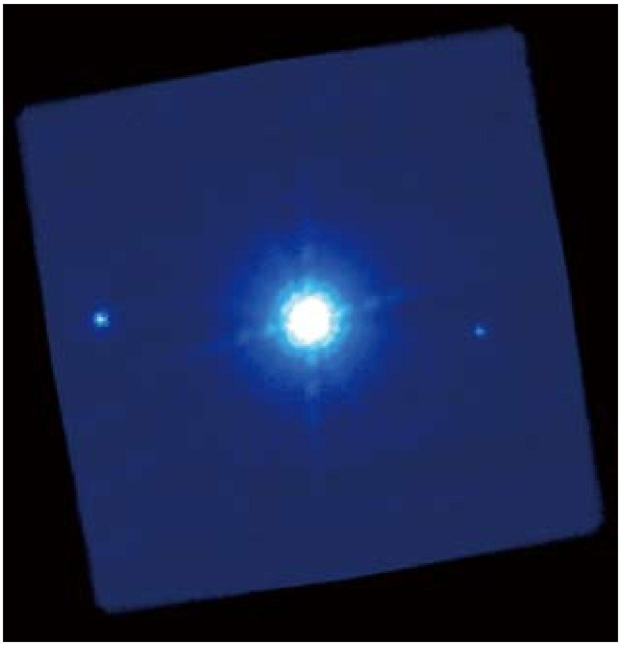


Figure 1: An image of HAT-P-7 taken with the Subaru HiCIAO. Two companion candidates are detected around HAT-P-7. The field of view is 12″ × 12″. North is up and east is to the left.

References

[1] Narita, N., et al.: 2009, *PASJ*, **61**, L35-L40.
[2] Narita, N., et al.: 2010, *PASJ*, **62**, 779-786.
[3] Winn, J. N., et al.: 2009, *ApJ*, **703**, L99-L103.

Nano-JASMINE Ready to Launch!

KOBAYASHI, Yukiyasu. GOUDA, Naoteru, YANO, Taihei
(NAOJ / Graduate Univeristy for Advanced Studies)

HATSUTORI, Yoichi
(NAOJ)

YAMADA, Yoshiyuki
(Kyoto University)

NIWA, Yoshito, MUROOKA, Junpei, SAKO, Nobutada, NAKASUKA, Shin’ichi
(University of Tokyo)

Nano-JASMINE is almost complete except for the final arrangements (Figure 1). The satellite is due for launch in the current fiscal year (2011)[1]. The bus part of Nano- JASMINE satellite was developed at the Nakasuka laboratory, University of Tokyo, which has considerable experience in developing very small satellite systems. The mission part of the satellite was developed jointly by the National Astronomical Observatory and Kyoto University. The developed satellite will be launched from the Alcantara Space Launcher onboard the Cyclone-4 rocket, which has been developed by Uclaina[2].

Figure 1: The Nano-JASMINE flight model in the ATC large clean room after experiments of optical alignments.

Nano-JASMINE is the first in a series of astrometry satellites promoted by the JASMINE project office. Although the satellite’s telescope has a diameter of only 5 cm, it will survey the entire sky in the zw-band (0.6–1.0 μm) during its 2-year operational life. It is expected that the satellite will measure more than 60,000 stars of magnitude less than 7 with an accuracy of less than 3 mas[3]. The European Space Agency (ESA) HIPPARCOS performed similar observations approximately 20 years ago; our mission can benefit from the large time gap between the HIPPARCOS observations and our observations, which will help us to measure accurately the proper motion of a large number of stars. Because the various techniques employed to achieve precise stellar positioning used in this mission will also be used in subsequent JASMINE missions, it is a great opportunity for the JASMINE team to verify and evaluate these techniques using real satellite data.

After the launch, we will use the Mizusawa 10 m antenna and the new 3 m antenna installed atop the 7th building of the engineering department at the University of Tokyo. We are now in the process of installing data transfer instruments at both these antenna stations, and are developing data transfer software. In the preliminary stages of satellite operation, the necessary satellite sever control will be performed from the Kiruna tracking station, located in the northern part of Sweden. The Kiruna tracking station, which is located inside the Arctic Circle, ensures a longer visibility time. Therefore, it is suitable for this mission because our satellite will be launched to a sun-synchronized orbit.

Analysis of the data acquired by Nano-JASMINE is complicated because the amount of data is enormous and all data must be solved integrated. GAIA, promoted by the ESA, has the same observation approach. It is known that GAIA’s analysis tool can be used for analyzing Nano-JASMINE data[4]. The GAIA team has welcomed the use of their tool for analyzing Nano-JASMINE data, because they are interested in validating their tool with real satellite data. We have reached a memorandum of cooperation with the ESA for analyzing Nano- JASMINE data.

References

[1] Kobayashi, Y., et al.: 2010, *SPIE*, **7731**, 77313Z.
[2] Niwa, Y., et al.: 2010, *SPIE*, **7731**, 773141.
[3] Hatsutori, Y. et al.: 2011, *EAS Publ. Series*, **45**, 397.
[4] Yamada, Y. et al.: 2011, *EAS Publ. Series*, **45**, 135.

Performance evaluation of Nano-JASMINE telescope flight model

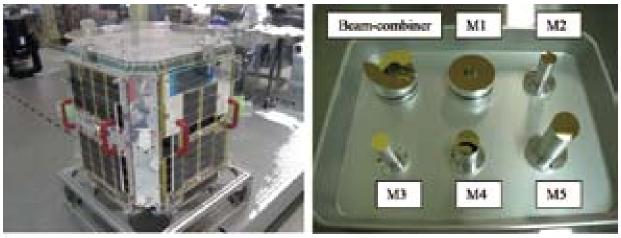
NIWA, Yoshito (NAOJ)
HATSUTORI, Yoichi (IBM Japan, Ltd.)
KOBAYASHI, Yukiyasu, GOUDA, Naoteru, YANO, Taihei (NAOJ)
YAMADA, Yoshiyuki (Kyoto university)

Nano-JASMINE is a very small, 35-kg mass, satellite for space astrometry[1,2], which will be launched by Cyclone-4 rocket from Brazil in 2011. The satellite is developed by National Astronomical Observatory of Japan, Kyoto University and University of Tokyo. Nano-JASMINE mounts a 5-cm effective diameter telescope and a time-delay integration (TDI) controlled fully depleted charge coupled device (FDCCD) image sensor which is sensitive to wavelength of zw-band ($600 < \lambda < 1000$ nm). Nano-JASMINE will perform firsttime demonstrations and experimentations for Japan astrometry mission in space. These trials are targeting for Japan Astrometry Satellite Mission for Infrared Exploration (JASMINE)[3]. By Nano-JASMINE mission, we are also going to measure positions of ten or twenty thousands of stars of zw < 7.5 mag for all-sky with an accuracy of about 3 milli-arcsecond.

Astrometry is a field of observational astrophysics that measures positions and proper motions of stars on the celestial sphere, and determines the distances to stars from the earth using trigonometric parallaxes due to earth orbit around the sun. Space telescopes for astrometry have much more advantage than ground-based telescopes; because of the effect of atmospheric motions, observed star images are blurry in the case of ground-based observations. Therefore, HIPPARCOS was launched by ESA in 1989, and observed about hundreds of thousands of star positions around the all-sky with one milli-arcsecond angular accuracy. In 2011, almost 22 years have passed since the end of the HIPPARCOS mission. Then, the errors in proper motions have accumulated over the years; the individual motions of stars and their uncertainties are large enough to degrade the HIPPARCOS data during these two decades of blank. Therefore, the Nano- JASMINE mission is beneficial.

Currently, satellite functional tests, which include electrical integration tests, vibration tests, thermal vacuum tests, and radiation tests, have almost finished, and long duration operational tests are in the process in preparation for the launch in August 2011. In this paper, we report a result of performance evaluation of mission system: a measurement of wave front error for the telescope.

If there are mirror surface errors for the telescope, such errors cause optical aberrations. Accordingly, shapes of point spread functions (PSF) are distorted, and the centroids of stellar images will be changed from true positions. Total budget for root mean square (RMS) wave front error is $\lambda/14$ at $\lambda = 800$ nm. The wave front error was measured for each mirror surface by use of a Zygo interferometer. The results are shown in Fig. 1. The total RMS wave front errors are both $\lambda/17$ at $\lambda = 800$ nm for upper and lower optical system. We also directly measured total wave front error for the fabricated telescope, which was placed in vacuum chamber and cool downed to 223 K, which is equal to the operating temperature on the orbit. As a result, the total RMS wave front errors are $\lambda/19$ and $\lambda/21$ for upper and lower optical system, respectively. This result indicates that the error level fulfills the requirement so that the telescope is given assurance for diffraction-limited performance on the orbit.



Mirror	RMS Wave front error (nm)	
	Upper	Lower
Beam combiner	16.6	14.2
1st	33.2	
2nd	20.6	
3rd	12.7	
4th	11.1	
5th	13.5	
Total	47.4	46.9

Figure 1: Top left: the flight model of Nano-JASMINE. Top right: the flight model of the telescope mirrors; M1 and M2 are hyperboloid mirrors as a primary mirror and a secondary mirror, respectively. M3 ~ M4 are flat mirrors. Bottom: wave front error of each mirror surface.

References

[1] Kobayashi, Y., et al.: 2006, *SPIE*, **6265**, 626544 1-10.
[2] Hatsutori, Y., et al.: 2009, *Proc. of the 27th ISTS*, 2009-m-10.
[3] Gouda, N.: 2011, *EAS Publications Series*, **45**, 393-396.

Inclined Orbits Prevail in Exoplanetary Systems

NARITA, Norio (NAOJ)
HIRANO, Teruyuki (MIT/University of Tokyo)
SATO, Bun'ei (Tokyo Institute of Technology)
AOKI, Wako, TAMURA, Motohide (NAOJ)

Since the discovery of the first exoplanet in 1995, scientists have identified more than 500 exoplanets, planets outside of our solar system, nearly all of which are giant planets. Most of these giant exoplanets closely orbit their host stars, unlike our solar system's giant planets, like Jupiter, that orbit the Sun from a distance. Accepted theories propose that these giant planets originally formed from abundant planet-forming materials far from their host stars and then migrated to their current close locations. Different migration processes have been suggested to explain close-in giant exoplanets.

Disk-planet interaction models of migration focus on interactions between the planet and its protoplanetary disk, the disk from which it originally formed. Sometimes these interactions between the protoplanetary disk and the forming planet result in forces that make the planet fall toward the central star. This model predicts that the spin axis of the star and the orbital axis of the planet will be in alignment with each other. Planet-planet interaction models of migration have focused on mutual scatterings among giant planets. Migration can occur from planet scattering, when multiple planets scatter during the creation of two or more giant planets within the protoplanetary disk. While some of the planets scatter from the system, the innermost one may establish a final orbit very close to the central star. Another planet-planet interaction scenario, Kozai migration, postulates that the long-term gravitational interaction between an inner giant planet and another celestial object such as a companion star or an outer giant planet over time may alter the planet's orbit, moving an inner planet closer to the central star. Few-body interactions, including planetplanet scattering and Kozai migration, could produce an inclined orbit between the planet and the stellar axis.

Overall, the inclination of the orbital axes of close-in planets relative to the host stars' spin axes emerges as a very important observational basis for supporting or refuting migration models upon which theories of orbital evolution center. We have conducted observations with the Subaru Telescope to investigate these inclinations for several systems so far. We measured the Rossiter-McLaughlin (hereafter, RM) effect of the systems and found evidence that some of their orbital axes incline relative to the spin axes of their host stars.

The RM effect refers to apparent irregularities in the radial velocity or speed of a celestial object in the observer's line of sight during planetary transits. Unlike the spectral lines that are generally symmetrical in measures of radial velocity, those with the RM effect deviate into an asymmetrical pattern. Such apparent variation in radial velocity during a transit reveals the sky-projected angle between the stellar spin axis and planetary orbital axis. Subaru Telescope has participated in previous discoveries of the RM effect, which we have investigated for over ten exoplanetary systems thus far. Among the observed planetary systems, we newly found that TrES-4b has a well-aligned orbit[1], whereas XO-4b[2] and HAT-P-11b[3] have highly inclined orbits (see Figure 1). The latest observational results about the RM effect, including those obtained independently of the findings reported here, suggest that about one-third of the observed systems have highly inclined planetary orbits. The few-body scenario of migration, whether caused by planet-planet scattering or Kozai migration, rather than the planetdisk scenario could account for their migration to the present locations.

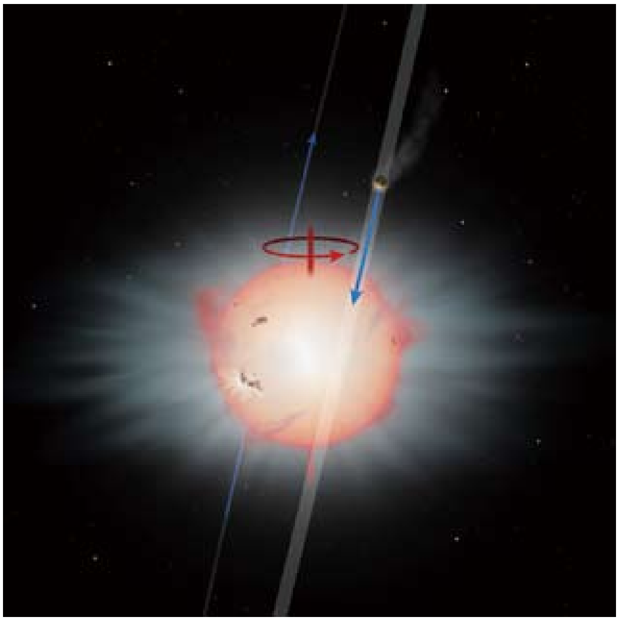


Figure 1: Illustration of the HAT-P-11 System Based on Observations from Subaru Telescope.

References

[1] Narita, N., et al.: 2010, *PASJ*, **62**, 653-660.
[2] Narita, N., et al.: 2010, *PASJ*, **62**, L61-L65.
[3] Hirano, T., et al.: 2011, *PASJ*, **63**, S531-S536.

Short Lifetime of Protoplanetary Disks in Low-metallicity Environments

YASUI, Chikako, SAITO Masao
(NAOJ)
KOBAYASHI, Naoto
(University of Tokyo)
TOKUNAGA, Alan T.
(University of Hawaii)
TOKOKU, Chihiro
(Tohoku University)

In order to understand protoplanetary disk evolution and planet formation in a wider range of environments than previously studied, we explored the lifetime of protoplanetary disks in the outermost Galaxy ($R_g \gtrsim 15$ kpc), which are known to have a very different metallicity from the solar neighborhood, [M/H] ~ −1 dex.

We obtained the deep near-infrared (NIR) images of six young clusters that are located in the outer Galaxy with known metallicity of $[O/H] \simeq -0.7$ dex using Subaru 8.2 m telescope[1]. We derived disk fraction for each cluster (Figure 1) and estimated disk lifetime in the environments (Figure 2). As a result, we found that disk fraction of the low-metallicity clusters declines rapidly in < 1 Myr, which is much faster than the ~ 5–7 Myr observed for the solar-metallicity clusters, suggesting that disk lifetime shortens with decreasing metallicity possibly with an $\sim 10^Z$ dependence[2].

Since the shorter disk lifetime reduces the time available for planet formation, this could be one of the major reasons for the well-known “planet-metallicity correlation”, which states that the probability of a star hosting a planet increases steeply with stellar metallicity. The reason for the rapid disk dispersal could be the increase of the mass accretion rate, and/or the effective far-ultraviolet and/or X-ray photoevaporation due to the low extinction; however, another unknown mechanism for the outer Galaxy environment could be contributing significantly. Although more quantitative observational and theoretical assessments are necessary, our results present the first direct observational evidence that can contribute to explaining the planet-metallicity correlation.

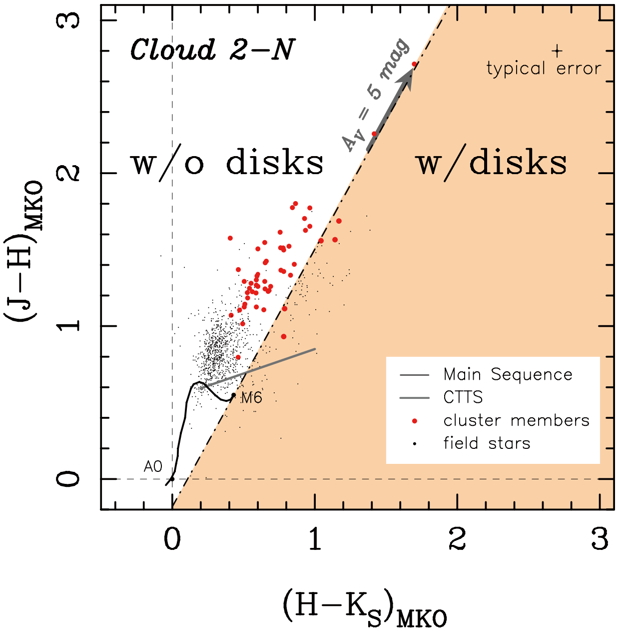


Figure 1: The way of deriving disk fraction for an example cluster, the Cloud 2-N cluster. Disk fraction is defined as the frequency of NIR excess stars (located in orange highlighted region) within a young cluster.

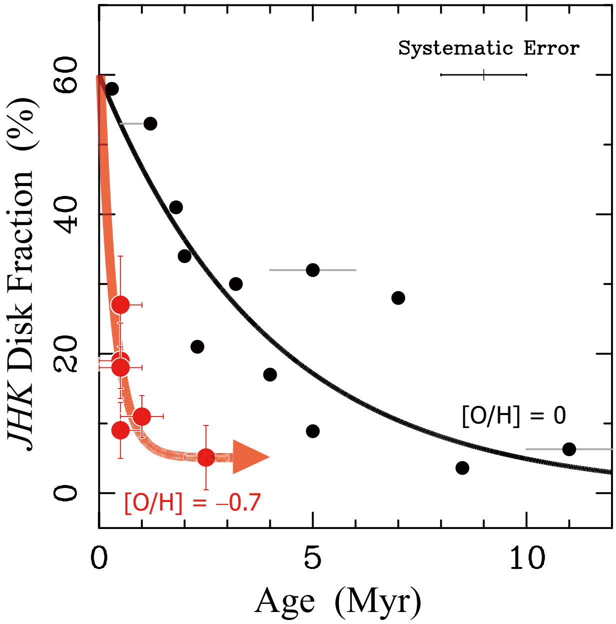


Figure 2: Disk fraction as a function of cluster age. JHK disk fractions of the young clusters with low metallicity are shown by red filled circles, while those of young clusters with solar metallicity are shown by black filled circles. The black line shows the disk fraction evolution under solar metallicity, while the red arrow shows the proposed JHK disk fraction evolution in low-metallicity environments.

References

[1] Yasui, C., et al.: 2009, *ApJ*, **705**, 54.
[2] Yasui, C., et al.: 2010, *ApJ*, **723**, L113.

Direct Imaging of Fine Structures in Giant Planet Forming Regions of the Protoplanetary Disk around AB Aurigae[*]

HASHIMOTO, Jun[1], TAMURA, Motohide[1], FUKUE, Tsubasa[1], KOKUBO, Eiichiro[1], KANDORI, Ryo[1]
KUSAKABE, Nobuhiko[1], MATSUO, Taro[1], MIYAMA, Syoken[1], MORINO, Jun-ichi[1], SUTO, Hiroshi[1]
KUDO, Tomoyuki[1], GOLOTA, Taras[1], GUYON, Olivier[1], HAYANO, Yutaka[1], HAYASHI, Masahiko[1]
HAYASHI, Saeko[1], ISHII, Miki[1], NISHIMURA, Tetsuo[1], PYO, Tae-Soo[1], TAKATO, Naruhisa[1]
EGNER, Sebastian[1], TERADA, Hiroshi[1], TOMONO, Daigo[1], TAKAMI, Hideki[1], USUDA, Tomonori[1]
MUTO, Takayuki[2], FUKAGAWA, Misato[3], INUTSUKA, Shu-ichiro[4], HONDA, Mitsuhiko[5], GOTO, Miwa[6]
HENNING, Thomas[6], CARSON, Joseph[6], BRANDER, Wolfgang[6], FELDT, Markus[6], THALMANN, Christian[6]
KNAPP, Gillian[7], MCELWAIN, Michael[7], TURNER, Edwin[7], MORO-MARTIN, Amaya[7]
MOMOSE, Munetake[8], OKAMOTO, Yoshiko[8], OHASHI, Nagayoshi[9], TAKAMI, Michihiro[9], GRADY, Carol[10]
HODDAP, Klaus[11], WISNIEWSKI, John[12], JANSON, Markus[13], ABE, Lyu[14], MAYAMA, Satoshi[15]
SUZUKI, Ryuji[16], WATANABE, Makoto[17], YAMADA, Toru[18]

1: NAOJ, 2: Tokyo Institute of Technology, 3: Osaka University, 4: Nagoyo University, 5: Kanagawa University, 6: Max Planck Institute for Astronomy, 7: Princeton University, 8: Ibaraki University, 9: Institute of Astronomy and Astrophysics, 10: Goddard Space Flight Center, 11: University of Hawaii, 12: University of Washington, 13: University of Toronto, 14: University of Nice, 15: The Graduate University for Advanced Studies, 16: TMT Observatory Corporation, 17: Hokkaido University, 18: Tohoku University

Circumstellar disks are usually formed around young stars and are intricately tied to the origin of planets (e.g., [1]). Giant planets have been considered to form via gas accretion onto rocky cores in such disks (e.g., [2]), which can successfully explain "normal" giant planets like ours. However, recent direct detections of companions with masses of a few up to a few tens of M_J at distances > 20 AU, beyond what had been thought to be the planet forming zone (e.g., [3]), pose a challenge for the standard core-accretion scenario where planets are formed *in-situ*. Thus, information on the detailed structures of the inner (r < 50 AU) regions of protoplanetary disks is crucial.

We report high-resolution 1.6 μm polarized intensity (*PI*) images of the circumstellar disk around the Herbig Ae star AB Aur at a radial distance of 22 AU (0.″15) up to 554 AU (3.″85)[4], which have been obtained by the high-contrast instrument HiCIAO with the dual-beam polarimetry. We revealed complicated and asymmetrical structures in the inner part (< 140 AU) of the disk, while confirming the previously reported outer (r > 200 AU) spiral structure. We have imaged a double ring structure at ~40 and ~100 AU and a ring-like gap between the two (Fig. 1). We found a significant discrepancy of inclination angles between two rings, which may indicate that the disk of AB Aur is warped. Furthermore, we found seven dips (the typical size is ~45 AU or less) within two rings, as well as three prominent *PI* peaks at ~40 AU. The observed structures, including a bumpy double ring, a ring-like gap, and a warped disk in the innermost regions, provide essential information for understanding the formation mechanism of recently deteced wide-orbit (r > 20 AU) planets.

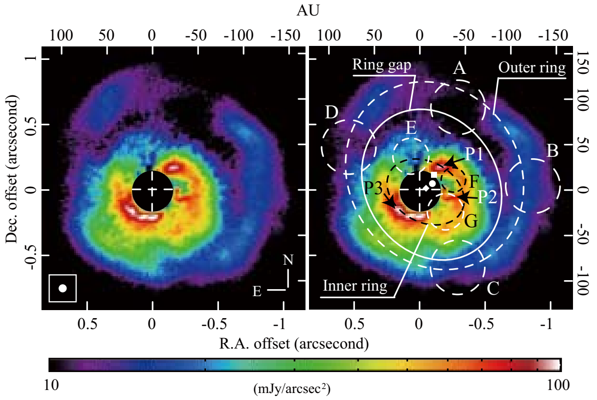


Figure 1: *PI* image with a coronagraphic occulting mask of 0.″3 diameter (left) and the features (right). Central position (0, 0) is the stellar position. The outer and inner rings are denoted by the dashed ellipsoids. The solid ellipsoid indicates the wide ring gap. The dashed circles (A to G) represent small dips in the two rings. The filled diamond, circle, and square represent the geometric center of the inner ring, ring gap, and outer ring, respectively. The field of view in both images is 2.″0 by 2.″0. The solid circle in the left-bottom inset represents the spatial resolution of 0.″06.

Reference

[1] Shu, F. H., Adams, F. C., Lizano, S.: 1987, *ARA&A*, **25**, 23.
[2] Pollack, J. B., el al.: 1996, *Icarus*, **124**, 62.
[3] Marois, C., et al.: 2008, *Science*, **322**, 1348.
[4] Hashimoto, J., et al.: 2011, *ApJ*, **729**, L17.

---

[*] Based on data collected at the Subaru Telescope, which is operated by the National Astronomical Observatory of Japan.

Imaging of a Transitional Disk Gap in Reflected Light: Indications of Planet Formation Around the Young Solar Analog LkCa 15*

THALMANN, Christian[1], GOTO, Miwa[1], HENNING, Thomas[1], CARSON, Joseph[1], BRANDER, Wolfgang[1]
FELDT, Markus[1], GRADY, Carol[2], WISNIEWSKI, John[3], JANSON, Markus[4], FUKAGAWA, Misato[5]
SHIBAI, Hiroshi[5], HONDA, Mitsuhiko[6], MULDERS, Gijs[7], MIN, Michiel[8], KNAPP, Gillian[9]
MCELWAIN, Michael[9], TURNER, Edwin[9], MORO-MARTIN, Amaya[9], HODDAP, Klaus[10], ABE, Lyu[11]
SERABYN, Eugene[12], TAKAMI, Michihiro[13], KUDO, Tomoyuki[14], GOLOTA, Taras[14], GUYON, Olivier[14]
HAYANO, Yutaka[14], HAYASHI, Masahiko[14], HAYASHI, Saeko[14], ISHII, Miki[14], NISHIMURA, Tetsuo[14]
PYO, Tae-Soo[14], TAKATO, Naruhisa[14], EGNER, Sebastian[14], TERADA, Hiroshi[14], TOMONO, Daigo[14]
TAKAMI, Hideki[14], USUDA, Tomonori[14], FUKUE, Tsubasa[14], HASHIMOTO, Jun[14], KANDORI, Ryo[14]
KUSAKABE, Nobuhiko[14], KUZUHARA, Masayuki[14], MATSUO, Taro[14], MIYAMA, Syoken[14]
MORINO, Jun-ichi[14], SUTO, Hiroshi[14], TAMURA, Motohide[14], SUZUKI, Ryuji[15]
WATANABE, Makoto[16], YAMADA, Toru[17]

1: Max Planck Institute for Astronomy, 2: Goddard Space Flight Center, 3: University of Washington, 4: University of Toronto, 5: Osaka University, 6: Kanagawa University, 7: University of Amsterdam, 8: University of Utrecht, 9: Princeton University, 10: University of Hawaii, 11: University of Nice, 12: Jet Propulsion Laboratory, 13: Institute of Astronomy and Astrophysics, 14: NAOJ, 15: TMT Observatory Corporation, 16: Hokkaido University, 17: Tohoku University

The circumstellar disks of gas and dust around newly formed stars are believed to be the birthplaces of giant planets. In some protoplanetary disks, evidence of gaps or inner cavities has been revealed through analysis of the infrared spectral energy distribution (SED; e.g., [1]) or interferometry at infrared (e.g., [2]) or millimeter wavelengths (e.g., [3]). These objects have been termed "transitional" disks, since they are thought to represent a transitional state of partial disk dissipation between the protoplanetary disk stage and the debris disk stage.

We present *H*- and K_s-band imaging data resolving the gap in the transitional disk around LkCa 15, revealing the surrounding nebulosity[4]. We detect sharp elliptical contours delimiting the nebulosity on the inside as well as the outside, consistent with the shape, size, ellipticity, and orientation of starlight reflected from the far-side disk wall, whereas the near-side wall is shielded from view by the disk's optically thick bulk. We note that forward scattering of starlight on the near-side disk surface could provide an alternate interpretation of the nebulosity. In either case, this discovery provides confirmation of the disk geometry that has been proposed to explain the spectral energy distributions (SED) of such systems, comprising an optically thick disk with an inner truncation radius of 46 AU enclosing a largely evacuated gap. Our data show an offset of the nebulosity contours along the major axis, likely corresponding to a physical pericenter offset of the disk gap. This reinforces the leading theory that dynamical clearing by at least one orbiting body is the cause of the gap. Based on evolutionary models, our high-contrast imagery imposes an upper limit of $21\,M_{\mathrm{Jup}}$ on companions at separations outside of $0\overset{\prime\prime}{.}1$ and of $13\,M_{\mathrm{Jup}}$ outside of $0\overset{\prime\prime}{.}2$. Thus, we find that a planetary system around LkCa 15 is the most likely explanation for the disk architecture.

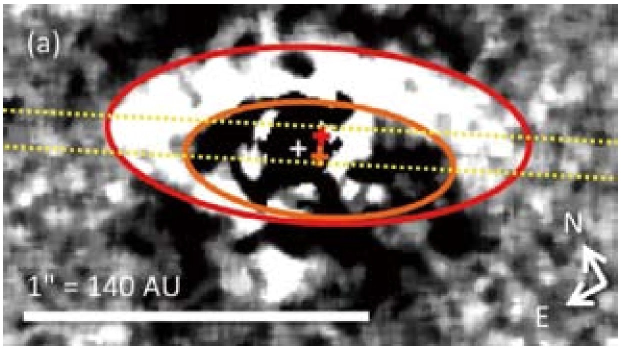


Figure 1: Ellipse fits to the inner and outer boundaries of the scattered light nebulosity seen in the HiCIAO *H*-band LOCI image after median filtering on the spatial scale of 5 pixels 1 FWHM and derotation by −29.3° (based on the position angle of 150.7 in [5]). The inner (orange) and outer (red) ellipses are offset from the star along the major axis by 51 mas and 57 mas and rotated by −4° and −3°, respectively. Their centers are marked by orange and red plus signs, respectively, while the star's position is indicated by a white plus sign.

References

[1] Calvet, N., et al.: 2002, *ApJ*, **568**, 1008.
[2] Ratzka, T., et al.: 2007, *A&A*, **471**, 173.
[3] Brown, J. M., et al.: 2009, *ApJ*, **704**, 496.
[4] Thalmann, C., et al.: 2010, *ApJ*, **718**, L87.
[5] Pietu, V., et al.: 2007, *A&A*, **476**, 163.

---

* Based on data collected at the Subaru Telescope, which is operated by the National Astronomical Observatory of Japan.

Outflow in a Luminous Quasar AKARI J1757+5907

AOKI, Kentaro (NAOJ)
OYABU, Shinki (Nagoya University)
DUNN, Jay P. (Augusta State University)
ARAV, Nahum, EDMONDS, Doug (Virginia Tech)
KORISTA, Kirk T. (Western Michigan University)
MATSUHARA, Hideo, TOBA, Yoshiki (Institute of Space and Astronautical Science)

Over the past decade it has been regarded that the mass of the black hole and the mass of the galactic bulge has the tight correlation. The black hole mass is ~0.1% of the bulge mass[1]. The outflow phenomena of gas is one of processes which may connect the growth of galactic bulge and black hole. Active black holes is capable to blow out gas in the host galaxies and may suppress the star formation activities (e.g., [2]). In fact outflow phenomena are ubiquitous among the galaxies which possess active black holes. The blueshifted absorption lines are the sign of the outflow. However, it has been still unclear the details of outflow phenomena around the black hole. The basic knowledge of the outflow are vague: How much amount of gas has been blown out? How long does the outflow last? Does the outflow significantly affect the star formation in the host galaxy?

We selected a luminous quasar, AKARI J1757+5907 as the target. This quasar was discovered during the follow-up observations of AKARI mid-infrared All-Sky Survey[3,4]. The follow-up low-resolution spectroscopy revealed that AKARI J1757+5907 is a $z = 0.615$ quasar that shows blueshifted absorption lines. Its apparent magnitude is 15th and very suitable for high resolution spectroscopy of absorption lines. More than three hours integration was done with HDS attached to the Subaru 8.2 m telescope. The resolving power was $R \sim 36000$.

Our high resolution spectroscopy revealed that the absorption consists of 9 distinct troughs (Figure 1). We can measure accurate column densities of He I*, Fe II and Mg II for the troughs at ~ −1000 km s^{-1}. We use photoionization models to constrain the ionization parameter, total hydrogen column density, and the number density of the outflowing gas. These constraints yield lower limits for the distance, and mass flow rate for the outflow of 3.7 kpc, and 70 $M_\odot$ yr^{-1}, respectively. This distance contrasts with the previous understanding of the outflow which occurs at the close to the black hole. The our derived mass flow rate and the velocity is similar to those recently discovered in massive post-starburst galaxies[5].

This research has been published in “*Outflow in Overlooked Luminous Quasar: Subaru Observations of AKARI J1757+5907*” *PASJ*, **63**, S457 (2011).

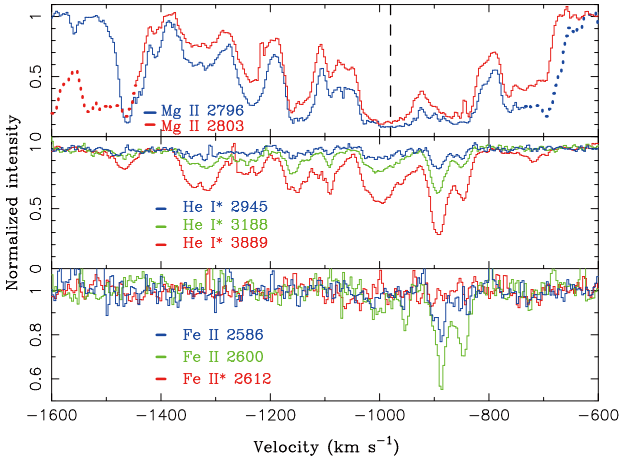


Figure 1: Outflow troughs in AKARI J1757+5907. Ordinate is a normalized flux density, and abscissa is velocity from the systemic redshift ($z = 0.61525$). Blended parts are denoted as dotted spectra. The dashed vertical line indicates the position of the blue component of [O III] emission line of this quasar. The velocity of that [O III] corresponds to the trough at ~ −1000 km s^{-1}.

References

[1] Häring, N., Rix, H.-W.: 2004, *ApJ*, **604**, L89.
[2] Di Matteo, T., Springel, V., Hernquist, L.: 2005, *Nature*, **433**, 604.
[3] Ishihara, D., et al.: 2010, *A&A*, **514**, A1.
[4] Murakami, H., et al.: 2007, *PASJ*, **59**, 369.
[5] Tremonti, C. A., Moustakas, J., Diamond-Stanic, A. M.: 2007, *ApJ*, **663**, L77.

Magnetic Energy Dissipation in the Outer Crust of Neutron Stars

TAKAHASHI R. Hiroyuki
(NAOJ)

Pushed by the accumulating observations of radio pulsars and accreting neutron stars (NSs), extensive studies have been performed to understand the evolution of magnetic fields in neutron stars. The radio pulsars are generally categorized into two classes: young ($< 10^7$ yr) pulsars with the magnetic field strength $B \simeq 10^{10\sim13}$ G, and the old millisecond radio pulsars, which have magnetic field strength as low as $10^{8\sim9}$ G. While most radio pulsars are isolated objects, the millisecond pulsars are predominantly in binaries, suggesting that the magnetic fields decay with time, perhaps by an accretion of matter from the binary companion.

For the isolated radio pulsars, it remains as an open question whether the NS magnetic fields do or do not decay with time. Recently, the discovery of magnetars, which would be a isolated NS with stronger magnetic fields ($B \sim 10^{15}$ G) has provided evidences for magnetic energy dissipation in neutron star[1], whose timescale is ~10 Myr[2]. At present, these ideas and new observations seem to favor the existence of the magnetic field decay in the isolated NSs.

Goldreich & Reisenegger[3] proposed a pioneering model of the magnetic field decay inside NSs, in which the large scale magnetic field is affected by the Hall turbulence. The magnetic energy is transported to the smaller scale due to the Hall cascade, leading to the dissipation via the Ohmic dissipation. The existence of Hall turbulence and the cascading process are numerically confirmed by electron Magnetohydrodynamic (EMHD) simulations[4]. However, the dissipation process, which should govern the magnetic field decay in NSs, cannot be treated consistently due to the MHD approximations.

In this paper, we perform Particle-In-Cell (PIC) simulations aiming to understand the decaying process in NSs[5]. Since the Maxwell equations and the equations of motion of plasma particles are consistently solved in PIC simulations, we can study the dissipation process without introducing phenomenological parameter (i.e., the electric resistivity).

Figure 1 shows numerical results of PIC simulations. Color shows the magnetic energy of turbulent fields and white curves denote for the magnetic field lines at the initial (left) and final (right) states. The initial magnetic field is consist of the uniform field that models the global field penetrating the NS and of the turbulent field that would be originated from the Hall cascade. The energy of initially imposed turbulent field is transported to the smaller scale through whistler waves. Since whistler waves propagate almost parallel to the global magnetic field lines, the cascading process becomes anisotropic. When the turbulent energy is cascaded down to the electron inertial scale, the magnetic energy is dissipated and the electrons are heated. The electrons with lower energy are heated in parallel to the magnetic field due to the Landau damping, while the electrons with higher energy is heated perpendicular to the magnetic field lines due to the cyclotron resonance. These two dissipation mechanisms make the electron distribution function anisotropic. Such the anisotropy of electron temperature is observed in magnetars, suggesting that the plasmas near the surface of NSs is heated by dissipation processes described above. Since the time scale of these dissipation processes is much shorter than the observed decay timescale, we speculate that the decay time scale is determined by the cascading time.

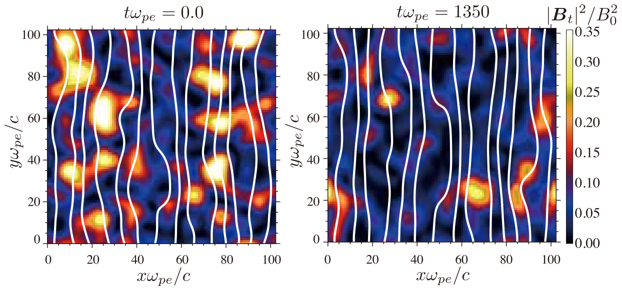


Figure 1: Numerical results of PIC simulations. Color and curves show the turbulent magnetic field energy and magnetic field lines at the initial (left) and final (right) states.

References

[1] Pons, J. A., Miralles, J. A., Geppert, U.: 2009, *A&A*, **496**, 207.
[2] Thompson, C., Duncan, R. C.: 1996, *ApJ*, **473**, 322.
[3] Goldreich, P., Reisenegger, A.: 1992, *ApJ*, **395**, 250.
[4] Cho, J., Lazarian, A.: 2004, *ApJ*, **615**, L41.
[5] Takahashi, H. R., Kotake K., Yasutake N.: 2011, *ApJ*, **728**, 151.

Constraints on the neutrino mass and the primordial magnetic field

YAMAZAKI, Dai G.
(NAOJ)
ICHIKI, Kiyotom
(Nagoya University)
KAJINO, Toshitaka
(NAOJ/University of Tokyo)
MATHEWS, Grant J.
(University of Notre Dame)

Recently cosmological observations and ground experiments constrain the neutrino-mass of order < 0.1–1 eV. If the velocities of such finite-mass neutrinos with the finite-mass are enough large, the time evolution of density fluctuations in the neutrinos free-streaming scale will be impeded. Therefore it is very important to limit the neutrino mass. At the same time, magnetic fields have been observed in clusters of galaxies with a strength of 0.1–1.0 μG. One possible explanation for such magnetic fields in galactic clusters is the existence of a primordial magnetic field (PMF) of order 1 nG whose field lines collapsed as the cluster formed. The PMF could have influenced a variety of phenomena in the early universe such as the cosmic microwave background (CMB)[1], and the formation of the large scale structure (LSS)[2].

In this regard, the alternative normalization parameter σ_8 is of particular interest as a measure of large-scale structure effects. It is defined as the root-mean-square of the matter density fluctuations in a comoving sphere of radius $8h^{-1}$ Mpc. It is determined by a weighted integral of the matter power spectrum. Observations which determine σ_8 provide information about the physical processes affecting the evolution of density-field fluctuations and the formation of structure on cosmological scales.

In this article, We consider the effect of a PMF on σ_8 and compare theoretically deduced values for σ_8 with the observed range. In this way we show that the degeneracy between the effects of a PMF and that of a finite neutrino mass on the matter density fluctuations can be effectively broken by combining the analysis with the CMB data at higher multipoles. We thus obtain not only insight into the underlying physical processes of density field fluctuations in the presence of a PMF, but also place new constraints on the amplitude and spectral index of the PMF and the sum of neutrino mass[3].

Figure 1 shows the constraints on the PMF parameter B_λ and the sum of neutrino masses Σm_ν for various fixed values of n_B and ranges of σ_8 as the caption. The expected parameters of the PMF from the combined analysis of the CMB and observed magnetic fields in galactic clusters is $B_\lambda < 2.0$ nG(1σ) and < 3.0 nG(2σ), while the expected value of σ_8 based upon observations is $0.75 < \sigma_8 < 0.85$. For this range of σ_8, the sum of the neutrino masses is constrained to be $\sum_{N_\nu} m_\nu < 0.11$ eV without the PMF. On the other hand, considering the PMF, from Fig. 1, the sum of the neutrino masses is constrained to be $\sum_{N_\nu} m_\nu < 0.24$ eV on $n_B = -1.5$ and < 0.6 eV on $n_B = -2.5$ for $N_\nu = 3$. This is a larger upper limit than that deduced previously because the effect of the PMF cancels the effect of neutrinos on the density fluctuations.

We confirm that the upper limit on the neutrino mass from σ_8 in the presence of a PMF is heavier than without a PMF even if we consider the matter contributions. We also have shown that the prior limited range on the sum of neutrino masses and PMF parameters is within the expected range for σ_8 from observations of the LSS. In principle, by applying our method to future observations it will be possible to obtain not only the upper but also the lower limits to the neutrino mass from cosmology in the presence of a PMF.

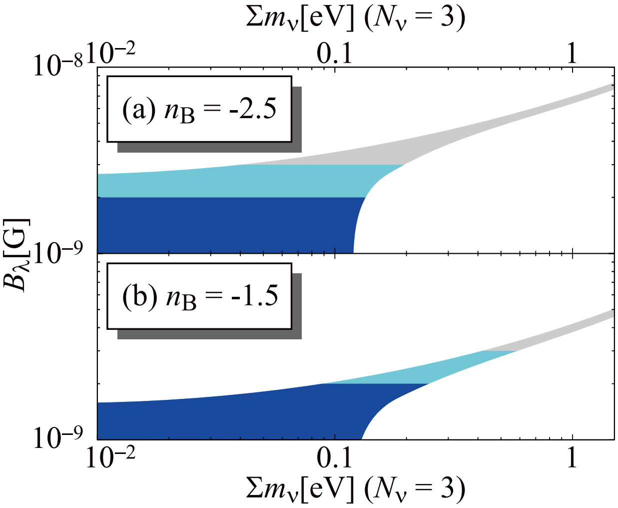


Figure 1: Excluded and allowed regions of ranges for σ_8 in the parameter plane of PMF amplitude B_λ vs. mass of neutrinos $\sum_{N_\nu=3} m_\nu$. n_B is the power-law spectral index of the PMF. All painted Regions indicate ranges of σ_8 as $0.75 < \sigma_8 < 0.85$ and gray, sky blue and blue ragions show $B_\lambda > 3.0$ nG, $2.0\text{ nG} < B_\lambda < 3.0$ nG and $B_\lambda < 2.0$ nG, respectively.

References

[1] Yamazaki, D. G., et al.: 2010, *Phys. Rev. D*, **81**, 023008.
[2] Yamazaki, D. G., et al.: 2008, *Phys. Rev. D*, **78**, 123001.
[3] Yamazaki, D. G., et al.: 2010, *Phys. Rev. D*, **81**, 103519.

A Novel Jet Model: Magnetically Collimated, Radiation-Pressure Driven Jet

TAKEUCHI, Shun (Kyoto University)
OHSUGA, Ken (Graduate University for Advanced Studies / NAOJ)
MINESHIGE, Shin (Kyoto University)

Relativistic jets from compact objects are ubiquitous phenomena in the Universe, but their driving mechanism has been an enigmatic issue over many decades. There are two models proposed: magnetohydrodynamic (MHD) jets which are driven by the magnetic process[1] and radiation-hydrodynamic (RHD) jets which are powered by the strong radiation-pressure force[2].

In the MHD jets, the magnetic effects work to accelerate and collimate the jets. However, we should remark that most of the previous MHD disk-jet simulations assumed that the underlying accretion flows are radiatively inefficient accretion flow (RIAF)[3,4]. The MHD jets launched from the RIAF can not account for the highly relativistic jets of the Galactic microquasars, since their high luminosities implies that the central black holes are surrounded by the luminous accretion disks. The luminous (super-Eddington) accretion flows drive the RHD jets. However, the opening angle of the RHD jets is thought to be relatively wide, since the there is no effective collimation mechanism.

Here, we propose a new type of jets, radiationmagnetohydrodynamic (RMHD) jets, based on our global RMHD simulation of luminous accretion flow onto a black hole shining above the Eddington luminosity[5]. In Figure 1, the accretion flow (the gas mass density, brown) and the RMHD jet in which velocities exceed the escape velocity (the velocity, white, blue) are plotted. The high-speed jet (~0.6*c*–0.7*c*) is represented by blue. White lines indicate the magnetic field lines. The *zz*-component of the radiation-pressure tensor (color), P_0^{zz}, overlaid with the radiation-pressure force vectors (arrows) on the meridional plane is projected on the left wall surface, while the magnetic pressure from the azimuthal component of the magnetic field (color), $B_\varphi^2/8\pi$, overlaid with the Lorentz force vectors (arrows) on the meridional plane is projected on the right wall surface.

We find that the RMHD jet can be accelerated up to the relativistic speed by the radiation-pressure force and is collimated by the Lorentz force of a magnetic tower, inflated magnetic structure made by toroidal magnetic field lines accumulated around the black hole, though radiation energy greatly dominates over magnetic energy. This magnetic tower is collimated by a geometrically thick accretion flow supported by radiation-pressure force. This type of jet may explain relativistic jets from Galactic microquasars, appearing at high luminosities.

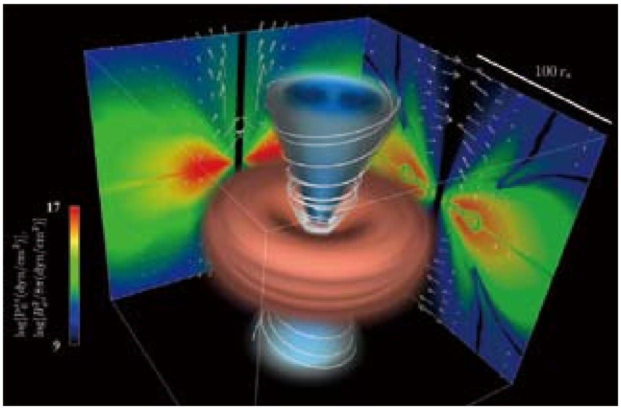


Figure 1: Bird's-eye view of the luminous accretion flow and the associated RMHD jet. The RMHD jet (blue) is accelerated by the strong radiation-pressure force from the super- Eddington disk (brown) and is collimated by the Lorentz force of a magnetic tower (white lines).

References

[1] Lovelace, R. V. E.: 1976, *Nature*, **262**, 649.
[2] Bisnovatyi-Kogan, G. S., Blinnikov, S. I.: 1977, *A&A*, **59**, 111.
[3] Ichimaru, S.: 1977, *ApJ*, **214**, 840.
[4] Narayan, R., Yi, I.: 1994, *ApJ*, **428**, L13.
[5] Ohsuga, K., Mineshige, S., Mori, M., Kato, Y.: 2009, *PASJ*, **61**, L7.

Formation of Terrestrial Planets from Protoplanets under a Realistic Accretion Condition

KOKUBO, Eiichiro
(NAOJ)

GENDA, Hidenori
(University of Tokyo)

It is generally accepted that the final stage of terrestrial planet formation is the giant impact stage where protoplanets or planetary embryos formed by oligarchic growth collide with one another to form planets [1,2]. This stage has been mainly studied by N-body simulations. So far all N-body simulations have assumed perfect accretion in which all collisions lead to accretion. However, this assumption would be inappropriate for grazing impacts that may result in escape of an impactor or hit-and-run. By performing Smoothed-Particle Hydrodynamic (SPH) collision simulations, [3] estimated that more than half of all collisions between like-sized protoplanets do not simply result in accumulation of a larger protoplanet, and this inefficiency lengthens the timescale of planet formation by a factor of 2 or more, relative to the perfect accretion case. The accretion inefficiency can also change planetary spin. [4] found that under the assumption of perfect accretion, the typical spin angular velocity of planets is as large as the critical spin angular velocity for rotational instability. However, in reality, the grazing collisions that have high angular momentum are likely to result in a hit-and-run, while nearly head-on collisions that have small angular momentum lead to accretion. In other words, small angular momentum collisions are selective in accretion. Thus, the accretion inefficiency may lead to slower planetary spin, compared with the perfect accretion case.

We clarify the statistical properties of terrestrial planets formed by giant impacts among protoplanets under a realistic accretion condition[5]. We derive an accretion condition for protoplanet collisions in terms of collision parameters, masses of colliding protoplanets and impact velocity and angle, by performing collision experiments with an SPH method. We implement the realistic accretion condition in N-body simulations and probe its effect to further generalize the model of terrestrial planet formation. We derive the statistical dynamical properties of terrestrial planets from results of a number of N-body simulations and compare the results with those in [6] and [4] where perfect accretion is adopted.

For the standard protoplanet system, the statistical properties of the planets obtained are the following. About half of collisions in the realistic accretion model do not lead to accretion. However, this accretion inefficiency barely lengthens the growth timescale of planets. The numbers of planets and Earth-sized planets are $\langle n \rangle \simeq 3$–$4$ and $\langle n_M \rangle \simeq 2$, respectively. The growth timescale is about 6–7×10^7 years. The masses of the largest and second-largest planets are $\langle M_1 \rangle \simeq 1.2\,M_\oplus$ and $\langle M_2 \rangle \simeq 0.7\,M_\oplus$. The largest planets tend to form around $\langle a_1 \rangle \simeq 0.8\,\mathrm{AU}$, while a_2 is widely scattered in the initial protoplanet region. Their eccentricities and inclinations are $\simeq 0.1$. These results are independent of the accretion model. The RMS spin angular velocity for the realistic accretion model is about 30% smaller than that for the perfect accretion model that is as large as the critical spin angular velocity for rotational instability (Fig. 1). The spin angular velocity and obliquity of planets obey Gaussian and isotropic distributions, respectively, independently of the accretion model.

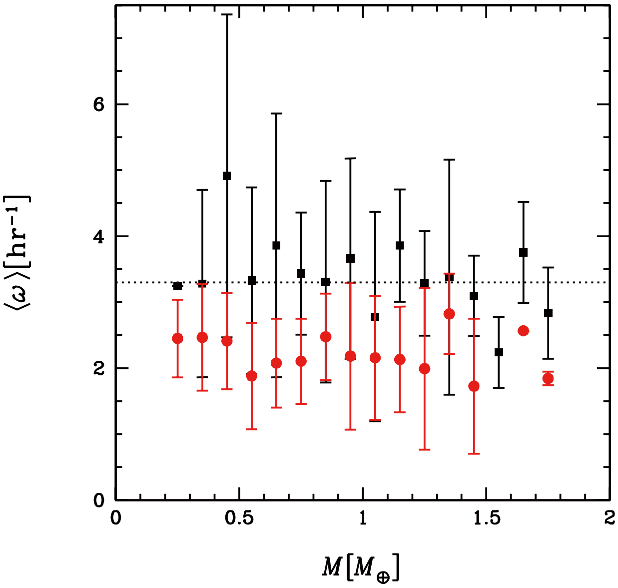


Figure 1: Average spin angular velocity of all planets formed in the 50 runs of the realistic (circle) and perfect (square) accretion models is plotted against their mass M with mass bin of $0.1\,M_\oplus$. The error bars indicate 1-σ and the dotted line shows ω_{cr}. [5]

References

[1] Wetherill, G. W.: 1985, *Science*, **228**, 877.
[2] Kokubo, E., Ida, S.: 1998, *Icarus*, **131**, 171.
[3] Agnor, C., Asphaug, E.: 2004, *ApJ*, **613**, L157.
[4] Kokubo, E., Ida, S.: 2007, *ApJ*, **671**, 2082.
[5] Kokubo, E., Genda, H.: 2010, *ApJ*, **714**, L21.
[6] Kokubo, E., Kominami, J., Ida, S.: 2006, *ApJ*, **642**, 1131.

N-body Simulation of Planetesimal Formation Through Gravitational Instability of a Dust Layer in Laminar Gas Disk

MICHIKOSHI, Shugo, KOKUBO, Eiichiro (NAOJ)
INUTSUKA Shu-Ichiro (Nagoya University)

In the standard scenario of planet formation, planetesimals are the precursors of planets. Their formation process is one of the unsolved problems of the planet formation theory. Beginning with micron-sized dust grains, they grow to centimeter size in a protoplanetary disk via collisional agglomeration. The least understood growth phase is growth from centimeter size to kilometer size.

One of the possible models for planetesimal formation is the gravitational instability model. A very thin and dense layer of settled dust aggregates in the mid-plane of the protoplanetary disk may be gravitationally unstable. Then the gravitational collapse of the dust layer occurs, and kilometer-sized planetesimals are formed directly. This scenario has the advantage of a very rapid formation timescale, which is on the order of the Keplerian time.

The linear analyses of the gravitational instability of dust layers have been performed extensively[1]. However, the nonlinear stage of the gravitational instability has not been studied well. We have investigated the planetesimal formation by gravitational instability by local *N*-body simulations[2,3]. In this study, we have considered the effect of gas drag force[4].

According to the linear analysis of gravitational instability without gas drag force, the stability of the disk is characterized by Toomre's Q value. When $Q < 1$, the disk is unstable. On the other hand, the linear analysis with gas drag force shows that the dust layer is always secularly unstable although Toomre's Q value is larger than unity.

In the initial stage, the growth time of the gravitational instability is longer than the timescales of the dust sedimentation and the decrease of the velocity dispersion. Thus, the velocity dispersion decreases and the disk shrinks vertically. As the velocity dispersion becomes sufficiently small, the gravitational instability finally becomes dominant.

We found that the the formation process is divided into three stages qualitatively: the formation of wakelike density structures, the creation of planetesimal seeds, and their collisional growth.

The top-right panel of Figure 1 shows the first stage of the planetesimal formation. The non-axisymmetric density structures appear. These structures are well-known in the dense planetary rings, which are caused by the gravitational instability.

As shown in the left-bottom panel of Figure 1, in the dense part of wakes, the wakes break into many fragment due to self-gravity. These are the planetesimal seeds. After the formation of planetesimal seeds, the rapid collisional growth begins. Several large planetesimals are formed and absorb almost all small particles.

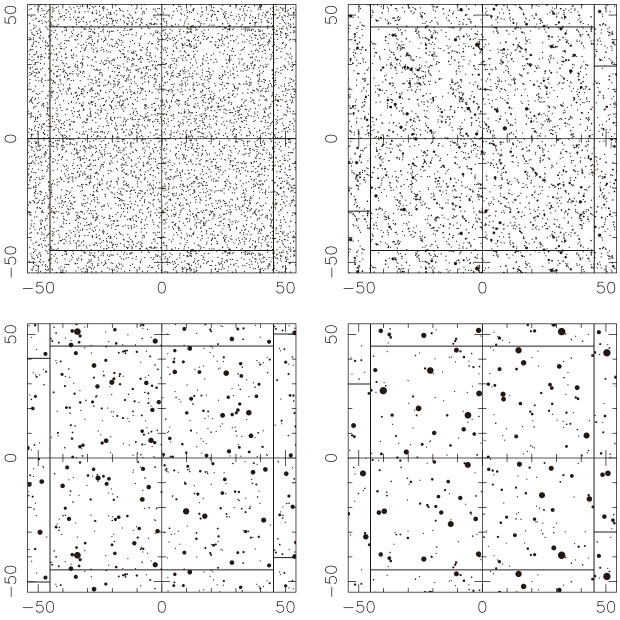


Figure 1: The snapshots of the *N*-body simulation of the planetesimal formation at $t = 0.0\ T_K$ (top-left), $t = 0.4\ T_K$ (top-right), $t = 0.8\ T_K$ (bottom-left), $t = 1.2\ T_K$ (bottom-right), where T_K is Keplerian period.

References

[1] Sekiya, M.: 1983, *Prog. Theor. Phys.*, **69**, 1116.
[2] Michikoshi, S., et al.: 2007, *ApJ*, ***657***, 521.
[3] Michikoshi, S., Kokubo, E., Inutsuka, S.-i.: 2009, *ApJ*, **703**, 1363.
[4] Michikoshi, S., Kokubo, E., Inutsuka, S.-i.: 2010, *ApJ*, **719**, 1021.

Light Element Synthesis in Core-collapse Supernovae

NAKAMURA, Ko
(NAOJ)
YOSHIDA, Takashi, SHIGEYAMA, Toshikazu
(University of Tokyo)
KAJINO, Toshitaka
(NAOJ / Graduate University for Advanced Studies)

Most of elements lighter than iron are synthesized via thermonuclear burning reactions in stars. Light-element isotopes such as Li, Be, and B (LiBeB) are, however, not produced in stellar burning phase because of the absence of stable nuclei with mass number of 8 and the fragility of ^{7}Li against hot proton. They are known to be produced from some cosmological and astrophysical processes: ^{7}Li from big bang nucleosynthesis; ^{7}Li and ^{11}B from asymptotic giant branch (AGB) stars and novae; and all stable isotopes of LiBeB from Galactic cosmicray (CR) nucleosynthesis. Another possible candidate is the neutrino-induced nucleosynthesis in core-collapse supernovae, where a fraction of neutrinos emitted form a proto-neutron star would interact with stellar materials and produce ^{11}B in inner C-rich shells and ^{7}Li in He-rich envelopes (Figure 1).

The supernova neutrino process is necessary to account for the high ^{11}B-to-^{10}B ratio observed in meteoritres. We investigated the neutrino process in Type Ic supernovae (SNe Ic), which should be terminal explosion of massive stars without H and He envelopes, to evaluate accurately the contribution of the neutrino process to Galactic Li(Be)B. Previous studies were limited in Type II explosions and this is the first report on the neutrino process in SNe Ic.

We consider a very energetic explosion of a 15 $M_\odot$ C/O star with the explosion energy $E_{\rm ex} = 3 \times 10^{52}$ erg corresponding to SN 1998bw. The explosion is simulated with 1-dimensional special-relativistic hydrodynamic code and nucleosynthesis is calculated as a postprocess. We assume a supernova neutrino model that neutrino luminosity decreases exponentially with a time scale of 3 s and that the neutrino temperature of each species does not change with time.

Our results[1] show that light elements are produced via the neutrino process both in the innermost region and in the outer envelope. In the innermost region, ^{4}He coming from α-rich freezeout is excited by neutrinos then decays to ^{3}H and ^{3}He, followed by α-capture reactions to produce ^{7}Li and ^{7}Be. In the outer layers, neutral current reactions of neutrinos produce ^{11}B (and ^{11}C). SNe Ic can produce LiBeB also by spallation reactions[2]. Resulting yield of ^{11}B from our SN 1998bw model with total neutrino energy of 3×10^{53} erg is about $1.6 \times 10^{-6} M_\odot$, which is comparable to the value estimated from typical SNe II model[3].

However, the frequency of highly energetic SNe Ic is quite low and borons in meteorites should be dominated by those that originated from SNe II and Galactic CRs. Contribution from SNe Ic might be outstanding in metaldeficient stars because an SN Ic progenitor is surrounded by its wind material and the light elements produced in the explosion are likely to be inherited directly by next generations of stars, which would show high BeB abundances as a Be-rich halo star HD106038 [4].

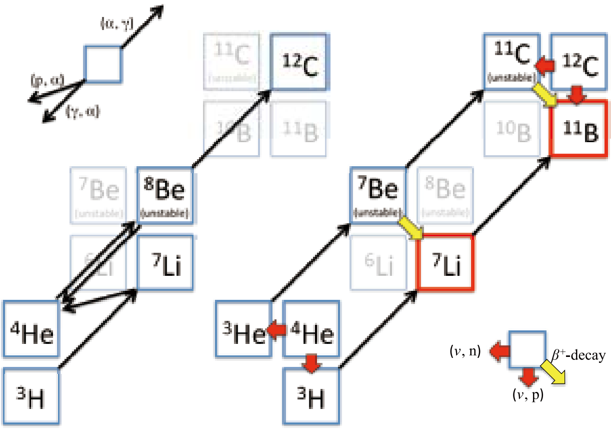


Figure 1: Nuclear reaction chain associated with LiBeB. *left*: Reactions in H and He burning. *right*: Neutrino-induced reactions producing ^{7}Li and ^{11}B.

References

[1] Nakamura, K., et al.: 2010, *ApJ*, **718**, L137.
[2] Nakamura, K., Shigeyama, T.: 2004, *ApJ*, **610**, 888.
[3] Rauscher, T., et al.: 2002, *ApJ*, **576**, 323.
[4] Smiljanic, R., et al.: 2008, *MNRAS*, **385**, L93.

Quantum Statistical Corrections to Astrophysical Photodisintegration Rates

MATHEWS, Grant J. (University of Notre Dame)
PEHLIVAN, Yamac (Mimar Sinan Fine Arts University)
BALANTEKIN, A. B. (University of Wisconsin)
KAJINO, Toshitaka (NAOJ/University of Tokyo)
KUSAKABE, Motohiko (University of Tokyo)

Tabulated rates for astrophysical photodisintegration reactions make use of Boltzmann statistics for the photons involved as well as the interacting nuclei. In this work[1] we have derived analytic corrections for the Planck-spectrum quantum statistics of the photon energy distribution. These corrections can be deduced directly from the detailed-balance condition without the assumption of equilibrium as long as the photons are represented by a Planck spectrum. Moreover we have shown that these corrections affect not only the photodisintegration rates but also modify the conditions of nuclear statistical equilibrium as represented in the Saha equation. We deduced new analytic corrections to the classical Maxwell- Boltzmann statistics which can easily be added to the reverse reaction rates of existing reaction network tabulations.

The key expressions in this work are the determination of revised thermonuclear reaction rates as,

$$\begin{aligned} \lambda_{\gamma 3} &= (1+R)[N_A\langle\sigma v(T_9)\rangle^*]_{12} \quad (1)\\ &\times\ 9.8685\times 10^9(\hat{\mu}T_9)^{3/2}\frac{G_1G_2}{G_3(1+\delta_{12})}e^{-11.605Q/T_9}\ , \end{aligned}$$

where T_9 is the temperature in units of 10^9 K, N_A is Avagadro's number, $[N_A\langle\sigma v(T_9)\rangle^*]$ is the tabulated thermonuclear reaction rate[2] in units of $\mathrm{cm}^3\ \mathrm{mol}^{-1}\ \mathrm{s}^{-1}$, Q is in units of MeV, and $\hat{\mu}$ is the reduced mass in atomic mass units. There is also a revised Saha equation of NSE

$$\begin{aligned} \frac{X_1X_2}{X_3} &= 9.8685\times 10^9(1+R)\frac{T_9^{3/2}\hat{\mu}^{5/2}}{\rho}\\ &\times\ \frac{G_1G_2}{G_3(1+\delta_{12})}e^{-11.605Q/T_9}\ . \quad (2) \end{aligned}$$

The quantity R in the Egs. (1) and (2) is the new correction for the difference between Maxwell Boltzmann and Planckian statistics for the photons. We have shown [1] that this correction factor can be written

$$R=\sum_{n=2}^{\infty}\frac{1}{n^{3/2}}\frac{[N_A\langle\sigma v(T_9/n)\rangle^*]}{[N_A\langle\sigma v(T_9)\rangle^*]}e^{-11.605(n-1)Q/T_9}\ , \quad (3)$$

The advantage of writing the expression this way is that it can be quickly deduced from existing reaction rate tables such as REACLIB[2].

The deviation of photodisintegration and NSE due to quantum statistics may impact the evolution of explosive nucleosynthesis environments for which one can encounter nuclei with small photodissociation thresholds, e.g. near the neutron or proton drip lines. To the extent that such nuclei are beta-decay waiting points, for example, the altered statistics will affect the timescale for the build up of abundances. Another possible application of the corrections deduced here is for the ionization equilibrium of atomic or molecular species with a low ionization potential in stellar atmospheres.

We have examined possible effects of these corrections on the *r*-process, the *rp*-process, explosive silicon burning, the *γ*-process, and big bang nucleosynthesis. We find that, in most cases one is quite justified in neglecting these corrections. The correction is largest for reactions near the drip line for an *r*-process with very high neutron density, or an *rp*-process at high-temperature[1] .

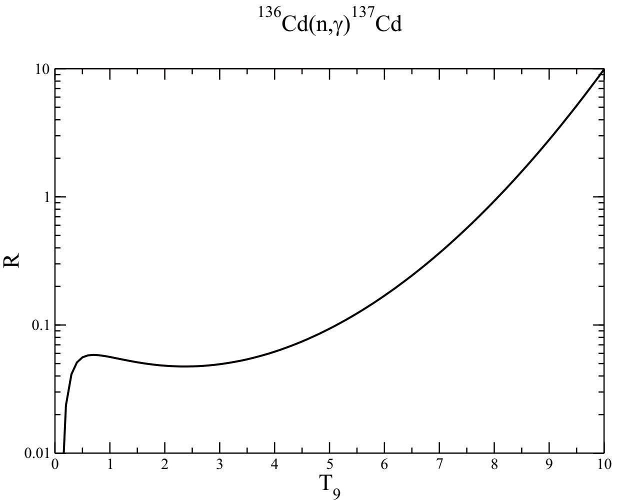


Figure 1: Correction factor R for the reverse rate of the ^{136}Cd(n, γ) ^{137}Cd reaction relevant to the *r*-process abundance peak near $A = 130$ for a high neutron-density environment. This was generated from Eq. (3) using the REACLIB compilation[2]. For typical r-process temperatures, $T_9 \sim$ 1–2, the correction is ~6%.

References

[1] Mathews, G., et al.: 2011, *ApJ*, **727**, 10.
[2] Cyburt, et al.: 2010, *ApJ*, **89**, 240; (REACLIB): http://groups.nscl.msu.edu/jina/reaclib/db/

Origin of Chirality of the Amino Acids

BOYD, Richard N.
(Lawrence Livermore National Lab., University of California)
KAJINO, Toshitaka
(NAOJ/University of Tokyo)
Onaka, Takashi
(University of Tokyo)

Half a century ago it was demonstrated by Miller [1] and Urey that at least some of the 20 amino acids on which we depend for life could be produced in a spark discharge in a chemical environment that may have existed early in the Earth's history. Thus the model of such an environment in a lightning storm became the accepted means for producing amino acids on Earth. However, the amino acids have been found to have a left-handed chirality, whereas the Miller-Urey mechanism produces equal numbers of left- and right-handed molecules. Furthermore, amino acids have been found in meteorites[2], and those that have a preferred chirality had more lefthanded molecules than right-handed molecules (at a level of 10%). Several mechanisms have been suggested as being the means by which the amino acid chirality is established. One widely accepted one involves circularly polarized light impinging on the molecules that are produced on Earth, although circularly polarized x-rays in the interstellar medium have also been suggested as a driver of chirality.

However, during the past several years, we have developed a model[3,4] for establishing amino acid chirality in the interstellar medium by selective molecular destruction of one chirality by neutrinos from a supernova. In this model, the strong magnetic field from the protoneutron star would orient the ^{14}N nuclei that are common to the amino acids to produce a significant fraction of those nuclei with their spins aligned with the neutrino spin. Neutrino helicity is a conserved quantum number, which is aways −1 for neutrinos and +1 for antineutrinos, namely the symmetry of left- or right-handedness is maximally broken in nature.

Angular momentum conservation requires that the $v + {}^{14}\mathrm{N} \rightarrow {}^{14}\mathrm{C} + e^+$ reaction (v denotes an electron antineutrino) requires transfer of one unit of angular momentum from the neutrino wave function when the spins are aligned, whereas the reaction could proceed with no angular momentum transfer when the spins are not aligned. This inhibits the reaction by roughly an order of magnitude for the aligned case, skewing the magnetic substate distribution in favor of one ^{14}N spin configuration and, therefore, one molecular chirality[5]. The intense magnetic field also modifies the antineutrino cross sections, thereby creating an antineutrino flux that is asymmetric by 3%[6]. This combination of effects would create a small chirality preference; we estimate it to be a maximum of 1×10^{-6}.

While the Galactic supernovae are not capable of processing all the molecules in the galaxy, several mechanisms exist for amplifying this chirality preference, and for spreading it throughout the Galaxy. It is also believed[3,4] that once a chirality preference was established on Earth, more amplification would drive that preference to homochirality.

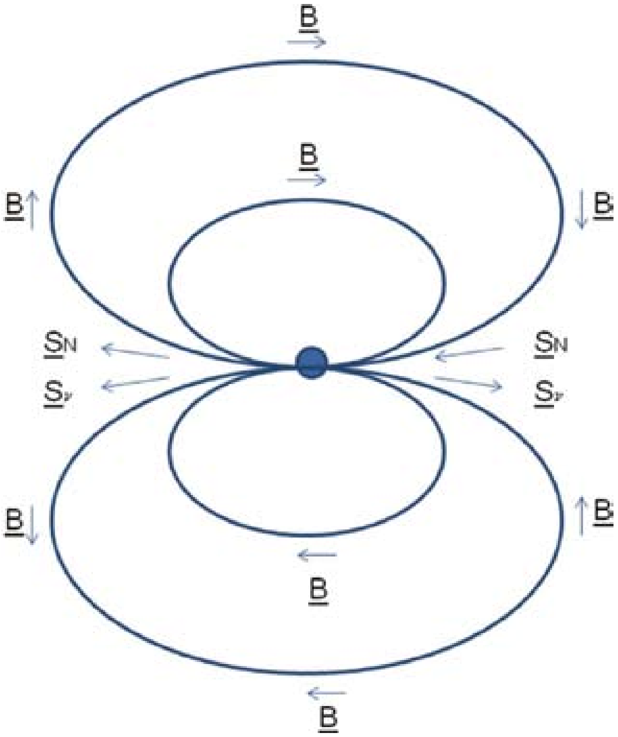


Figure 1: Schematic diagram of the magnetic fields, B, surrounding a nascent neutron star and the spins of the ^{14}N nuclei, S_N, and of the neutrinos, Sv, emitted from the collapse of the supernova that created the neutron star.

References

[1] Miller, S. L.: 1953, *Science*, **117**, 528.
[2] Cronin, J. R., Pizzarello, S.: 1997, *Science*, **275**, 951.
[3] Boyd, R. N., Kajino, T., Onaka, T.: 2010, *Astrobiology*, **10**, 561.
[4] Boyd, R. N., Kajino, T., Onaka, T.: 2011, *Int. J. Mol. Sci.*, **12**, 3432.
[5] Buckingham, A. D.: 2004, *Chem. Phys. Lett.*, **398**, 1.
[6] Maruyama, T., et al.: 2011, *Phys. Rev. D*, **83**, 081303(R).

Recurrent Planet Formation and Intermittent Protostellar Outflows

MACHIDA, Masahiro
(Kyushu University)

Since 1995, over 550 exo-planets have been discovered. It is considered that a large fraction of exo-planets are the gas giant planet. Recently, some planets were observed by SUBARU telescope with direct image. They orbit at >10 AU far from the central star. However, the classical planet formation theory cannot explain the formation of such planets. To understand the formation of such planets, we need to consider the formation of the circumstellar disk, in which planet forms. In this study, we investigated the formation of the circumstellar disk from the prestellar cloud stage. As the initial state, we adopted the spherical cloud. Then, we added the rotation and magnetic field comparable to the observation to this cloud.

As a result of calculation, we found that dissipation of the magnetic field is closely related to the formation of the gas giant planet[1]. Our previous studies showed that the first core that is formed before the protostar formation is directly transformed into the circumstellar disk after the protostar formation[2,3]. At the moment of the birth of the protostar, the circumstellar disk is more massive than the protostar and is gravitationally unstable. However, when the initial cloud is very weakly (or no) magnetized, a spiral structure develops in the circumstellar disk, and it effectively transfers the angular momentum outward. Then, the gas in the circumstellar disk falls onto the central star and the surface density gradually decreases. Therefore, the circumstellar disk becomes stable against gravity and suppresses fragmentation or the gas giant planet formation.

On the other hand, when the magnetic field dissipates in the circumstellar disk, fragmentation occurs and the gas giant planet appears. The circumstellar disk has a lower surface density in the outer disk region where the ionization degree is relatively high and magnetic field is well coupled with neutral gas. Thus, the angular momentum in such region effectively transfers by the magnetic braking, and the gas can flow into the inner disk region. In addition, the magnetic field drives the protostellar outflow as shown in Figure 1. The magnetic field is decoupled from the neutral gas in the inner disk region, because higher surface density lowers the ionization degree. In such a region, the magnetic field dissipates by the Ohmic dissipation. As a result, the angular momentum transfer due to the magnetic field is not effective. Thus, the gas accumulates and the disk surface density continues to increase because the gas flows from the outer region. Finally, the disk becomes highly unstable against the gravity and fragmentation occurs to form the gas giant planet. However, after fragmentation, the protoplanet falls onto the protostar because the massive disk gravitationally interacts with protoplanet. After the falling, fragmentation occurs and protoplanet appears again. The planet formation and its falling onto the protostar last until the infalling gas is depleted. It is considered that the planet appeared just before the infalling envelope is depleted evolves into the gas giant planet orbiting the region far from the central star. In addition, protoplanet's motion disturbs the protostellar outflow. The protostellar outflow synchronizes with the orbital motion of the protoplanet. We may confirm the existence of the protoplanet and its orbital motion from the intermittent outflow.

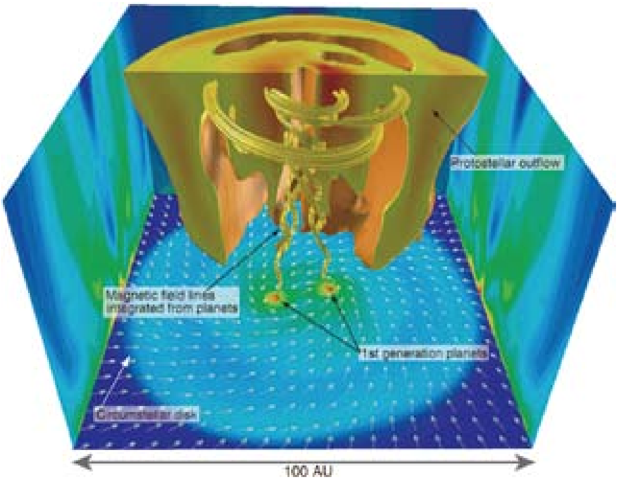


Figure 1: Gas giant planet formation due to the gravitational instability in the protoplanetary disk. Color and lines represent the gas density and magnetic field line, respectively. The yellow structure above the disk indicates the protostellar outflow.

References

[1] Machida, M. N., Inutsuka, S., Matsumoto, T.: 2011a, *ApJ*, **729**, 42.
[2] Machida, M. N., Matsumoto, T.: 2011b, *MNRAS*, **413**, 2767.
[3] Machida, M. N., Inutsuka, S., Matsumoto, T.: 2010, *ApJ*, **724**, 1006.

Dust and Chemical Abundances of the Sagittarius Dwarf Galaxy Planetary Nebula Hen2-436

OTSUKA, Masaaki, MEIXNER, Margaret
(STScI)
RIEBEL, David
(Johns Hopkins University)
HYUNG, Siek
(Chungbuk National University)
TAJITSU, Akito, IZUMIURA, Hideyuki
(NAOJ)

We have estimated elemental abundances and dust mass of the planetary nebula (PN) Hen2-436 in the Sagittarius (Sgr) spheroidal dwarf galaxy using ESO/VLT FORS2, Magellan/MMIRS, and *Spitzer*/IRS spectra.

We have detected candidates of fluorine [F II]λ4790, krypton [Kr III]λ6826, and phosphorus [P II]λ7875 lines and successfully estimated the abundances of these elements for the first time. These elements are known to be synthesized by neutron capture process in the He-rich intershell during the thermally pulsing AGB phase. We present a relation between C, F, P, and Kr abundances among PNe and C-rich stars. The detections of F and Kr in Hen2-436 support the idea that F and Kr together with C are synthesized in the same layer and brought to the surface by the third dredge-up (Fig. 1).

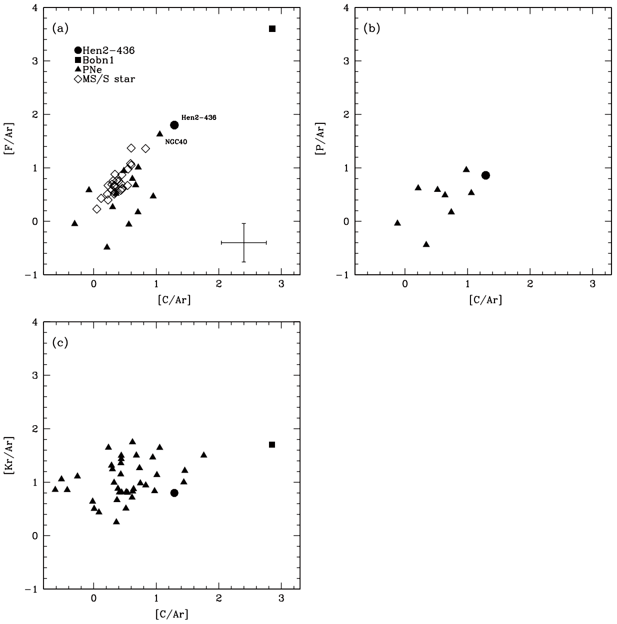


Figure 1: (*a*): The [F/Ar]–[C/Ar] diagram. The typical error is indicated by the cross (the same for the other diagrams). BoBn1 is a Sgr PN. (*b*): The [P/Ar]–[C/Ar] diagram. (*c*): The [Kr/Ar]–[C/Ar] diagram.

To investigate the status of the central star of the PN, nebula condition, and dust properties, we construct a theoretical spectral energy distribution (SED) model to match the observed SED with Cloudy. By comparing the derived luminosity and temperature of the central star with theoretical evolutionary tracks, we conclude that the initial mass of the progenitor is likely to be ~1.5–2.0 $M_\odot$ and the age is ~3000 yr after the AGB phase. The observed elemental abundances of Hen2-436 can be explained by a theoretical nucleosynthesis model with a star of initial mass 2.25 $M_\odot$, $Z = 0.008$ and LMC compositions. We have estimated the dust mass to be $2.9 \times 10^{-4} M_\odot$ (amorphous carbon only, Fig. 2a) or $4.0 \times 10^{-4} M_\odot$ (amorphous carbon and PAH, Fig. 2b). Based on the assumption that most of the observed dust is formed during the last two thermal pulses and the dust-to-gas mass ratio is 5.58×10^{-3}, the dust mass-loss rate and the total mass-loss rate are $< 3.1 \times 10.8 M_\odot \text{yr}^{-1}$ and $< 5.5 \times 10.6 M_\odot \text{yr}^{-1}$, respectively. Our estimated dust mass-loss rate is comparable to a Sgr dwarf galaxy AGB star with similar metallicity and luminosity[1].

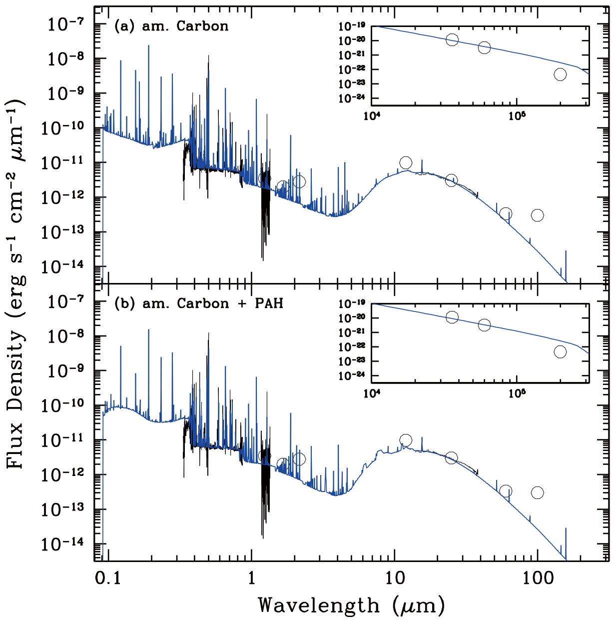


Figure 2: The predicted SED from Cloudy modelings (blue lines). The observed data are indicated by the black lines or circles. In the inner small boxes we plot the radio data and the predicted SED. (*a*) The predicted SED by Cloudy considering amorphous carbon only. (*b*) The predicted SED considering amorphous carbon and PAH grains.

Reference

[1] Otsuka, M., et al.: 2011, *ApJ*, **729**, 39.

Polarization Interferometric nulling coronagraph for high-contrast imaging

MURAKAMI, Naoshi (Hokkaido University)
YOKOCHI, Kaito (Tokyo University of Agriculture and Technology/NAOJ)
NISHIKAWA, Jun, TAMURA, Motohide (NAOJ)
KUROKAWA, Takashi (Tokyo University of Agriculture and Technology)
TAKEDA, Mitsuo (The University of Electro-Communications)
BABA, Naoshi (Hokkaido University)

We propose a novel nulling interferometer based on polarization interferometry, which we call a polarization interferometric nulling coronagraph (PINC), for direct detection of extrasolar planets[1]. The PINC is a fully-symmetric modified Michelson interferometer using polarizing beam splitters (PBS), in which achromatic half-wave plates (HWP) such as Fresnel rhombs are installed. Two crossed polarizers (±45°) are also installed in front of and behind the interferometer. The HWPs provide an achromatic π-phase difference between two light beams from subapertures (SA_1, SA_2) extracted from a telescope pupil, and eliminate an on-axis star light (Fig. 1, *top*).

From Jones calculus, the achievable contrast of the PINC has been estimated to be about 10^{-10} at 5 λ/D over a wavelength range from 1.6 to 2.2 μm. We also carried out laboratory experiments on the PINC using two laser light sources (wavelengths of λ = 532 and 671 nm). Figure 1(*bottom*) shows a picture of the laboratory simulator of the PINC. As the HWPs, we used commercially-available Fresnel rhombs made of BK7. Figure 2*a*,*b* shows results of the laboratory experiments. As a result, we obtained a halo suppression level of about 10^{-6} at 5 λ/D for both wavelengths.

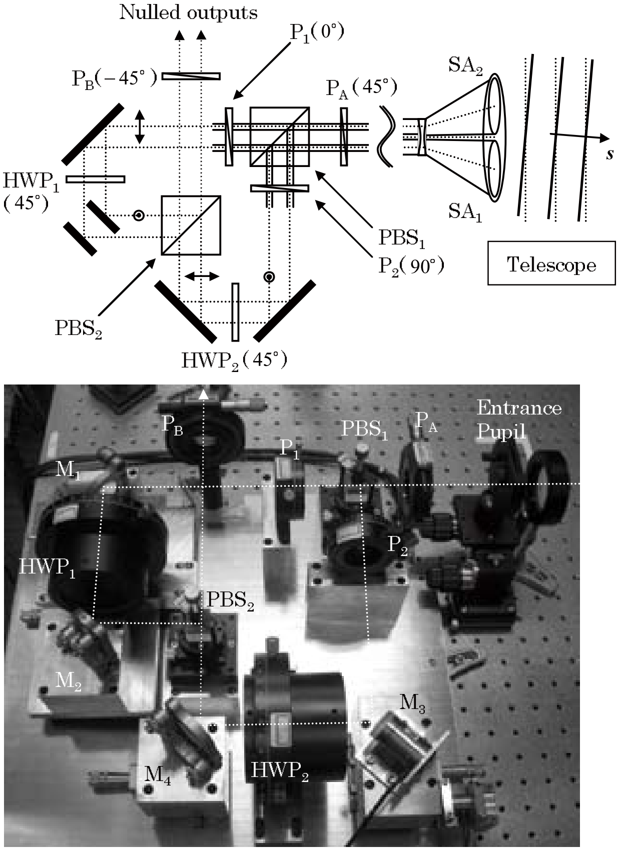


Figure 1: (*Top*) A principle and (*bottom*) a laboratory simulator of the PINC.

The experimentally acquired contrast curves (Fig. 2*a*,*b*) were well fitted to those of the computer simulations assuming a phase aberration of 3 nm rms and an optical-path difference (OPD) error of 3.7 nm (Fig. 2*a*',*b*'). Thus it is expected that higher contrasts will be realized by introducing a high-performance OPD control and an extreme adaptive optics system.

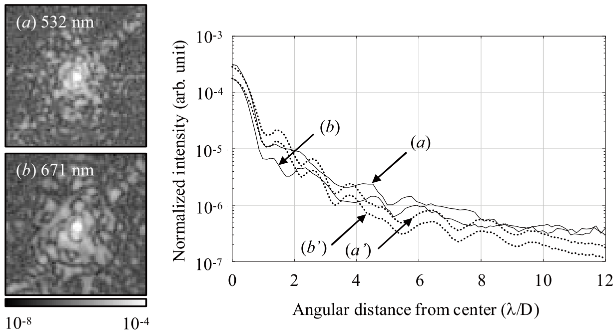


Figure 2: Experimental results of laboratory demonstrations: (*left*) acquired coronagraphic images and (*right*) radial profiles of coronagraphic images obtained by (*a*,*b*) experiments and (*a*',*b*') numerical simulations.

Reference

[1] Murakami, N., et al.: 2010, *Appl. Opt.*, **49**, D106.

Speckle level suppression using an unbalanced nulling interferometer in a high-contrast imaging system

YOKOCHI, Kaito
(Tokyo University of Agriculture and Technology / NAOJ)

MURAKAMI, Naoshi
(Hokkaido University)

NISHIKAWA, Jun, TAMURA, Motohide
(NAOJ)

ABE, Lyu
(University of Nice)

TAVROV, Alexander
(Space Research Institute)

TAKEDA, Mitsuo
(The University of Electro-Communications)

KUROKAWA, Takashi
(Tokyo University of Agriculture and Technology)

High-contrast imaging systems with a stellar halo suppression level of 10^{-10} are required for direct detection of Earth-like extra-solar planets. Here $\lambda/10000$ rms wavefront quality is required for the optics to suppress the speckle level, and a coronagraph will be used to reduce the diffracted light of a parent star.

We investigated a novel high-contrast imaging system with an unbalanced nulling interferometer (UNI) followed by phase and amplitude correction (PAC) adaptive optics (AO), which not only can reduce starlight but also can suppress the speckle level by a virtual wavefront correction beyond the limit of the AO performance[1].

The present system consists of four stages, i.e., a first AO, the UNI, the PAC AO, and a final coronagraph (Fig. 1). In the experiments the UNI adopted a modified lateral shearing Mach-Zehnder interferometer which we call PINC (Polarization Interferometric Nulling Colonagraph[2]. We did not use the first AO here. We confirmed that the aberrations of the input wavefront were sufficiently magnified by the UNI, cf., $\lambda/100$ rms to $\lambda/16$ rms, thanks to the amplitude difference between the two wavefronts which were split and combined in the UNI.

Next at the PAC AO system, the magnified aberrations were effectively corrected in amplitude and phase with two deformable mirrors (Boston Micromachines Corp.) to the initial aberration level of $\lambda/100$ rms (Fig. 2). Here the electric field distribution was suppressed to $\lambda/550$ rms virtually by the product with the reduced mean amplitude after the UNI, although the observed aberration level was identical to the initial wavefront (AO performance). According to the pupil plane field, the suppression level of the speckle pattern at the focus of the final coronagraph (3D Sagnac nulling interferometer) was 7.0×10^{-4}, which was 0.073 times reduction from the initial (AO-limited) level of 9.5×10^{-3}.

Thus we demonstrated that the wavefront correction after the aberration magnification by the UNI can reduce the wavefront aberrations and the speckle level beyond the limit of the AO performance, and the UNIPAC would be an effective wavefront correction method in high-contrast imaging systems.

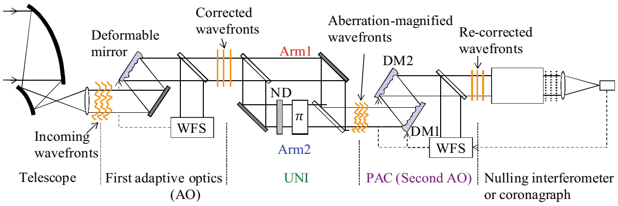


Figure 1: Schematic of coronagraph optics with UNI (unbalanced nulling interferometer).

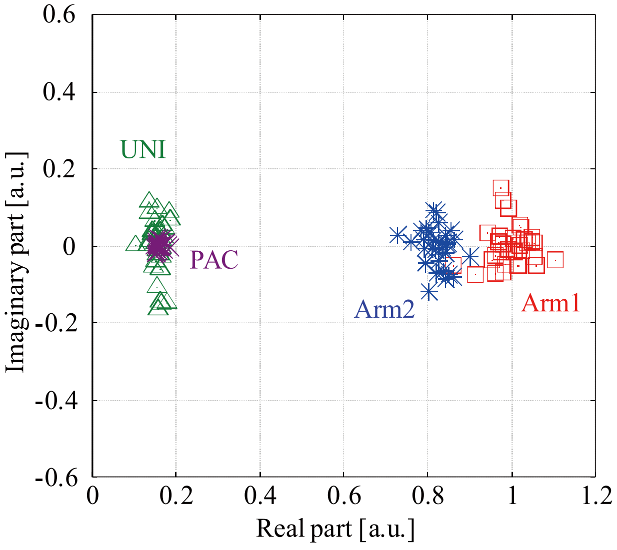


Figure 2: Electric field changes with the UNI (unbalanced nulling interferometer) and PAC (phase amplitude correction) processes.

References

[1] Yokochi, K., et al.: 2011, *Opt. Express*, **19**, 4957.
[2] Murakami, N., et al.: 2010, *Appl. Opt.*, **49**, D106.

Outburst of Comet 217P/LINEAR

SARUGAKU, Yuki
(ISAS/JAXA)
ISHIGURO, Masateru
(Seoul National University)
UENO, Munetaka, USUI, Fumihiko
(ISAS/JAXA)
WATANABE, Junichi
(NAOJ)

Comet 217P/LINEAR is a short-period comet detected by the Lincoln Near-Earth Asteroid Research program as the name indicates. The discovery was on 2001 July 11, and was confirmed as a Jupiter family comet having a period of 7.8 years. Because the most recent perihelion passage was expected on 2009 September, we monitored this comet with the Kiso 105 cm Schmidt Telescope. The images revealed a day-by-day variation of the 217P/LINEAR shape, indicating an outburst occurred. Since our observation started before the outburst event, we examined the morphological evolution of the expanding dust cloud produced by the outburst[1]. It was found that the dust cloud expanded at a velocity of 120–140 $\mathrm{m\,s^{-1}}$ and that the comet became brighter by 1.7–2.3 mag. Using the observational result, we estimated that the onset time was 2009 October 13.4, and that the total mass released by the outburst was in the range of 10^6–10^9 kg. No fragments or split nuclei brighter than 18.5 mag (1.1 km in radius) were confirmed in our observations. Compared with other outbursts[2], we concluded that it was a relatively small event for an outburst.

Reference

[1] Sarugaku, Y., et al.: 2010, *ApJ*, **724**, L118-L121.
[2] Watanabe, J.-I., et al.: 2009, *PASJ*, **61**, 679-685.

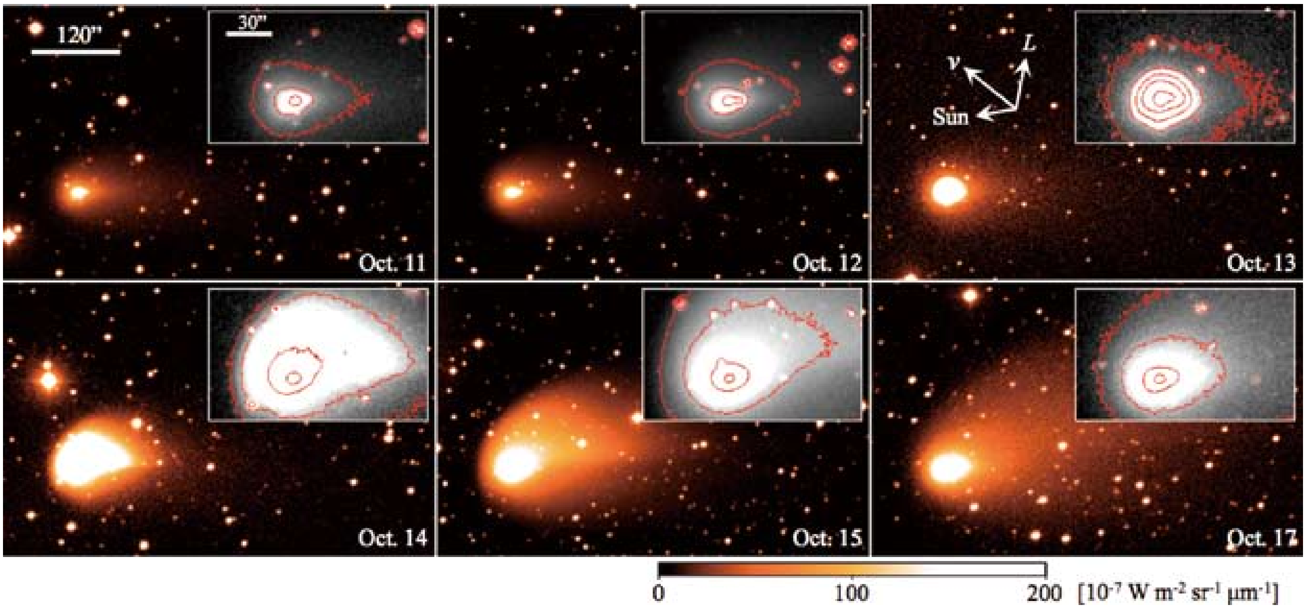


Figure 1: *Rc* band images of 217P/LINEAR observed on 2009 October 11–15, and 17. Sky brightness is subtracted. The upper right boxes show close up images near nuclei with contour lines of $10^{-4.5}$, $10^{-4.0}$, $10^{-3.5}$, $10^{-3.0}$, and $10^{-2.5}$ $\mathrm{W\,m^{-2}\,sr^{-1}\,\mu m^{-1}}$ from the outer side. The arrows in the October 13 image indicate the Sun direction (Sun), the angular momentum vector (L), and comet movement (v) on the projected plane, respectively. The appearances of 217P/LINEAR on October 11 and 12 were similar, but clearly changed day by day after October 13. It was found that the dust cloud expanded and was blown away by the radiation pressure.

II Publications, Presentations

1. Refereed Publications

Abadie, J., et al. including **Hayama, K.**, **Kawamura, S.**: 2010, Search for Gravitational-wave Inspiral Signals Associated with Short Gamma-ray Bursts During LIGO's Fifth and Virgo's First Science Run, *ApJ*, **715**, 1453-1461.

Abadie, J., et al. including **Hayama, K.**, **Kawamura, S.**: 2010, All-sky search for gravitational-wave bursts in the first joint LIGO-GEO-Virgo run, *Phys. Rev. D*, **81**, 102001.

Abadie, J., et al. including **Hayama, K.**, **Kawamura, S.**: 2010, Search for gravitational waves from compact binary coalescence in LIGO and Virgo data from S5 and VSR1, *Phys. Rev. D*, **82**, 102001.

Abadie, J., et al. including **Hayama, K.**, **Kawamura, S.**: 2010, TOPICAL REVIEW: Predictions for the rates of compact binary coalescences observable by ground-based gravitational-wave detectors, *Class. Quantum Grav.*, **27**, 173001.

Abadie, J., et al. including **Hayama, K.**, **Kawamura, S.**: 2010, First Search for Gravitational Waves from the Youngest Known Neutron Star, *ApJ*, **722**, 1504-1513.

Abadie, J., et al. including **Hayama, K.**, **Kawamura, S.**: 2010, Calibration of the LIGO gravitational wave detectors in the fifth science run, *Nucl. Instrum. Methods. Phys. Res. A*, **624**, 223-240.

Abadie, J., et al. including **Hayama, K.**, **Kawamura, S.**: 2011, Search for gravitational waves associated with the August 2006 timing glitch of the Vela pulsar, *Phys. Rev. D*, **83**, 042001.

Abbott, B. P., et al. including **Hayama, K.**, **Kawamura, S.**: 2010, Searches for Gravitational Waves from Known Pulsars with Science Run 5 LIGO Data, *ApJ*, **713**, 671-685.

Abbott, B. P., et al. including **Hayama, K.**, **Kawamura, S.**: 2010, Search For Gravitational-wave Bursts Associated with Gamma-ray Bursts using Data from LIGO Science Run 5 and Virgo Science Run 1, *ApJ*, **715**, 1438-1452.

Agatsuma, K., Arai, K., **Fujimoto, M.-K.**, **Kawamura, S.**, Kuroda, K., Miyakawa, O., Miyoki, S., Ohashi, M., Suzuki, T., **Takahashi, R.**, **Tatsumi, D.**, Telada, S., Uchiyama, T., Yamamoto, K., CLIO collaborators: 2010, Thermal-noise-limited underground interferometer CLIO, *Class. Quantum Grav.*, **27**, 084022.

Amanullah, R., et al. including **Furusawa, H.**, **Kashikawa, N.**, The Supernova Cosmology Project: 2010, Spectra and Hubble Space Telescope Light Curves of Six Type Ia Supernovae at $0.511 < z < 1.12$ and the Union2 Compilation, *ApJ*, **716**, 712-738.

Ando, H., Tsuboi, Y., **Kambe, E.**, Sato, B.: 2010, Oscillations in the G-type Giants, *PASJ*, **62**, 1117-1126.

Ando, K., **Nagayama, T.**, Omodaka, T., Handa, T., **Imai, H.**, Nakagawa, A., Nakanishi, H., **Honma, M.**, **Kobayashi, H.**, **Miyaji, T.**: 2011, Astrometry of Galactic Star-Forming Region ON2N with VERA: Estimation of the Galactic Constants, *PASJ*, **63**, 45-51.

Ando, M., et al. including **Kawamura, S.**, **Agatsuma, K.**, **Ejiri, Y.**, **Fujimoto, M.**, **Fukushima, M.**, **Hayama, K.**, **Ishizaki, H.**, **Izumi, K.**, **Kotake, K.**, **Nakamura, K.**, **Nishida, E.**, **Obuchi, Y.**, **Ohishi, N.**, **Okada, N.**, **Suzuki, R.**, **Takahashi, R.**, **Torii, Y.**, **Ueda, A.**, **Yamazaki, T.**: 2010, DECIGO and DECIGO pathfinder, *Class. Quantum Grav.*, **27**, 084010.

Aoki, K.: 2010, Broad Balmer-Line Absorption in SDSS J172341.10+555340.5, *PASJ*, **62**, 1333.

Aoki, K., Oyabu, S., Dunn, J. P., Arav, N., Edmonds, D., Korista K. T., Matsuhara, H., Toba, Y.: 2011, Outflow in Overlooked Luminous Quasar: Subaru Observations of AKARI J1757+5907, *PASJ*, **63**, S457.

Aoki, W., Beers, T. C., Honda, S., Carollo, D.: 2010, Extreme Enhancements of *r*-process Elements in the Cool Metal-poor Main-sequence Star SDSS J2357-0052, *ApJ*, **723**, L201-L206.

Arai, A., et al. including **Yamashita, T.**, **Okita, K.**, **Yanagisawa, K.**: 2010, Optical and Near-Infrared Photometry of Nova V2362 Cyg: Rebrightening Event and Dust Formation, *PASJ*, **62**, 1103-1108.

Arimatsu, K., **Izumiura, H.**, Ueta, T., Yamamura, I., Onaka, T.: 2011, Detection of the Detached Dust Shell of U Antliae at Mid-infrared Wavelengths with AKARI/IRC, *ApJ*, **729**, L19.

Arimoto, M., et al. including **Shirasaki, Y.**: 2010, Spectral-Lag Relations in GRB Pulses Detected with HETE-2, *PASJ*, **62**, 487.

Asaki, Y., **Deguchi, S.**, Imai, H., Hachisuka, K., **Miyoshi, M.**, **Honma, M.**: 2010, Distance and Proper Motion Measurement of the Red Supergiant, S Persei, with VLBI H_2O Maser Astrometry, *ApJ*, **721**, 267-277.

Baba, J., **Saitoh, T. R.**, **Wada, K.**: 2010, On the Interpretation of the l-v Features in the Milky Way Galaxy, *PASJ*, **62**, 1413-1422.

Barro, G, Perez-Gonalez, P. G., Ashby, M. L. N, Kajisawa, M., **Miyazaki, S.**, Villar, V., Yamada, T.: 2011, UV-to-FIR Analysis of Spitzer/IRAC Sources in the Extended Groth Strip. I. Multi-wavelength Photometry and Spectral Energy Distributions, *ApJS*, **193**, 13.

Bayliss, M. B., Gladders, M. D., **Oguri, M.**, Hennawi, J. F., Sharon, K., Koester, B. P., Dahle, H.: 2011, The Redshift Distribution of Giant Arcs in the Sloan Giant Arcs Survey, *ApJ*, **727**, L26.

Bayliss, M. B., Hennawi, J. F., Gladders, M. D., Koester, B. P., Sharon, K., Dahle, H., **Oguri, M.**: 2011, Gemini/GMOS Spectroscopy of 26 Strong-lensing-selected Galaxy Cluster Cores, *ApJS*, **193**, 8.

Bedding, T. R., et al. including **Kambe, E.**, **Izumiura, H.**: 2010, Multi-Site Campaign to Measure Solar-Like Oscillations in Procyon. II. Mode Frequencies, *ApJ*, **713**, 935-949.

Bekki, K., **Tsujimoto, T.**: 2010, Origin of the Unusually Low Nitrogen Abundances in Young populations of the Large Magellanic Cloud, *ApJ*, **721**, 1515-1522.

Berger, T. E., Slater, G., Hurlburt, N., Shine, R., Tarbell, T., Title, A., Lites, B. W., **Okamoto, T. J.**, Ichimoto, K., **Katsukawa, Y.**, Magara, T., **Suematsu, Y.**, Shimizu, T.: 2010, Quiescent Prominence Dynamics Observed with the Hinode Solar Optical Telescope. I. Turbulent Upflow Plumes, *ApJ*, **716**, 1288-1307.

Bernat, D., et al. including **Martinache, F.**: 2010, A Close

Companion Search Around L Dwarfs Using Aperture Masking Interferometry and Palomar Laser Guide Star Adaptive Optics, *ApJ*, **715**, 724-735.

Boyd, R. N., **Kajino, T.**, Onaka, T.: 2010, Supernovae and the Chirality of the Amino Acids, *Astrobiology*, **10**, 561-568.

Burningham, B., Leggett, S. K., Lucas, P. W., Pinfield, D. J., Smart, R. L., Day-Jones, A. C., Jones, H. R. A., Murray, D., Nickson, E., **Tamura, M.**, Zhang, Z., Lodieu, N., Tinney, C. G., Zapatero Osorio, M. R.: 2010, The discovery of a very cool binary system, *MNRAS*, **404**, 1952-1961.

Burningham, B., et al. including **Tamura, M.**, **Ishii, M.**, **Kuzuhara, M.**: 2010, 47 new T dwarfs from the UKIDSS Large Area Survey, *MNRAS*, **406**, 1885-1906.

Bussey, D. B., McGovern, J. A., Spudis, P. D., Neish, C. D., **Noda, H.**, **Ishihara, Y.**, Sorensen, S.-A.: 2010, Illumination conditions of the south pole of the Moon derived using Kaguya topography, *Icarus*, **208**, 558-564.

Caselli, P., Keto, E., Pagani, L., **Aikawa, Y.**: 2010, Water vapor toward starless cores: The Herschel view, *A&A*, **521**, 29-33.

Cheoun, M. K., Ha, E., **Kajino, T.**: 2011, Neutrino reactions on Ar^{40} for solar and core-collapsing supernova neutrinos, *Phys. Rev. C*, **83**, 28801.

Cheoun, M. K., Ha, E., Kim, K. S., **Kajino, T.**: 2010, Neutrino reactions via neutral and charged current by quasi-particle random phase approximation (QRPA), *J. Phys. G*, **37**, 55101.

Cheoun, M. K., Ha, E., Lee, S. Y., Kim, K. S., So, W. Y., **Kajino, T.**: 2010, Neutrino reactions on ^{12}C by the quasiparticle random-phase approximation, *Phys. Rev. C*, **81**, 28501.

Cheoun, M. K., Hayakawa, T., **Kajino, T.**, Chiba, S.: 2010, Neutrino reactions on La^{138} and Ta^{180} via charged and neutral currents by the quasiparticle random phase approximation, *Phys. Rev. C*, **82**, 35504.

Currie, T., et al. including **Pyo, T.-S.**: 2011, A Combined Subaru/VLT/MMT 1–5 μm Study of Planets Orbiting HR 8799: Implications for Atmospheric Properties, Masses, and Formation, *ApJ*, **729**, 128-147.

Dawson, J. R., McClure-Griffiths, N. M., Kawamura, A., **Mizuno, N.**, Onishi, T., Mizuno, A., Fukui, Y.: 2011, Supershells as Molecular Cloud Factories: Parsec Resolution Observations of H I and ^{12}CO(J = 1–0) in GSH 287+04-17 and GSH 277+00+36, *ApJ*, **728**, 127.

Deguchi, S., **Koike, K.**, **Kuno, N.**, Matsunaga, N., Nakashima, J., **Takahashi, S.**: 2011, SiO Maser Spectra of V407 Cyg after the 2010 March Nova Outburst, *PASJ*, **63**, 309-315.

Deguchi, S., Nakashima, J., Zhang, Y., Chong, S. S. N., **Koike, K.**, Kwok, S.: 2010, SiO and H$_2$O Maser Observations of Red Supergiants in Star Clusters Embedded in the Galactic Disk, *PASJ*, **62**, 391-407.

Deguchi, S., Shimoikura, T., **Koike, K.**: 2010, SiO Maser Survey off the Galactic Plane: A Signature of Streaming Motion, *PASJ*, **62**, 525-546.

Derwaman. B., Nakamura, T., **Yoshida, F.**: 2011, Subaru lightcurve observations of sub-km-sized main-belt asteroids, *PASJ*, **63**, S555.

Ebizuka, N., Ichiyama, K., Yamada, T., Tokoku, C., Onodera, M., Hanesaka, M., Kodate, K., Katsuno Uchimoto, Y., Maruyama, M., Shimasaku, K., Tanaka, I., Yoshikawa, T., **Kashikawa, N.**, **Iye, M.**, Ichikawa, T.: 2011, Cryogenic Volume-Phase Holographic Grisms for MOIRCS, *PASJ*, **63**, S605-S612.

Escapa, A., **Fukushima, T.**: 2011, Free Translational Oscillations of Icy Bodies with a Subsurface Ocean using a Variational Approach, *AJ*, **141**, 77-101.

Espada, D., Peck, A. B., Matsushita, S., Sakamoto, K., Henkel, C., **Iono, D.**, Israel, F. P., Muller, S., Petitpas, G., Pihlstrom, Y., Taylor, G. B., Trung, D. V.: 2010, Disentangling the Circumnuclear Environs of Centaurus A: II. On the Nature of the Broad Absorption Line, *ApJ*, **720**, 666-678.

Finoguenov, A., et al. including **Sekiguchi, K.**: 2010, X-ray groups and clusters of galaxies in the Subaru-XMM Deep Field, *MNRAS*, **403**, 2063-2076.

Fish, V. L., et al. including **Honma, M.**, **Oyama, T.**: 2011, 1.3 mm Wavelength VLBI of Sagittarius A*: Detection of Time-variable Emission on Event Horizon Scales, *ApJ*, **727**, L36.

Fok, H. S., Shum, C. K., Yi, Y., **Araki, H.**, Ping, J., Williams, J. G., Fotopoulos, G., **Noda, H.**, **Goossens, S.**, Huang, Q., **Ishihara, Y.**, **Matsumoto, K.**, Oberst, J., **Sasaki, S.**: 2011, Accuracy assessment of lunar topography models, *Earth, Planets and Space*, **63**, 15-23.

Fomalont, E., Johnston, K., Fey, A., Boboltz, D., **Oyama, T.**, **Honma, M.**: 2011, The Position/Structure Stability of Four ICRF2 Sources, *AJ*, **141**, 91.

Fontani, F., Cesaroni, R., **Furuya, R. S.**: 2010, Class I and Class II methanol masers in high-mass star-forming regions, *A&A*, **517**, A56.

Fujii, M., Iwasawa, M., Funato, Y., **Makino, J.**: 2010, The Origin of S-stars and a Young Stellar Disk: Distribution of Debris Stars of a Sinking Star Cluster, *ApJ*, **716**, L80-L84.

Fujiwara, H., Onaka, T., Ishihara, D., **Yamashita, T.**, Fukagawa, M., Nakagawa, T., Kataza, H., Ootsubo, T., Murakami, H.: 2010, Enstatite-rich Warm Debris Dust Around HD165014, *ApJ*, **714**, L152-L156.

Fukagawa, M., **Tamura, M.**, Itoh, Y., Oasa, Y., **Kudo, T.**, **Hayashi, S. S.**, Kato, E., Ootsubo, T., Itoh, Y., Shibai, H., **Hayashi, M.**: 2010, Subaru Near-Infrared Imaging of Herbig Ae Stars, *PASJ*, **62**, 347-370.

Fukue, T., **Tamura, M.**, **Kandori, R.**, **Kusakabe, N.**, Hough, J. H., Bailey, J., Whittet, D. C. B., Lucas, P. W., **Nakajima, Y.**, **Hashimoto, J.**: 2010, Extended High Circular Polarization in the Orion Massive Star Forming Region: Implications for the Origin of Homochirality in the Solar System, *Origins of Life and Evolution of Biospheres*, **40**, 335.

Fukui, A., et al. including **Narita, N.**, **Tamura, M.**: 2011, Measurements of Transit Timing Variations for WASP-5b, *PASP*, **63**, 287-300.

Fukushima, T.: 2010, Fast Computation of Incomplete Elliptic Integral of First Kind by Half Argument Transformation, *Numer. Math.*, **116**, 687-719.

Fukushima, T.: 2010, Precise Computation of Acceleration due to Uniform Ring or Disk, *Celest. Mech. Dyn. Astron.*, **108**, 339-356.

Furusawa, H., **Okura, Y.**, Mineo, S., **Takata, T.**, **Nakata, F.**, Tanaka, M., Katayama, N., Itoh, R., **Yasuda, N.**, **Miyazaki, S.**, **Komiyama, Y.**, **Utsumi, Y.**, Uchida, T., Aihara, T.: 2011, First On-Site Data Analysis System for Subaru/Suprime-Cam, *PASJ*,

63, S585-S603.

Furusawa, J., **Sekiguchi, K.**, **Takata, T.**, **Furusawa, H.**, Shimasaku, K., Simpson, C., Akiyama, M.: 2011, The Mass-dependent Clustering History of K-selected Galaxies at $z < 4$ in the SXDS/UDS Field, *ApJ*, **727**, 111-123.

Furuya, R. S., **Cesaroni, R.**, Shinnaga, H.: 2011, Infall, outflow, and rotation in the G19.61-0.23 hot molecular core, *A&A*, **525**, A72.

Gallagher, A. J., Ryan, S. G., García Pérez, A. E., **Aoki, W.**: 2010, The barium isotopic mixture for the metal-poor subgiant star HD 140283, *A&A*, **523**, A24.

Geers, V., Scholz, A., Jayawardhana, R., Lee, E., Lafrenière, D., **Tamura, M.**: 2011, Substellar Objects in Nearby Young Clusters (SONYC). II. The Brown Dwarf Population of ρ Ophiuchi, *ApJ*, **726**, 23.

Gobat, R., Daddi, E., Onodera, M., Finoguenov, A., Renzini, A., **Arimoto, N.**, Bouwens, R., Brusa, M., Chary, R.R., Cimatti, A., Dickinson, M., Kong, X., Mignoli, M.: 2010, A mature cluster with X-ray emission at $z = 2.07$, *A&A*, **526**, A133.

Goossens, S., **Matsumoto, K.**, Liu, Q., **Kikuchi, F.**, Sato, K., **Hanada, H.**, **Ishihara, Y.**, **Noda, H.**, Kawano, N., Namiki, N., Iwata, T., Lemoine, F. G., Rowlands, D. D., Harada, Y., Chen, M.: 2011, Lunar gravity field determination using SELENE same-beam differential VLBI tracking data, *J. Geod.*, **85(4)**, 205-228.

Goossens, S.: 2010, Applying spectral leakage corrections to gravity field determination from satellite tracking data, *Geophys. J. Int.*, **181**, 1459-1472.

Goswami, A., **Aoki, W.**: 2010, HD209621: abundances of neutron-capture elements, *MNRAS*, **404**, 253-264.

Goto, M., et al. including **Terada, H.**, **Usuda, T.**: 2010, Fundamental Vibrational Transition of CO During the Outburst of EX Lupi in 2008, *ApJ*, **728**, 5.

Goto, T., et al. including **Kodama, T.**, **Hwang, N.**: 2010, Environmental dependence of $8\,\mu$m luminosity functions of galaxies at $z \sim 0.8$. Comparison between RXJ1716.4+6708 and the AKARI NEP-deep field, *A&A*, **514**, A7-11.

Goto, T., et al. including **Hwang, N.**: 2010, Evolution of infrared luminosity functions of galaxies in the AKARI NEP-deep field. Revealing the cosmic star formation history hidden by dust, *A&A*, **514**, A6-17.

Gouda, N., JASMINE working group: 2010, JASMINE: Infrared Space Astrometry Mission, *Transcations of the Japan Society for Aeronautical and Space Science, Aerospace Technology Japan*, **8**(No.ists27), To.4.7-To.4.12.

Groen, D., Portegies Zwart, S., **Ishiyama, T.**, **Makino, J.**: 2011, High-performance gravitational N-body simulations on a planet-wide-distributed supercomputer, *Computational Science and Discovery*, **4**, 015001.

Guyon, O., **Martinache, F.**, Belikov. R., Soummer, R.: 2010, High Performance PIAA Coronagraphy with Complex Amplitude Focal Plane Masks, *ApJS*, **190**, 220-232.

Hagiwara, Y.: 2010, Two Epochs of Very Large Array Observations of Water Maser Emission in the Active Galaxy NGC 6240, *AJ*, **140**, 1905-1910.

Hanada, H., Iwata, T., Liu, Q., **Kikuchi, F.**, **Matsumoto, K.**, **Goossens, S.**, **Harada, Y.**, **Asari, K.**, **Ishikawa, T.**, **Ishihara, Y.**, **Noda, H.**, **Tsuruta, S.**, Petrova, N., Kawano, N., **Sasaki, S.**, Sato, K., Namiki, N., **Kono, Y.**, **Iwadate, K.**, **Kameya, O.**, **Shibata, K.**, **Tamura, Y.**, Kamata, S., Yahagi, Y., Masui, W., Tanaka, K., Maejima, H., Hong, X., Ping, J., Shi, X., Huang, Q., Aili, Y., Ellingsen, S., Schlüter, W.: 2010, Overview of differential VLBI observations of lunar orbiters in SELENE (Kaguya) for precise orbit determination and lunar gravity field study, *Space Sci. Rev.*, **154**, 123-144.

Harikae, S., **Kotake, K.**, **Takiwaki, T.**: 2010, Neutrino Pair Annihilation in Collapsars: A Ray-tracing Method in Special Relativity, *ApJ*, **713**, 304-317.

Harikae, S., **Kotake, K.**, **Takiwaki, T.**, **Sekiguchi Y.**: 2010, A General Relativistic Ray-tracing Method for Estimating the Energy and Momentum Deposition by Neutrino Pair Annihilation in Collapsars, *ApJ*, **720**, 614-625.

Harra, L. K., Magara, T., **Hara, H.**, **Tsuneta, S.**, **Okamoto, T. J.**, Wallace, A. J.: 2010, Response of the Solar Atmosphere to the Emergence of ‘Serpentine’ Magnetic Field, *Solar Phys.*, **263**, 105-119.

Hashimoto, J., et al. including **Tamura, M.**, **Kudo, T.**, **Fukue, T.**, **Kokubo, E.**, **Egner, S.**, **Golota, T.**, **Hayano, Y.**, **Hayashi, M.**, **Hayashi, S.**, **Ishii, M.**, **Kandori, R.**, **Kusakabe, N.**, **Matsuo, T.**, **Miyama, S.**, **Morino, J.-I.**, **Nishimura, T.**, **Pyo, T.-S.**, **Suto, H.**, **Takato, N.**, **Terada, H.**, **Tomono, D.**, **Takami, H.**, **Usuda, T.**: 2011, Direct Imaging of Fine Structures in Giant Planet-forming Regions of the Protoplanetary Disk Around AB Aurigae, *ApJ*, **729**, L17-L21.

Hashimoto, T., Nagao, T., **Yanagisawa, K.**, Matsuoka, K., Araki, N.: 2011, Spatially Extended [P II] $1.188\,\mu$m and [Fe II] $1.257\,\mu$m Emission Lines in a Nearby Seyfert Galaxy NGC 1068 Observed with OAO/ISLE, *PASJ*, **63**, L7-L11.

Hashimoto, T., Ohta, K., **Aoki, K.**, **Tanaka, I.**, Yabe, K., Kawai, N., **Aoki, W.**, **Furusawa, H.**, **Hattori, T.**, **Iye, M.**, Kawabata, K. S., Kobayashi, N., **Komiyama, Y.**, **Kosugi, G.**, **Minowa, Y.**, **Mizumoto, Y.**, Niino, Y., Nomoto, K., **Noumaru, J.**, **Ogasawara, R.**, **Pyo, T.-S.**, Sakamoto, T., **Sekiguchi, K.**, **Shirasaki, Y.**, Suzuki, M., **Tajitsu, A.**, **Takata, T.**, Tamagawa, T., **Terada, H.**, Totani, T., **Watanabe, J.**, Yamada, T., Yoshida, A.: 2010, "Dark" GRB 080325 in a Dusty Massive Galaxy at $z \sim 2$, *ApJ*, **719**, 378-384.

Hatsukade, B., Kohno, K., Aretxaga, I., Austermann, J. E., **Ezawa, H.**, Hughes, D. H., Ikarashi, S., **Iono, D.**, **Kawabe, R.**, Khan, S., **Matsuo, H.**, Matsuura, S., **Nakanishi, K.**, **Oshima, T.**, Perera, T., Scott, K. S., Shirahata, M., Takeuchi, T. T., **Tamura, Y.**, Tanaka, K., Tosaki, T., Wilson, G. W., Yun, M. S.: 2011, AzTEC/ASTE 1.1-mm Survey of the AKARI Deep Field South: Source Catalogue and Number Counts, *MNRAS*, **411**, 102-116.

Hayakawa, T., **Kajno, T.**, Chiba, S., Mathews, G. J.: 2010, New Estimate for the Time-Dependent Thermal Nucleosynthesis of 180Tam in Supernova Nucleosynthesis, *Phys. Rev. C*, **81**, 52801.

Hayakawa, T., Mohr, P., **Kajno, T.**, Chiba, S., Mathews, G. J.: 2010, Reanalysis of the ($J = 5$) state at 592 keV ^{180}Ta and its role in the ν-process nucleosynthesis of ^{180}Ta in supernova, *Phys. Rev. C*, **82**, 58801.

Higuchi, A. E., **Kurono, Y.**, **Saito, M.**, **Kawabe, R.**: 2010, A Mapping Survey of Dense Associated with Embedded Clusters II: Can Clump-Climp Collisions Induce Stellar Clusters?, *ApJ*,

719, 1813-1827.

Hikage, C., Takada, M., **Hamana, T.**, Spergel, D.: 2011, Shear power spectrum reconstruction using the pseudo-spectrum method, *MNRAS*, **412**, 65-74.

Hinkley, S., et al. including **Martinache, F.**: 2011, Establishing alpha Oph as a Prototype Rotator: Improved Astrometric Orbit, *ApJ*, **726**, 104-110.

Hirano, T., **Narita, N.**, Shporer, A., Sato, B., **Aoki, W.**, **Tamura, M.**: 2011, A Possible Tilted Orbit of the Super-Neptune HAT-P-11b, *PASJ*, **63**, S531-S536.

Hirota, A., **Kuno, N.**, Sato, N., Nakanishi, H., Tosaki, T., Sorai, K.: 2010, Variation of Molecular Gas Properties Across the Spiral Arms in IC 342: Large-Scale ^{13}CO(1–0) Emission, *PASJ*, **62**, 1261-1275.

Hirota, T., **Honma, M.**, Imai, H., **Sunada, K.**, **Ueno, Y.**, **Kobayashi, H.**, **Kawaguchi, N.**: 2011, Astrometry of H_2O Masers in Nearby Star-Forming Regions with VERA. IV. L 1448 C, *PASJ*, **63**, 1-8.

Hirota, T., Sakai, N., Yamamoto, S.: 2010, Depletion of CCS in a Candidate Warm-carbon-chain-chemistry Source L483, *ApJ*, **720**, 1370-1373.

Honda, M., Inoue, A. K., Okamoto, Y. K., Kataza, H., Fukagawa, M., **Yamashita, T.**, **Fujiyoshi, T.**, **Tamura, M.**, **Hashimoto, J.**, Miyata, T., Sako, S., Sakon, I., Fujiwara, H., Kamizuka,T. Onaka, T.: 2010, Pre-transitional Disk Nature of the AB Aur Disk, *ApJ*, **718**, L199-L233.

Honda, S., **Aoki, W.**, Arimoto, N., Sadakane, K.: 2011, Enrichment of Heavy Elements in the Red Giant S 15-19 in the Sextans Dwarf Spheroidal Galaxy, *PASJ*, **63**, S523-S529.

Honma, M., **Hirota, T.**, **Kan-Ya, Y.**, **Kawaguchi, N.**, **Kobayashi, H.**, Kurayama, T., **Sato, K.**: 2011, Astrometry of the Star-Forming Region IRAS 05137+3919 in the Far Outer Galaxy, *PASJ*, **63**, 17-22.

Hughes, A., Wong, T., Ott, J., Muller, E., Pineda, J. L., Mizuno, Y., Bernard, J.-P., Paradis, D., Maddison, S., Reach, W. T., Staveley-Smith, L., Kawamura, A., Meixner, M., Kim, S., Onishi, T., **Mizuno, N.**, Fukui, Y.: 2010, Physical properties of giant molecular clouds in the Large Magellanic Cloud, *MNRAS*, **406**, 2065-2086.

Iguchi, S., Okuda, T., Sudou, H.: 2010, A Very Close Binary Black Hole in a Giant Elliptical Galaxy 3C 66B and its Black Hole Merger, *ApJ*, **724**, L166-L170.

Imai, H., Nakashima, J., **Deguchi, S.**, **Yamauchi, A.**, Nakagawa, A., **Nagayama, T.**: 2010, Japanese VLBI Network Mapping of SiO $v=3$ $J=1$–0 Maser Emission in W Hydrae, *PASJ*, **62**, 431-439.

Imai, H., Tafoya, D., **Honma, M.**, **Hirota, T.**, **Miyaji, T.**: 2011, Annual Parallax Distance and Kinematical Property of H_2O Masers in IRAS 19312+1950, *PASJ*, **63**, 81-87.

Imamura, T., Iwata, T., Yamamoto, Z., Mochizuki, N., **Kono, Y.**, **Matsumoto, K.**, Liu, Q., **Noda, H.**, **Hanada, H.**, Oyama, K., Nabatov, A., Futaana, Y., Saito, A., Ando, H.: 2010, Studying the Lunar Ionosphere with SELENE Radio Science Experiment, *Space Sci. Rev.*, **154**, 305-316.

Imanishi, M., Ichikawa, K., Takeuchi, T., Kawakatu, N., **Oi, N.**, **Imase, K.**: 2011, Infrared 3-4 micron spectroscopy of nearby PG QSOs and AGN-nuclear starburst connections in high-luminosity AGN populations, *PASJ*, **63**, S447-456.

Imanishi, M., Nakagawa, T., Shirahata, M., Ohyama, Y., Onaka, T.: 2010, AKARI IRC infrared 2.5–5 micron spectroscopy of a large sample of luminous infrared galaxies, *ApJ*, **721**, 1233-1261.

Inada, N., et al. including **Oguri, M.**, **Morokuma, T.**: 2010, The Sloan Digital Sky Survey Quasar Lens Search. IV. Statistical Lens Sample from the Fifth Data Release, *AJ*, **140**, 403-415.

Indriolo, N., Blake, G. A., Goto, M., **Usuda, T.**, Oka, T., Geballe, T. R., Fields, B. D., McCall, B. J.: 2010, Investigating the Cosmic-ray Ionization Rate Near the Supernova Remnant IC 443 through H_3^+ Observations, *ApJ*, **724**, 1357.

Inoue, A. K., Kousai, K., **Iwata, I.**, Matsuda, Y., Nakamura, E., Horie, M., Hayashino, T., Tapken, C., Akiyama, M., Noll, S., Yamada, T., Burgarella, D., Nakamura, Y.: 2011, Lyman 'bump' galaxies - II. A possible signature of massive extremely metal-poor or metal-free stars in $z=3.1$ Lyα emitters, *MNRAS*, **411**, 2336.

Inoue, H., **Noguchi, T.**, Kohno, K.: 2010, SIS junction as a microwave noise source, *J. Phys. C*, **234**, 042014.

Inoue, T., Yamazaki, R., Inutsuka, S.: 2010, Two-Step Acceleration Model of Cosmic Rays at Middle-Aged Supernova Remnants: Universality in Secondary Shocks, *ApJ*, **723**, L108-L112.

Inoue, Y., Inoue, S., **Kobayashi, M. A. R.**, Totani, T., Kataoka, J., Sato, R.: 2011, Searching for the most distant blazars with the Fermi Gamma-ray Space Telescope, *MNRAS*, **411**, 464-468.

Inutsuka, S., **Machida, M. N.**, Matsumoto, T.: 2010, Emergence of Protoplanetary Disks and Successive Formation of Gaseous Planets by Gravitational Instability, *ApJ*, **718**, 58-62.

Ireland, M., Kraus, A., **Martinache, F.**, Law, N., Hillenbrand, L. A.: 2011, Two Wide Planetary-mass Companions to Solar-type Stars in Upper Scorpius, *ApJ*, **726**, 113.

Ishiguro, M., Ham, J.-B., Tholen, D. J., Elliott, G. T., Micheli, M., Niwa, T., Sakamoto, M., Matsuda, K., Urakawa, S., Yoshimoto, K., Sarugaku, Y., Usui, F., Hasegawa, S., **Iwata, I.**, **Ozaki, S.**, **Kuroda, D.**, Ootsubo, T.: 2011, Search for the Comet Activity of 107P/(4015) Wilson-Harrington during 2009/2010 Apparition, *ApJ*, **726**, 101.

Ishiguro, M., **Watanabe, J.**, Sarugaku, Y., Ootsubo, T., **Kuroda, D.**, Honda, M., Miyata, T., **Yanagisawa, K.**, Mito, H., **Fukushima, H.**, Niwa, T., Sakamoto, M., Narusawa, S., Akisawa, H.: 2010, 2007 Outburst of 17P/Holmes: The Albedo and the Temperature of the Dust Grains, *ApJ*, **714**, 1324-1333.

Ishihara, Y., Morota, T., Nakamura, R., **Goossens, S.**, **Sasaki, S.**: 2011, Anomalous Moscoviense basin: Single oblique impact or double impact origin?, *Geophys. Res. Lett.*, **38**, L03201.

Ishikawa, R., **Tsuneta, S.**, Jurčák, J.: 2010, Three-Dimensional View of Transient Horizontal Magnetic Fields in the Photosphere, *ApJ*, **713**, 1310-1321.

Ishikawa, R., **Tsuneta, S.**, Jurčák, J.: 2010, Spatial and Temporal Distributions of Transient Horizontal Magnetic Fields with Deep Exposure, *ApJ*, **718**, L171-L175.

Ishiyama, F., **Takahashi, R.**: 2010, The bounce hardness index of gravitational waves, *Class. Quantum Grav.*, **27**, 245021.

Ishiyama, T., **Makino, J.**, Ebisuzaki, T.: 2010, Gamma-ray Signal from Earth-mass Dark Matter Microhalos, *ApJ*, **723**, L195-L200.

Isogai, M., Seki, M., Ikeda, Y., **Akitaya, H.**, Kawabata, K. S.:

2010, Orbital Elements of the Symbiotic Star Z Andromedae from Optical Linear Polarization During the Quiescent Phase, *AJ*, **140**, 235-241.

Ita, Y., Onaka, T., Tanabé, T., Matsunaga, N., Matsuura, M., Yamamura, I., Nakada, Y., **Izumiura, H.**, Ueta, T., Mito, H., Fukushi, H., Kato, D.: 2010, AKARI Near- to Mid-Infrared Imaging and Spectroscopic Observations of the Small Magellanic Cloud. I Bright Point Source List, *PASJ*, **62**, 273-286.

Ito, H., **Tsuneta, S.**, Shiota, D., Tokumaru, M., Fujiki, K.: 2010, Is the Polar Region Different from the Quiet Region of the Sun?, *ApJ*, **719**, 131-142.

Ito, T.: 2010, Asymmetric cratering on the Moon: Case of the raw near-Earth asteroid population, *Adv. Geosci.*, **25**, 109-119.

Ito, T., Malhotra, R.: 2010, Asymmetric impacts of near-Earth asteroids on the Moon, *A&A*, **519**, A63.

Ito, T., **Yoshida, F.**: 2010, Near-Infrared Lightcurves of a Very Young Asteroid, Karin, *Adv. Geosci.*, **19**, 285.

Ito, T., **Yoshida, F.**: 2010, Young asteroid families and their lightcurve observation at Maidanak Observatory, Uzbekistan, *Adv. Geosci.*, **25**, 161-172.

Janson, M., et al. including **Egner, S.**, **Golota, T.**, **Guyon, O.**, **Hashimoto, J.**, **Hayano, Y.**, **Hayashi, M.**, **Hayashi, S.**, **Ishii, M.**, **Iye, M.**, **Kandori, R.**, **Kudo, T.**, **Kusakabe, N.**, **Kuzuhara, M.**, **Matsuo, T.**, **Miyama, S.**, **Morino, J.-I.**, **Nishimura, T.**, **Pyo, T.-S.**, **Takato, N.**, **Terada, H.**, **Tomono, D.**, **Takami, H.**, **Usuda, T.**, **Tamura, M.**: 2011, Near-infrared Multi-band Photometry of the Substellar Companion GJ 758 B, *ApJ*, **728**, 85-90.

Jurčák, J., **Katsukawa, Y.**: 2010, Temporal downflows in a penumbra, *A&A*, **524**, A21.

Kajisawa, M., Ichikawa, T., **Tanaka, I.**, Yamada, T., Akiyama, M., Suzuki, R., Tokoku, C., Katsuno, U. Y., Konishi, M., Yoshikawa, T., Nishimura, T., Omata, K., Ouchi, M., **Iwata, I.**, **Hamana, T.**, Onodera, M.: 2011, MOIRCS Deep Survey. IX. Deep Near-Infrared Imaging Data and Source Catalog, *PASJ*, **63**, S403.

Kamikura, M., **Naruse, M.**, **Asayama, S.**, **Satou, N.**, Shan, W., **Sekimoto, Y.**: 2010, Development of a 385–500 GHz Orthomode Transducer (OMT), *J. Infrared, Millimeter, and Terahertz Waves*, **31**, 697-707.

Kamio, S., **Hara, H.**, **Watanabe, T.**, Fredvik, T., Hansteen, V. H.: 2010, Modeling of EIS Spectrum Drift from Instrumental Temperatures, *Solar Phys.*, **266**, 209-223.

Kano, R., Shimizu, T., Tarbell, T. D.: 2010, Hinode Observation of Photospheric Magnetic Activities Triggering X-ray Microflares Around a Well-developed Sunspot, *ApJ*, **720**, 1136-1145.

Käppeler, F., Gallino, R., Bisterzo, S., **Aoki, W.**: 2011, The s process: Nuclear physics, stellar models, and observations, *Rev. of Modern Phys.*, **83**, 157-194.

Kato, T., et al. including **Imada, A.**: 2010, Survey of Period Variations of Superhumps in SU UMa-Type Dwarf Novae. II The Second Year (2009-2010), *PASJ*, **62**, 1525-1584.

Katsukawa, Y., Jurčák, J.: 2010, A new type of small-scale downflow patches in sunspot penumbrae, *A&A*, **524**, A20.

Kawagoe, S., Yoshida, T., **Kajino, T.**, Suzuki, H., Sumiyoshi, K., Yamada, S.: 2010, Neutrino oscillation and expected event rate of supernova neutrinos in adiabatic explosion model, *Phys. Rev. D*, **81**, 123014.

Kawaharada, M., Okabe, N., Umetsu, K, Takizawa, M., Matsushita, K., Fukazawa, Y., **Hamana, T.**, **Miyazaki, S.**, Nakazawa, K., Ohashi, T.: 2010, Suzaku Observation of A1689: Anisotropic Temperature and Entropy Distributions Associated with the Large-scale Structure, *ApJ*, **714**, 423-441.

Kawamura, S., et al. including **Akutsu, T.**, **Ishizaki, H.**, **Obuchi, Y.**, **Okada, N.**, **Takahashi, R.**, **Torii, Y.**, **Ueda, A.**, **Yamazaki, T.**: 2011, The Japanese space gravitational wave antenna: DECIGO, *Class. Quantum Grav.*, **28**, 094011.

Kawamura, S.: 2010, Ground-based interferometers and their science reach, *Class. Quantum Grav.*, **27**, 084001.

Kayo, I., Inada, N., **Oguri, M.**, **Morokuma, T.**, Hall, P. B., Kochanek, C. S., Schneider, D. P.: 2010, Eight New Quasar Lenses from the Sloan Digital Sky Survey Quasar Lens Search, *AJ*, **139**, 1614-1621.

Kida, S., et al. including **Niinuma, K.**: 2010, Radio Variability of a Fermi Large Area Telescope Bright Source 0FGL J1847.8+3223, *ApJ*, **714**, L36-L40.

Kikuchi, K., **Fujii, Y.**: 2010, Flight Model Performance of 640-GHz Superconductor–Insulator–Superconductor Mixers for JEM/SMILES Mission, *J. Infrared Millimeter, and Terahertz Waves*, **31**, 1205-1211.

Kimura, M., et al. including **Tamura, N.**, **Takato, N.**, **Tait, P.**, **Elms, B.**, **Kurakami, T.**, **Noumaru, J.**, **Ohshima, N.**: 2010, Fibre Multi-Object Spectrograph (FMOS) for the Subaru Telescope, *PASJ*, **62**, 1135-1147.

Kino, M., Asano, K.: 2011, Mini-radio lobes in AGN core illumination and their hadronic gamma-ray afterlight, *MNRAS*, **412**, L20-L24.

Kitagawa, N., Yokoyama, T., Imada, S., **Hara, H.**: 2010, Mode Identification of MHD Waves in an Active Region Observed with Hinode/EIS, *ApJ*, **721**, 744-749.

Kiuchi, K., **Sekiguchi, Y.**, Shibata, M., Taniguchi, K.: 2010, Exploring Binary-Neutron-Star-Merger Scenario of Short-Gamma-Ray Burst by Gravitational-Wave Observation, *Phys. Rev. Lett.*, **104**, 141101.

Koda, J., **Sawada, T.**, Wright, M. C. H., Teuben, P., Corder, S. A., Patience, J., Scoville, N., Donovan, J. M., Egusa, F.: 2011, CO ($J = 1$–0) Imaging of M51 with CARMA and the Nobeyama 45 m Telescope, *ApJS*, **193**, 19.

Kohyama, T., Shibai, H., Fukagawa, M., **Hibi, Y.**: 2010, A New Galactic Extinction Map in the Cygnus Region, *ApJ*, **719**, 873-880.

Kojima, K., **Kajino, T.**, Mathews, G. J.: 2010, Growth of Cosmological Perturbation by Extra Anisotropic Stress, *J. Cosmol. Astropart. Phys.*, **2**, 18.

Kojima, T., **Kuroiwa, K.**, **Uzawa, Y.**, **Kroug, M.**, Takeda, M., **Fujii, Y.**, **Kaneko, K.**, **Miyachi, A.**, Wang, Z., Ogawa, H.: 2010, A Low-Noise Terahertz SIS Mixer Incorporating a Waveguide Directional Coupler for LO Injection, *J. Infrared Millimeter, and Terahertz Waves*, **31**, 1321-1330.

Kokubo, E., Genda, H.: 2010, Formation of Terrestrial Planets from Protoplanets under a Realistic Accretion Condition, *ApJ*, **714**, L21-L25.

Komiya, Y., Habe, A., Suda, Y., Fujimoto, M. Y.: 2010, Formation History of Metal-poor Halo Stars with the Hierarchical Model and the Effect of Inter Stellar Matter Accretion on the Most

Metal-poor Stars, *ApJ*, **717**, 542-561.

Komugi, S., **Yasui, C.**, Kobayashi, N., **Hatsukade, B.**, Kohno, K., Sofue, Y., Kyu, S.: 2011, Deep CO Observations and the CO-to-H_2 Conversion Factor in DDO 154, a Low Metallicity Dwarf Irregular Galaxy, *PASJ*, **63**, L1-L15.

Konishi, M., Akiyama, M., Kajisawa, M., Ichikawa, T., Suzuki, R., Tokoku, C., Katsuno Uchimoto, Y., Yoshikawa, T., **Tanaka, I.**, Onodera, M., Ouchi, M., **Omata, K.**, **Nishimura, T.**, Yamada, T.: 2010, MOIRCS Deep Survey. VII: NIR Morphologies of Star-forming Galaxies at Redshift $z\sim1$, *PASJ*, **63**, S363-S377.

Koyama, Y., **Kodama, T.**, Shimasaku, K., **Hayashi, M.**, Okamura, S., **Tanaka, I.**, Tokoku, C.: 2010, Panoramic Hα and mid-infrared mapping of star formation in a $z=0.8$ cluster, *MNRAS*, **403**, 1611-1624.

Kratzer, R. M., Richards, G. T., Goldberg, D. M., **Oguri, M.**, Kochanek, C. S., Hodge, J. A., Becker, R. H., Inada, N.: 2011, Analyzing the Flux Anomalies of the Large-separation Lensed Quasar SDSS J1029+2623, *ApJ*, **728**, L18.

Kubo, M., Low, B. C., Lites, B. W.: 2010, Granular-scale Magnetic Flux Cancellations in the Photosphere, *ApJ*, **712**, 1321-1330.

Kudo, N., Torii, K., Machida, M., Davis, T. A., Tsutsumi, K., Fujishita, M., Moribe, N., Yamamoto, H., Okuda, T., Kawamura, A., **Mizuno, N.**, Onishi, T., Maezawa, H., Mizuno, A., Tanaka, K., Yamaguchi, N., **Ezawa, H.**, Takahashi, K., Nozawa, S., Matsumoto, R., Fukui, Y.: 2011, High Excitation Molecular Gas in the Galactic Center Loops; ^{12}CO ($J=2$–1 and $J=3$–2) Observations, *PASJ*, **63**, 171-197.

Kudoh, T., Basu, S.: 2011, Formation of Collapsing Cores in Subcritical Magnetic Clouds: Three-dimensional Magnetohydrodynamic Simulations with Ambipolar Diffusion, *ApJ*, **728**, 123.

Kuiper, E.., Hatch, N. A., Rottgering, H. J. A., Miley, G. K., Overzier, R. A., Venemans, B. P., De Breuck, C., Croft, S., Kajisawa, M., **Kodama, T.**, Kurk, J. D., Pentericci, L., Stanford, S. A., **Tanaka, I.**, Zirm, A. W.: 2010, A galaxy populations study of a radio-selected protocluster at $z\sim3.1$, *MNRAS*, **405**, 969.

Kupriyanova, E. G., Melnikov, V. F., Nakariakov, V. M., **Shibasaki, K.**: 2010, Types of Microwave Quasi-Periodic Pulsations in Single Flaring Loops, *Solar Phys.*, **267**, 329-342.

Kuroda K., **the LCGT Collaboration**: 2010, Status of LCGT, *Class. Quantum Grav.*, **27**, 084004.

Kusakabe, M., **Kajino, T.**, Yoshida, T., Mathews, G. J.: 2010, New results on catalyzed BBN with a long-lived negatively-charged massive particle, *Phys. Rev. D*, **81**, 83521.

Lara, M., **Fukushima, T.**, Ferrer, S.: 2010, First-Order Rotation Solution of an Oblate Rigid Body under the Torque of a Perturber in Circular Orbit, *A&A*, **519**, A1.

Letarte, B., Hill, V., Tolstoy, E., Jablonka, P., Shetrone, M., Venn, K. A., Spite, M., Irwin, M. J., Battaglia, G., Helmi, A., Primas, F., Francois, P., Kaufer, A., Szeifert, T., **Arimoto, N.**, Sadakane, K.: 2010, A high-resolution VLT/FLAMES study of infividual stars in the centre of the Fornax dwarf spheroidal galaxy, *A&A*, **523**, A17.

Li, Z.-Y., Wang, P., Abel, T., **Nakamura, F.**: 2010, Lowering the Characteristic Mass of Cluster Stars by Magnetic Fields and Outflow Feedback, *ApJ*, **720**, L26-L30.

Li, J., An, T., Shen, Z.-Q., **Miyazaki, A.**: 2010, ATCA Observations of SiO Masers in the Galactic Center, *ApJ*, **720**, L56-L61.

Lites, B. W., Casini, R., Manso Sainz, R., Jurčák, J., Ichimoto, K., **Ishikawa, R.**, **Okamoto, T. J.**, **Tsuneta, S.**, Bellot Rubio, L.: 2010, Scattering Polarization in the Fe I 630 nm Emission Lines at the Extreme Limb of the Sun, *ApJ*, **713**, 450-457.

Lites, B. W., **Kubo, M.**, Berger, T., Frank, Z., Shine, R., Tarbell, T., Title, A., **Okamoto, T. J.**, Otsuji, K.: 2010, Emergence of Helical Flux and the Formation of an Active Region Filament Channel, *ApJ*, **718**, 474-487.

Liu, Q., et al. including **Kikuchi, F.**, **Matsumoto, K.**, **Goossens, S.**, **Hanada, H.**, **Ishikawa, T.**, **Tsuruta, S.**, **Asari, K.**, **Ishihara, Y.**, **Noda, H.**, **Sasaki, S.**, **Sato, K.**, **Shibata, K.**, **Tamura, Y.**, **Jike, T.**, **Kameya, O.**: 2010, Same-beam VLBI Observations of SELENE for Improving Lunar Gravity Field Model, *Radio Sci.*, **45**, RS2004.

Liu, Q., **Matsumoto, K.**, Iwata, T., Namiki, N., **Noda, H.**, **Hanada, H.**, **Ishihara, Y.**, **Goossens, S.**, **Kikuchi, F.**, **Asari, K.**, **Tsuruta, S.**, **Ishikawa, T.**, **Sasaki, S.**, Takano, T.: 2011, Effect of Phase Pattern of Antennas Onboard Flying Spin Satellites on Doppler Measurements for Lunar Gravity Field, *IEEE Trans., Aerospace Electron. Syst.*, **47**, 405-419.

Liu, Y., Sato, B., **Takeda, Y.**, Ando, H., Zhao, G.: 2010, Stellar Parameters and Abundance Analysis of 58 Late G Giants, *PASJ*, **62**, 1071.

Lucas, P. W., Tinney, C. G., Burningham, B., Leggett, S. K., Pinfield, D. J., Smart, R., Jones, H. R. A., Marocco, F., Barber, R. J., Yurchenko, S. N., Tennyson, J., **Ishii, M.**, **Tamura, M.**, Day-Jones, A. C., Adamson, A., Allard, F., Homeier, D.: 2010, The discovery of a very cool, very nearby brown dwarf in the Galactic plane, *MNRAS*, **408**, L56-L60.

Machida, M. N., Inutsuka, S., Matsumoto, T.: 2010, Formation Process of the Circumstellar Disk: Long-term Simulations in the Main Accretion Phase of Star Formation, *ApJ*, **724**, 1006-1020.

Machida, M. N., Inutsuka, S., Matsumoto, T.: 2011, Recurrent Planet Formation and Intermittent Protostellar Outflows Induced by Episodic Mass Accretion, *ApJ*, **729**, 42-59.

Machida, M. N., **Kokubo, E.**, Inutsuka, S., Matsumoto, T.: 2010, Gas Accretion onto a Protoplanet and Formation of a Gas Giant Planet, *MNRAS*, **405**, 1227-1243.

Maciejewski, A. J., Przybylska, M., **Yoshida, H.**: 2010, Necessary conditions for classical super-integrability of a certain family of potentials in constant curvature spaces, *J. Phys. A: Math. Theor.*, **43**, 382001.

Maciejewski, G., Dimitrov, D., Neuhäuser, R., Tetzlaff, N., Niedzielski, A., Raetz, St., Chen, W. P., Walter, F., Marka, C., Baar, S., Krejcová, T., Budaj, J., Krushevska, V., **Tachihara, K.**, Takahashi, H., Mugrauer, M.: 2011, Transit timing variation and activity in the WASP-10 planetary system, *MNRAS*, **411**, 1204-1212.

Makiya, R., Totani, T., **Kobayashi, M. A. R.**: 2011, Contribution from Star-forming Galaxies to the Cosmic Gamma-ray Background Radiation, *ApJ*, **728**, 158-166.

Marocco, F., Smart, R. L., Jones, H. R. A., Burningham, B., Lattanzi, M. G., Leggett, S. K., Lucas, P. W., Tinney, C. G., Adamson, A., Evans, D. W., Lodieu, N., Murray, D. N., Pinfield, D. J., **Tamura, M.**: 2010, Parallaxes and physical properties of

11 mid-to-late T dwarfs, *A&A*, **524**, A38.

Martinache, F.: 2010, Kernel Phase in Fizeau Interferometry, *ApJ*, **724**, 464-469.

Maruta, H., **Nakamura, F.**, Nishi, R., Ikeda, N., Kitamura, Y.: 2010, Physical Properties of Dense Cores in the ρ Ophiuchi Main Cloud and a Significant Role of External Pressures in Clustered Star Formation, *ApJ*, **714**, 680-698.

Maruyama, T., **Yasutake, N.**, Tatsumi, T.: 2010, Equation of State of Structured Matter at Finite Temperature, *Prog. Theor. Phys. Supp.*, **186**, 69-74.

Maruyama, T., **Kajino, T.**, **Yasutake, N.**, Cheoun, M-K., Ryu, C-Y.: 2011, Asymmetric neutrino emission from magnetized proto-neutron star matter including hyperons in relativistic mean field theory, *Phys. Rev. D*, **83**, 081303.

Mathews, G. J., Pehlivan, Y., **Kajino, T.**, Balantekin, A. B., Kusakabe, M.: 2011, Quantum Statistical Corrections to Astrophysical Photodisintegration Rates at High Temperature, *ApJ*, **727**, 10.

Matsubayashi, K., **Yagi, M.**, **Goto, T.**, Akita, A., Sugai, H., Kawai, A., Shimono, A., **Hattori, T.**: 2011, Spatially Resolved Spectroscopic Observations of a Possible E+A Progenitor: SDSS J160241.00+521426.9, *ApJ*, **729**, 29-40.

Matsuda, Y., Richard, J., Smail, I., **Kashikawa, N.**, Shimasaku, K., Frye, B. L., Yamada, T., Nakamura, Y., Hayashino, T., Fujii, T.: 2010, A search for galaxies in and around an HI overdense region at z = 5, *MNRAS*, **403**, L54-L58.

Matsumoto, K., **Goossens, S.**, **Ishihara, Y.**, Liu, Q., **Kikuchi, F.**, Iwata, T., Namiki, N., **Noda, H.**, **Hanada, H.**, Kawano, N., Lemoine, F. G., Rowlands, D. D.: 2010, An improved lunar gravity field model from SELENE and historical tracking data: revealing the farside gravity features, *J. Geophys. Res.*, **115**, E06007.

Matsuo, T., Traub, W. A., Hattori, M., **Tamura, M.**: 2011, A New Concept for Direct Imaging and Spectral Characterization of Exoplanets in Multi-planet Systems, *ApJ*, **729**, 50.

Matsushita, S., **Kawabe, R.**, Kohno, K., Tosaki, T., Vila-Vilaro, B.: 2010, Dense and Warm Molecular Gas and Warm Dust in Nearby Galaxies, *PASJ*, **62**, 409-421.

Mayama, S., **Tamura, M.**, Hanawa, T., Matsumoto, T., **Ishii, M.**, **Pyo, T.-S.**, **Suto, H.**, Naoi, T., Kudo, T., **Hashimoto, J.**, Nishiyama, S., **Kuzuhara, M.**, **Hayashi, M.**: 2010, Direct Imaging of Bridged Twin Protoplanetary Disks in a Young Multiple Star, *Science*, **327**, 306-308.

McGreer, I., Hall, P. B., Fan, X., Bian, F., Inada, N., **Oguri, M.**, Strauss, M. A., Schneider, D. P., Farnsworth, K.: 2010, SDSS J094604.90+183541.8: A Gravitationally Lensed Quasar at z= 4.8, *AJ*, **140**, 370-378.

Medhi, B. J., Maheswar G., Pandey, J. C., **Tamura, M.**, Sagar, R.: 2010, Polarization towards the young open cluster NGC 6823, *MNRAS*, **403**, 1577-1591.

Michikoshi, S., **Kokubo, E.**, Inutsuka, S.: 2010, *N*-Body Simulation of Planetesimal Formation through Gravitational Instability and Coagulation. II. Accretion Model, *ApJ*, **719**, 1021-1031.

Minamidani, T., Tanaka, T., Mizuno, Y., **Mizuno, N.**, Kawamura, A., **Onishi, T.**, **Hasegawa, T.**, **Tatematsu, K.**, Takekoshi, T., **Sorai, K.**, Moribe, N., Torii, K., Sakai, T., Muraoka, K., Tanaka, K., **Ezawa, H.**, Kohno, K., Kim, S., Rubio, M., Fukui, Y.: 2011, Dense Clumps in Giant Molecular Clouds in the Large Magellanic Cloud: Density and Temperature Derived from ^{13}CO(J = 3–2) Observations, *AJ*, **141**, 73.

Minniti, D., et al. including **Tamura, M.**: 2010, VISTA Variables in the Via Lactea (VVV): The public ESO near-IR variability survey of the Milky Way, *New Astron.*, **15**, 433-443.

Misawa, T., Kawabata, K. S., Eracleous, M., Charlton, J. C., **Kashikawa, N.**: 2010, A Spectropolarimetric Test of the Structure of the Intrinsic Absorbers in the Quasar HS 1603+3820, *ApJ*, **719**, 1890-1895.

Miura, R., **Okumura, S. K.**, Tosaki, T., **Tamura, Y.**, **Kurono, Y.**, **Kuno, N.**, **Nakanishi, K.**, Sakamoto, S., **Hasegawa, T.**, **Kawabe, R.**: 2010, Aperture Synthesis Observations of CO, HCN, and 89 GHz Continuum Emission toward NGC 604 in M 33: Sequential Star Formation Induced by Supergiant H II Region, *ApJ*, **724**, 1120-1132.

Momose, R., **Okumura, S. K.**, Koda, J., **Sawada, T.**: 2010, Star Formation Efficiency in the Barred Spiral Galaxy NGC 4303, *ApJ*, **721**, 383-394.

Moritani, Y., Nogami, D., Okazaki, A. T., **Imada, A.**, **Kambe, E.**, Honda, S., Hashimoto, O., Ishino, Y., Suzuki, Y., Tanaka, J.: 2010, High-dispersion spectroscopic monitoring of the Be/X-ray binary A0535+26/V725 Tau I: The long-term profile variability, *MNRAS*, **405**, 467-476.

Motogi, K., **Sorai, K.**, Habe, A., **Honma, M.**, **Kobayashi, H.**, **Sato, K.**: 2011, New Distance and Revised Natures of High-Mass Star Formation in G5.89-0.39, *PASJ*, **63**, 31-44.

Muller, E., Ott, J., Hughes, A., Pineda, J. L., Wong, T., **Mizuno, N.**, Kawamura, A., Mizuno, Y., Fukui, Y., Onishi, T., Rubio, M.: 2010, Characterizing the Low-Mass Molecular Component in the Northern Small Magellanic Cloud, *ApJ*, **712**, 1248-1258.

Müller, T. G., et al. including **Kuroda, D.**, **Yanagisawa, K.**, **Nagayama, S.**: 2011, Thermo-physical properties of 162173 (1999 JU3), a potential flyby and rendezvous target for interplanetary missions, *A&A*, **525**, A145.

Murakami, N., et al. including **Matsuo, H.**: 2010, Calibration of the AKARI Far-Infrared Imaging Fourier-Transform Spectrometer, *PASJ*, **62**, 1155-1166.

Murakami, N., **Nishikawa, J.**, **Yokochi, K.**, **Tamura, M.**, Baba, N., Abe, L.: 2010, Achromatic eight-octant phase-mask coronagraph using photonic crystal, *ApJ*, **714**, 772-777.

Murakami, N., **Yokochi, K.**, **Nishikawa, J.**, **Tamura, M.**, Kurokawa, T., Takeda, M., Baba, N.: 2010, Polarization interferometric nulling coronagraph for high-contrast imaging, *Appl. Opt.*, **49**, D106-D114.

Nagai, H., Suzuki, K., Asada, K., **Kino, M.**, Kameno, S., Doi, A., Inoue, M., Kataoka, J., Bach, U., **Hirota, T.**, **Matsumoto, N.**, **Honma, M.**, **Kobayashi, H.**, Fujisawa, K.: 2010, VLBI Monitoring of 3C 84 (NGC 1275) in Early Phase of the 2005 Outburst, *PASJ*, **62**, L11-L15.

Nagashima, K., Zhao, J.-W., Kosovichev, A. G., **Sekii, T.**: 2011, Detection of Supergranulation Alignment in Polar Regions of the Sun by Helioseismology, *ApJ*, **726**, L17.

Nagayama, T., Omodaka, T., Nakagawa, A., Handa, T., **Honma, M.**, **Kobayashi, H.**, **Kawaguchi, N.**, **Miyaji, T.**: 2011, Astrometry of Galactic Star-Forming Region Onsala 1 with VERA: Estimation of Angular Velocity of Galactic Rotation at the Sun, *PASJ*, **63**, 23-30.

Nakajima, T., **Morino, J.-I.**, Fukagawa, M.: 2010, Potential Members of Stellar Kinematical Groups within 20 pc of the Sun, *AJ*, **140**, 713-722.

Nakajima, T., **Takano, S.**, Kohno, K., Inoue, H.: 2011, Detections of C_2H, Cyclic-C_3H_2 and $H^{13}CN$ in NGC 1068, *ApJ*, **728**, L38-L47.

Nakamura, F., et al. including **Kamazaki, T.**, **Kawabe, R.**, **Shimajiri, Y.**, **Tachihara, K.**, **Kurono, Y.**, **Umemoto, T.**: 2011, The Molecular Outflows in the ρ Ophiuchi Main Cloud: Implications for Turbulence Generation, *ApJ*, **726**, 46-60.

Nakamura, K., Yoshida, T., Shigeyama, T., **Kajino, T.**: 2010, Boron Synthesis in Type Ic Supernovae, *ApJ*, **718**, L137-L140.

Nakamura, T., Dermawan, B., **Yoshida, F.**: 2011, Sphericity preference in shapes of sub-km-sized fast-rotating main-belt asteroids, *PASJ*, **63**, S577.

Nakashima, J., **Deguchi, S.**, **Imai, H.**, Kemball, A., Lewis, B. M.: 2011, Maser Properties of the Enigmatic IRAS Sources 19312+1950, *ApJ*, **728**, 76.

Nakayama, H., Takada, N., Ichihashi, Y., Awazu, S., Shimobaba, T., Masuda, N., Ito, T.: 2010, Real-time color electroholography using multiple graphics processing units and multiple high-definition liquid-crystal display panels, *Appl. Opt.*, **49**, 5993-5996.

Namiki, N., Iwata, T., Kawano, N., Fuke, F., Tateno, N., **Asari, K.**, **Noda, H.**, **Kono, Y.**, **Hanada, H.**, Yahagi, Y., Yamamoto, Z., Tanaka, K., Yamada, M., **Matsumoto, K.**, **Goossens, S.**: 2010, Ground compatibility tests for gravity measurement of SELENE: Accuracies of two- and four-way Doppler and range measurements, *Space Sci. Rev.*, **154**, 103-121.

Narita, N., Hirano, T., Sanchis-Ojeda, R., Winn, J. N., Holman, M. J., Sato, B., **Aoki, W.**, **Tamura, M.**: 2010, The Rossiter-McLaughlin Effect of the Transiting Exoplanet XO-4b, *PASJ*, **62**, L61-L65.

Narita, N., et al. including **Kudo, T.**, **Kandori, R.**, **Egner, S. E.**, **Golota, T.**, **Guyon, O.**, **Hashimoto, J.**, **Hayano, Y.**, **Hayashi, M.**, **Hayashi, S. S.**, **Ishii, M.**, **Kusakabe, N.**, **Kuzuhara, M.**, **Matsuo, T.**, **Miyama, S. M.**, **Morino, J.-I.**, **Nishimura, T.**, **Pyo, T.-S.**, **Suenaga, T.**, **Suto, H.**, **Takahashi, Y. H.**, **Takato, N.**, **Terada, H.**, **Tomono, D.**, **Takami, H.**, **Usuda, T.**, **Tamura, M.**: 2010, Search for Outer Massive Bodies around Transiting Planetary Systems: Candidates of Faint Stellar Companions around HAT-P-7, *PASJ*, **62**, 779-786.

Narita, N., Sato, B., Hirano, T., Winn, J. N., **Aoki, W.**, **Tamura, M.**: 2010, Spin-Orbit Alignment of the TrES-4 Transiting Planetary System and Possible Additional Radial-Velocity Variation, *PASJ*, **62**, 653-660.

Narukage, N., Sakao, T., **Kano, R.**, **Hara, H.**, **Shimojo, M.**, **Bando, T.**, Urayama, F., Deluca, E., Golub, L., Weber, M., Grigis, P., Cirtain, J., **Tsuneta, S.**: 2011, Coronal-Temperature-Diagnostic Capability of the Hinode/X-Ray Telescope Based on Self-Consistent Calibration, *Solar Phys.*, **269**, 169-236.

Niino, Y., Choi, J.-H, **Kobayashi, M. A. R.**, Nagamine, K., Totani, T., Zhang, B.: 2011, Luminosity Distribution of Gamma-ray Burst Host Galaxies at Redshift $z = 1$ in Cosmological Smoothed Particle Hydrodynamic Simulations: Implications for the Metallicity Dependence of GRBs, *ApJ*, **726**, 88-99.

Niinuma, K., Nagayama, T., **Hirota, T.**, **Honma, M.**, Motogi, K., Nakagawa, A., Kurayama, T., **Kan-Ya, Y.**, **Kawaguchi, N.**, **Kobayashi, H.**, **Ueno, Y.**: 2011, Astrometry of H_2O Masers in the Massive Star-Forming Region IRAS 06061+2151 with VERA, *PASJ*, **63**, 9-16.

Nishiyama, S., Hatano, H., **Tamura, M.**, Matsunaga, N., Yoshikawa, T., Suenaga, T., Hough, J. H., Sugitani, K., Nagayama, T., Kato, D., Nagata, T.: 2010, Magnetic Field Configuration at the Galactic Center Investigated by Wide-field Near-infrared Polarimetry: Transition from a Toroidal to a Poloidal Magnetic Field, *ApJ*, **722**, L23-L27.

Nishizawa, A., Taruya, A., **Kawamura, S.**: 2010, Cosmological test of gravity with polarizations of stochastic gravitational waves around 0.1–1 Hz, *Phys. Rev. D*, **81**, 104043.

Nishizawa, A. J., Takada, M., Hamana, T., **Furusawa, H.**: 2010, A Clipping Method to Mitigate the Impact of Catastrophic Photometric Redshift Errors on Weak Lensing Tomography, *ApJ*, **718**, 1252-1265.

Nyu, D., Nakagawa, A., Matsui, M., **Imai, H.**, Sofue, Y., Omodaka, T., Kurayama, T., Kamohara, R., **Hirota, T.**, **Honma, M.**, **Shibata, K. M.**, **Kobayashi, H.**, Iwadate, K., **Miyaji, T.**: 2011, Astrometry of AGB Variables with VERA: Annual Parallax and the Orbit of SY Sculptoris in the Galaxy, *PASJ*, **63**, 63-70.

Oguri, M.: 2010, The Mass Distribution of SDSS J1004+4112 Revisited, *PASJ*, **62**, 1017-1024.

Oguri, M., Marshall, P. J.: 2010, Gravitationally Lensed Quasars and Supernovae in Future Wide-Field Optical Imaging Surveys, *MNRAS*, **405**, 2579-2593.

Oguri, M., Takada, M.: 2011, Combining cluster observables and stacked weak lensing to probe dark energy: Self-calibration of systematic uncertainties, *Phys. Rev. D*, **83**, 023008.

Oguri, M., Takada, M., Okabe, N., Smith, G. P.: 2010, Direct measurement of dark matter halo ellipticity from two-dimensional lensing shear maps of 25 massive clusters, *MNRAS*, **405**, 2215-2230.

Oi, N., **Imase, K.**, **Imanishi, M.**: 2010, Comparison of AGN and nuclear starburst activity in Seyfert 1 and 2 galaxies over a wide luminosity range based on near-infrared 2–4 micron spectroscopy, *PASJ*, **62**, 1509-1524.

Okamoto, T. J., **Tsuneta, S.**, Berger, T. E.: 2010, A Rising Cool Column as a Signature of Helical Flux Emergence and Formation of Prominence and Coronal Cavity, *ApJ*, **719**, 583-590.

Onodera, M., **Arimoto, N.**, Daddi, E., Renzini, A., Kong, X., Cimatti, A. Broadhurst, T., Alexander, D. M.: 2010, A Wide Area Survey for High-Redshift Massive Galaxies. II. Near-Infrared Spectroscopy of BzK-Selected Massive Star-Forming Galaxies, *ApJ*, **715**, 385-405.

Onodera, M., et al. including **Arimoto, N.**, **Tamura, N.**: 2010, A $z = 1.82$ Analog of Local Ultla-massive Ellipticall Galaxies, *ApJ*, **715**, L6-L11.

Onodera, S., **Kuno, N.**, Tosaki, T., Kohno, K., **Nakanishi, K.**, **Sawada, T.**, Muraoka, K., **Komugi, S.**, **Miura, R.**, **Kaneko, H.**, **Hirota, A.**, **Kawabe, R.**: 2010, Breakdown of Kennicutt-Schmidt Lawa at GMC Scales in M33, *ApJ*, **722**, L127-L131.

Ootsubo, T., Usui, F., Kawakita, H., Ishiguro, M., **Furusho, R.**, Hasegawa, S., Ueno, M., **Watanabe, J.**, Sekiguchi, T., Wada, T., Ohyama, Y., Oyabu, S., Matsuhara, H., Onaka, T., Nakagawa, T., Murakami, H.: 2010, Detection of Parent H_2O and CO_2 Molecules in the 2.5–5 μm Spectrum of Comet C/2007 N3 (Lulin) Observed with AKARI, *ApJ*, **717**, L66-L70.

Ota, K., **Iye, M.**, **Kashikawa, N.**, Shimasaku, K., Ouchi, M., Totani, T., **Kobayashi, M. A. R.**, Nagashima, M., Harayama, A., **Kodaka, N.**, **Morokuma, T.**, **Furusawa, H.**, **Tajitsu, A.**, **Hattori, T.**: 2010, Lyα Emitters at $z=7$ in the Subaru/XMM-Newton Deep Survey Field: Photometric Candidates and Luminosity Functions, *ApJ*, **722**, 803-811.

Ota, K. Ly, C., Malkan, M. A., Motohara, K., Hayashi, M., Shimasaku, K., Morokuma, T., **Iye, M.**, **Kashikawa, N.**, **Hattori, T.**: 2010, Spitzer Space Telescope Constraint on the Stellar Mass of a $z=6.96$ Lyα Emitter, *PASJ*, **62**, 1167-1175.

Otsuka, M., Meixner, M., Riebel, D., Hyung, S., **Tajitsu, A.**, **Izumiura, H.**: 2011, Dust and Chemical Abundances of the Sagittarius Dwarf Galaxy Planetary Nebula Hen2-436, *ApJ*, **729**, 39.

Otsuka, M., **Tajitsu, A.**, Hyung, S., Izumiura, H.: 2010, The Origin and Evolution of the Halo PN BoBn 1: From a Viewpoint of Chemical Abundances Based on Multiwavelength Spectra, *ApJ*, **723**, 658-683.

Ouchi, M., Shimasaku, K., **Furusawa, H.**, Saito, T., Yoshida, M., Akiyama, M., Ono, Y., Yamada, T., Ota, K. **Kashikawa, N.**, **Iye, M.**, **Kodama, T.**, Okamura, S., Simpson, C., Yoshida, M.: 2010, Statistics of 207 Lyα Emitters at a Redshift Near 7: Constraints on Reionization and Galaxy Formation Models, *ApJ*, **723**, 869-894.

Park, S. Q., Barmby, P., Wilner, S. P., Ashby, M. L. N., Fazio, G. G., Georgakakis, A., Ivison, R. J., Konidaris, N. P., **Miyazaki, S.**, Nandra, K., Rosario, D. J.: 2010, AEGIS: A Multiwavelength Study of Spitzer Power-law Galaxies, *ApJ*, **717**, 1181-1201.

Portegies Zwart, S., **Ishiyama, T.**, Groen, D., Nitadori, K., **Makino, J.**, de Laat, C., McMillan, S., Hiraki, K., Harfst, S., Grosso, P.: 2010, Simulating the Universe on an Intercontinental Grid of Supercomputers, *IEEE Computer*, **43**, 63-70.

Reed, M. D., et al. including **Sekiguchi, K.**: 2011, Whole Earth Telescope observations of the subdwarf B star KPD 1930+2752: a rich, short-period pulsator in a close binary, *MNRAS*, **412**, 371-390.

Rex, M., et al. including **Ezawa, H.**, **Kawabe, R.**: 2010, The Far-Infrared/Submillimeter Properties of Galaxies Located Behind the Bullet Cluster, *A&A*, **518**, L13.

Reznikova, V. E., Melnikov, V. F., Ji, H., **Shibasaki, K.**: 2010, Dynamics of the flaring loop system 2005 August 22 observed in microwaves and Hard X-Rays, *ApJ*, **724**, 171-181.

Reznikova, V. E., **Shibasaki, K.**: 2011, Flare quasi-periodic pulsations with growing periodicity, *A&A*, **525**, 112.

Röllig, M., et al. including **Mizuno, N.**: 2011, Photon dominated regions in NGC 3603. [CI] and mid-J CO line emission, *A&A*, **525**, A8.

Ryu, C. Y., **Kajino, T.**, **Maruyama, T.**, Cheoun, M. K.: 2011, Properties of the proto-neutron star with smeared trapped neutrinos, *Phys. Rev. C*, **83**, 018802.

Sadakane, K., **Kambe, E.**, Sato, B., Honda, S., Hashimoto, O.: 2010, An Abundance Analysis of the Primary Star of the Peculiar Eclipsing Binary ε Aurigae out of the Eclipsing Phase, *PASJ*, **62**, 1381-1390.

Saigo, K., **Tomisaka, K.**: 2010, Spectrum Energy Distribution and Submillimeter Image of a Rotating First Core, *ApJ*, **728**, 78-87.

Saitoh, T. R., **Makino, J.**: 2010, FAST: A Fully Asynchronous Split Time-Integrator for a Self-Gravitating Fluid, *PASJ*, **62**, 301-314.

Sakai, N., Sakai, T., **Hirota, T.**, Yamamoto, S.: 2010, Distributions of Carbon-chain Molecules in L1527, *ApJ*, **722**, 1633-1643.

Sakai, N., Shiino, T., **Hirota, T.**, Sakai, T., Yamamoto, S.: 2010, Long Carbon-chain Molecules and Their Anions in the Starless Core, Lupus-1A, *ApJ*, **718**, L49-L52.

Sakai, T., Sakai, N., **Hirota, T.**, Yamamoto, S.: 2010, A Survey of Molecular Lines Toward Massive Clumps in Early Evolutionary Stages of High-mass Star Formation, *ApJ*, **714**, 1658-1671.

Samal, M. R., Pandey, A. K., Ojha, D. K., Ghosh, S. K., Kulkarni, V. K., **Kusakabe, N.**, **Tamura, M.**, Bhatt, B. C., Thompson, M. A., Sagar, R.: 2010, A Multiwavelength Study of Star Formation in the Vicinity of Galactic H II Region Sh 2-100, *ApJ*, **714**, 1015-1036.

Sanna, A., Moscadelli, L., Cesaroni, R., Tarchi, A., **Furuya, R. S.**: 2010, VLBI study of maser kinematics in high-mass star-forming regions. I. G16.59-0.05, *A&A*, **517**, A71.

Sanna, A., Moscadelli, L., Cesaroni, R., Tarchi, A., **Furuya, R. S.**: 2010, VLBI study of maser kinematics in high-mass star-forming regions. II. G23.01-0.41, *A&A*, **517**, A78.

Sano, H., et al. including **Mizuno, N.**: 2010, Star-forming Dense Cloud Cores in the TeV Gamma-ray SNR RX J1713.7-3946, *ApJ*, **724**, 59-68.

Sarugaku, Y., Ishiguro, M., Ueno, M., Usui, F., **Watanabe, J.**: 2010, Outburst of Comet 217P/LINEAR, *ApJ*, **724**, L118-L121.

Sasada, M., Uemura, M., Arai, A., Fukazawa, Y., Kawabata, K. S., Ohsugi, T., **Yamashita, T.**, Isogai, M., Nagae, O., Uehara, T., Mizuno, T., Katagiri, H., Takahashi, H., Sato, S., **Kino, M.**: 2010, Multiband Photopolarimetric Monitoring of an Outburst of the Blazar 3C 454.3 in 2007, *PASJ*, **62**, 645-652.

Sato, B., Omiya, M., Liu, Y., Harakawa, H., **Izumiura, H.**, **Kambe, E.**, Toyota, E., Murata, D., Lee, B.-C., Masuda, S., **Takeda, Y.**, Yoshida, M., Itoh, Y., Ando, H., **Kokubo, E.**, Ida, S., Zhao, G., Han, I.: 2010, Substellar Companions to Evolved Intermediate-Mass Stars: HD 145457 and HD 180314, *PASJ*, **62**, 1063-1069.

Sato, M., Reid, M. J., Brunthaler, A., Menten, K. M.: 2010, Trigonometric Parallax of W51 Main/South, *ApJ*, **720**, 1055-1065.

Sato, M., **Watanabe, J.**: 2010, Forecast for Phoenicids in 2008, 2014, and 2019, *PASJ*, **62**, 509-513.

Sato, M., **Hirota, T.**, Reid, M. J., **Honma, M.**, **Kobayashi, H.**, Iwadate, K., **Miyaji, T.**, **Shibata, K. M.**: 2010, Distance to G14.33-0.64 in the Sagittarius Spiral Arm: H_2O Maser Trigonometric Parallax with VERA, *PASJ*, **62**, 287-299.

Scott, K. S., Yun, M. S., Wilson, G. W., Austermann, J. E., Aretxaga, I., **Ezawa, H.**, Ferrusca, D., **Hatsukade, B.**, Hughes, D. H., **Iono, D.**, Giavalisco, M., **Kawabe, R.**, Kohno, K., Mauskopf, P. D., **Oshima, T.**, Perera, T. A., Rand, J., **Tamura, Y.**, Tosaki, T., Velazquez, M., Williams, C. C.: 2010, Deep 1.1 mm-Wavelength Imaging of the GOODS-S Field by AzTEC/ASTE - I. Source Catalogue and Number Counts, *MNRAS*, **405**, 2260-2278.

Sekiguchi, Y.: 2010, An Implementation of the microphysics in full general relativity: a general relativistic leakage scheme, *Class. Quantum Grav.*, **27**, 114107.

Sekiguchi, Y.: 2010, Stellar core collapse in full general relativity with micophysics –Formulation and Spherical collapse test–, *Prog. Theor. Phys.*, **124**, 331-379.

Shi, S. C., **Sekimoto, Y.**: 2010, Development of Submillimeter-Wave SIS Mixers and ALMA Receivers, *Japan Society of Infrared Science and Technology*, **19**, 33-36.

Shim, H., Im, M., Lee, H. M., Lee, M. G., Kim, S. J., Hwang, H. S., **Hwang, N.**, Ko, J., Lee, J. C., Lim, S., Matsuhara, H., Seo, H., Wada, T., **Goto, T.**: 2011, Merging Galaxy Cluster A2255 in Mid-infrared, *ApJ*, **727**, 14-35.

Shimajiri, Y., **Kawabe, R.**, Takakuwa, S., **Saito, M.**, Tsukagoshi, T., Momose, M., Ikeda, N., Akiyama, E., Austermann, J. E., **Ezawa, H.**, **Fukue, K.**, **Hiramatsu, M.**, Hughes, D., Kitamura, Y., Kohno, K., **Kurono, Y.**, Scott, K. S., Wilson, G., Yoshida, A., Yun, M. S.: 2011, New Panoramic View of ^{12}CO and 1.1 mm Continuum Emission in the Orion A Molecular Cloud. I. Survey Overview and Possible External Triggers of Star Formation, *PASJ*, **63**, 105-123.

Shimobaba, T., **Nakayama, H.**, Masuda, N., Ito, T.: 2010, Rapid calculation of Fresnel computer-generated-hologram using look-up table and wavefront-recording plane methods for three-dimensional display, *Opt. Express*, **18**, 19504-19509.

Shimono, A., Sugai, H., Kawai, A., Matsubayashi, K., Ohtani, H., Ozaki, S., Hattori, T., **Kosugi, G.**: 2010, A Study of Three-Dimensional Kinematics of the Narrow-Line Region of the Seyfert Galaxy NGC 4151 Based on Integral Field Spectroscopy, *PASJ*, **62**, 225-238.

Shirasaki, Y., Tanaka, M., **Ohishi M.**, **Mizumoto Y.**, **Yasuda N.**, **Takata T.**: 2011, Early Science Result from the Japanese Virtual Observatory: AGN and Galaxy Clustering at $z = 0.3$ to 3.0, *PASJ*, **63**, S469-S491.

Sofue, Y., Machida, M., **Kudoh, T.**: 2010, The Primordial Origin Model of Magnetic Fields in Spiral Galaxies, *PASJ*, **62**, 1191-1201.

Sotani, H.: 2010, Toroidal oscillations of slowly rotating relativistic star in tensor-vector-scalar theory, *Phys. Rev. D*, **82**, 124061.

Sotani, H., **Yasutake, N.**, Maruyama, T., Tatsumi, T.: 2011, Signatures of hadron-quark mixed phase in gravitational waves, *Phys. Rev. D*, **83**, 024014.

Suematsu, Y.: 2010, Review of Hinode results, *Astron. Nachr.*, **331**, 605-608.

Sugitani, K., **Nakamura, F.**, **Tamura, M.**, Watanabe, M., **Kandori, R.**, Nishiyama, S., **Kusakabe, N.**, **Hashimoto, J.**, Nagata, T., Sato, S.: 2010, Near-infrared Imaging Polarimetry of the Serpens Cloud Core: Magnetic Field Structure, Outflows, and Inflows in a Cluster Forming Clump, *ApJ*, **716**, 299-314.

Sugiyama, K., **Fujisawa, K.**, Doi, A., **Honma, M.**, Isono, Y., **Kobayashi, H.**, Mochizuki, N., Murata, Y., **Sawada-Satoh, S.**, Wajima, K.: 2011, Internal Proper Motions of Methanol Masers at 6.7 GHz in Massive Star-Forming Region Onsala 1, *PASJ*, **63**, 53-61.

Suwa, Y., **Kotake, K.**, **Takiwaki, T.**, Whitehouse, S., Liebendörfer, M., Sato, K.: 2010, Explosion Geometry of a Rotating 13Ms Star Driven by the SASI-Aided Neutrino-Heating Supernova Mechanism, *PASJ*, **62**, L49-L53.

Suwa, T., Hirashita, H., **Tamura, Y.**: 2010, A Simple Approach to the High-Redshift Sub-Millimeter Galaxies, *Astrophys. Space. Sci.*, **330**, 219-226.

Tadaki, K., **Kodama, T.**, Koyama, Y., **Hayashi, M.**, **Tanaka, I.**, Tokoku, C.: 2011, Cosmic Star Formation Activity at $z = 2.2$ Probed by Hα Emission Line Galaxie, *PASJ*, **63**, S437-S446.

Tafoya, D., Imai, H., Gomez, Y., Torrelles, J. M., Patel, N. A., Anglada, G., Miranda, L. F., **Honma, M.**, **Hirota, T.**, **Miyaji, T.**: 2011, Measurement of the Distance and Proper Motions of the H$_2$O Masers in the Young Planetary Nebula K 3-35, *PASJ*, **63**, 71-80.

Takahashi, H. R., **Kotake, K.**, **Yasutake, N.**: 2011, Magnetic Field Decay due To the Wave-Particle Resonances in the Outer Crust of the Neutron Stars, *ApJ*, **728**, 151-157.

Takahashi, H. R., **Masada, Y.**: 2011, Stability MRI-Turbulent Accretion Disks, *ApJ*, **727**, 106-114.

Takahashi, S., **Deguchi, S.**, **Kuno, N.**, Shimoikura, T., **Yoshida, F.**: 2010, A Search for Water Masers in the Saturnian System, *PASJ*, **62**, L17-L21.

Takakuwa, S., Ohashi, N., **Aikawa, Y.**: 2011, Carbon-chain and Organic Molecules Around Very Low Luminosity Protostellar Objects of L1521F-IRS and IRAM 04191+1522, *ApJ*, **728**, 101-110.

Takami, M., **Tamura, M.**, Enya, K., Ootsubo, T., Fukagawa, M., Honda, M., Okamoto, Y., Sako, S., **Yamashita, T.**, Hasegawa, S., Kataza, H., Matsuhara, H., Nakagawa, T., Goicoechea, J., R., Isaak, K., Swinyard, B.: 2010, Studies of expolanets and solar systems with SPICA, *Adv. Space Res.*, **45**, 1000-1006.

Takeda, Y., Honda, S., **Kawanomoto, S.**, Ando, H., **Sakurai, T.**: 2010, Behavior of Li abundances in solar-analog stars. II. Evidence of the connection with rotation and stellar activity, *A&A*, **515**, A93.

Takeda, Y., **Kambe, E.**, Sadakane, K., Masada, S.: 2010, Oxygen and Neon Abundances of B-Type Stars in Comparison with the Sun, *PASJ*, **62**, 1239-1248.

Takeda, Y., Takada-Hidai, M.: 2011, Exploring the [S/Fe] Behavior of Metal-Poor Stars with the S I 1.046 micron Lines, *PASJ*, **63**, S537.

Takeda, Y., Takada-Hidai, M.: 2011, Chromospheres in Metal-Poor Stars Evidenced from the He I 10830Å Line, *PASJ*, **63**, S547.

Takeuchi, S., **Ohsuga, K.**, Mineshige, S.: 2010, A Novel Jet Model: Magnetically Collimated, Radiation-Pressure Driven Jet, *PASJ*, **62**, L43-L47.

Takeuchi, T., Yamamoto, H., Torii, K., Kudo, N., Hayakawa, T., Kawamura, A., **Mizuno, N.**, **Onishi, T.**, Mizuno, A., **Ogawa, H.**, Fukui, Y.: 2010, NANTEN Survey of Molecular Clouds toward the Galactic Center; Association of Compact Astronomical Objects, *PASJ*, **62**, 557-612.

Tamura, Y., et al. including **Iono, D.**, **Ezawa, H.**, **Hatsukade, B.**, **Kawabe, R.**, **Nakanishi, K.**: 2010, Submillimeter Array Identification of the Millimeter-Selected Galaxy SSA22-AzTEC1: A Protoquasar in a Protocluster?, *ApJ*, **724**, 1270-1282.

Tanaka, I., De Breuck, C., Kurk, J. D., Taniguchi, Y., **Kodama, T.**, Matsuda, Y., Packham, C., Zirm, A., Kajisawa, M., Ichikawa, T., Seymour, N., Stern, D., Stockton, A., Venemans, B. P., Vernet, J.: 2011, Discovery of an Excess of Halpha Emitters around 4C 23.56 at $z = 2.48$, *PASJ*, **63**, S415-S435.

Tanaka, M., Kawabata, K. S., Yamanaka, M., Maeda, K., **Hattori, T.**, **Aoki, K.**, Nomoto, K., **Iye, M.**, **Sasaki, T.**, Mazzali, P. A., Pian, E.: 2010, Spectropolarimetry of Extremely Luminous Type Ia Supernova 2009dc: Nearly Spherical Explosion of Super-Chandrasekhar Mass White Dwarf, *ApJ*, **714**, 1209-1216.

Tanaka, N., Furuzawa, A., Miyoshi, S. J., Tamura, T., **Takata, T.**: 2010, Suzaku Observations of the Merging Cluster Abell 85: Temperature map and Impact Direction, *PASJ*, **62**, 743-754.

Tanikawa, K., Yamamoto, T., **Sôma, M.**: 2010, Solar Eclipses in the First Half of the Chunqiu Period, *PASJ*, **62**, 797-809.

Tatematsu, K., **Hirota, T.**, **Kandori, R.**, **Umemoto, T.**: 2010, Chemical Variation in Molecular Cloud Cores in the Orion A Cloud, *PASJ*, **62**, 1473-1482.

Thalmann, C., et al. including **Egner, S.**, **Fukue, T.**, **Guyon, O.**, **Hashimoto, J.**, **Hayano, Y.**, **Hayashi, M.**, **Hayashi, S.**, **Ishii, M.**, **Kandori, R.**, **Kudo, T.**, **Kusakabe, N.**, **Kuzuhara, M.**, **Matsuo, T.**, **Miyama, S.**, **Morino, J.-I.**, **Nishimura, T.**, **Pyo, T.-S.**, **Suto, H.**, **Takato, N.**, **Terada, H.**, **Tomono, D.**, **Takami, H.**, **Usuda, T.**, **Tamura, M.**: 2010, Imaging of a Transitional Disk Gap in Reflected Light: Indications of Planet Formation Around the Young Solar Analog LkCa 15, *ApJ*, **718**, L87-L91.

Tomida, K., **Machida, M. N.**, **Saigo, K.**, **Tomisaka, K.**, Matsumoto, T.: 2010, Exposed Long-lifetime First Core: A New Model of First Cores Based on Radiation Hydrodynamics, *ApJ*, **725**, L239-L244.

Tomida, K., **Tomisaka, K.**, Matsumoto, T., **Ohsuga, K.**, **Machida, M. N.**, **Saigo, K.**: 2010, Radiation Magnetohydrodynamics Simulation of Proto-stellar Collapse: Two-component Molecular Outflow, *ApJ*, **714**, L58-L63.

Tomisaka, K.: 2011, Origin of Molecular Outflow Determined from Thermal Dust Polarization, *PASJ*, **63**, 147-158.

Torii, K., et al. including **Mizuno, N.**, **Onishi, T.**, **Ezawa, H.**, **Ogawa, H.**: 2010, Temperature and Density in the Foot Points of the Molecular Loops in the Galactic Center; Analysis of Multi-J Transitions of ^{12}CO ($J = 1$–0, 3–2, 4–3, 7–6), ^{13}CO ($J =$ 1–0), and C^{18}O ($J = 1$–0), *PASJ*, **62**, 675-695.

Torii, K., Kudo, N., Fujishita, M., Kawase,T., Yamamoto, H., Kawamura, A., **Mizuno, N.**, Onishi, T., Mizuno, A., Machida, M., Takahashi, K., Nozawa, S., Matsumoto, R., Fukui, Y.: 2010, A Detailed Observational Study of Molecular Loops 1 and 2 in the Galactic Center, *PASJ*, **62**, 1307-1332.

Tsuboi, M., **Miyazaki, A.**, **Nakanishi, K.**, Kotani, T.: 2010, Millimeter Light Curve with Abrupt Jump in Cyg X-3 2008 April-May Outburst, *PASJ*, **62**, 1391-1398.

Tsujimoto, T.: 2011, Turn-off of deuterium astration in the recent star formation of the Galaxy disc, *MMRAS*, **410**, 2540-2548.

Tsukagoshi, T., **Saito, M.**, Kitamura, Y., **Momose, M.**, **Shimajiri, Y.**, **Hiramatsu, M.**, Ikeda, N., Kamegai, K., Wilson, G., Yun, M. S., Scott, K., Austermann, J., Perera, T., Hughes, D., Aretxaga, I., Mauskopf, P., **Ezawa, H.**, Kohno, K., **Kawabe, R.**: 2011, Detection of Strong Millimeter Emission from the Circumstellar Dust Disk Around V1094 Sco: Cold and Massive Disk around a T Tauri Star in a Quiescent Accretion Phase?, *ApJ*, **726**, 45.

Tsukamoto, Y.: 2011, The self gravity effect on the orbital stability of Twotinos, *Icarus*, **212**, 911-921.

Uehara, T., Uemura, M., Kawabata, K. S., Fukazawa, Y., Yamazaki, R., Arai, A., Sasada, M., Ohsugi, T., Mizuno, T., Takahashi, H., Katagiri, H., **Yamashita, T.**, Ohno, M., Sato, G., Sato, S., **Kino, M.**: 2010, Infrared/optical - X-ray simultaneous observations of X-ray flares in GRB 071112C and GRB 080506, *A&A*, **519**, A56-A74.

Ueta, T., Stencel, R. E., Yamamura, I., Geise, K. M., Karska, A., **Izumiura, H.**, Nakada, Y., Matsuura, M., Ita, Y., Tanabé, T., Fukushi, H., Matsunaga, N., Mito, H., Speck, A. K.: 2010, The interface between the stellar wind and interstellar medium around R Cassiopeiae revealed by far-infrared imaging, *A&A*, **514**, A16.

Utsumi, Y., **Goto, T.**, **Kashikawa, N.**, **Miyazaki, S.**, **Komiyama, Y.**, **Furusawa, H.**, Overzier, R.: 2010, A Large Number of $z > 6$ Galaxies Around a QSO at $z = 6.43$: Evidence for a Protocluster?, *ApJ*, **721**, 1680-1688.

Van Putten, M. H. P. M., Kanda, N., Tagoshi, H., **Tatsumi, D.**, **Fujimoto, M.-K.**, Della Valle, M.: 2011, Prospects for true calorimetry on Kerr black holes in core-collapse supernovae and mergers, *Phys. Rev. D*, **83**, 44046.

Wang, Y., Beuther, H., Bik, A., Vasyunina, T., Jiang, Z., Puga, E., Linz, H., Rodón, J. A., Henning, Th., **Tamura, M.**: 2011, Different evolutionary stages in the massive star-forming region S255 complex, *A&A*, **527**, A32.

Watanabe, T., **Hara, H.**, Sterling, A. C., Harra, L. K.: 2010, Production of High-temperature Plasmas During the Early Phases of a C9.7 Flare, *ApJ*, **719**, 213-219.

Watanabe, Y., **Sorai, K.**, **Kuno, N.**, Habe, A.: 2011, Refined Molecular Gas Mass and Star-Formation Efficiency in NGC 3627, *MNRAS*, **411**, 1409-1417.

White, G. J., et al. including **Hwang, N.**, **Goto, T.**: 2010, A deep survey of the AKARI north ecliptic pole field . I. WSRT 20 cm radio survey description, observations and data reduction, *A&A*, **517**, A54-76.

Winn, J. N., Johnson, J. A., Howard, A. W., Marcy, G. W., Bakos, G. Á., Hartman, J., Torres, G., Albrecht, S., **Narita, N.**: 2010, The HAT-P-13 Exoplanetary System: Evidence for Spin-Orbit Alignment and a Third Companion, *ApJ*, **718**, 575-582.

Yagi, M., Yoshida, M., **Komiyama, Y.**, **Kashikawa, N.**, **Furusawa, H.**, Okamura, S., Graham, A. W., Miller, N. A., Carter, D., Mobasher, B., Jogee, S.: 2010, A Dozen New Galaxies Caught in the Act: Gas Stripping and Extended Emission Line Regions in the Coma Cluster, *AJ*, **140**, 1814-1829.

Yaji, Y., Tashiro, M. S., Isobe, N., **Kino, M.**, Asada, K., Nagai, H., **Koyama, S.**, Kusunose, M.: 2010, Evidence of Non-thermal X-ray Emission from Radio Lobes of Cygnus A, *ApJ*, **714**, 37-44.

Yamada, M., Fujita, Y., **Matsuo, H.**, Sugiyama, N.: 2010, Search for the Sunyaev-Zel'dovich Effect in a Giant Radio Galaxy B1358+305, *AJ*, **139**, 2494-2503.

Yamagishi, M., Kaneda, H., Ishihara, D., **Komugi, S.**, **Suzuki, T.**, Onaka, T.: 2010, AKARI Infrared Observations of the Edge-On Spiral Galaxy NGC3079, *PASJ*, **62**, 1085.

Yamamoto, T., **Sakurai, T.**: 2010, Thermal and Magnetic Parameters in Solar Flares Derived from GOES X-Ray Light Curves, *PASJ*, **62**, 755-767.

Yamazaki, D., Ichiki, K., **Kajino, T.**, Mathews, G. J.: 2010, Constraint on the Neutrino Mass and Primordial Magnetic Field from sigma_8, *Phys. Rev. D*, **81**, 103519.

Yasui, C., Kobayashi, N., Tokunaga, A. T., **Saito, M.**, Tokoku, C.: 2010, Short Lifetime of Protoplanetary Disks in Low-metallicity Environments, *ApJ*, **723**, L113-L116.

Yoda, T., Handa, T., Kohno, K., **Nakajima, T.**, Kaiden, M., Yonekura, Y., Ogawa, H., **Morino, J.-I.**, Dobashi, K.: 2010, The AMANOGAWA-2SB Galactic Plane SurveyI. Data on the Galactic Equator, *PASJ*, **62**, 1277-1289.

Yokochi, K., Murakami, N., **Nishikawa, J.**, Abe, L., **Tamura, M.**, Tavrov, A. V., Takeda, M., Kurokawa, T.: 2011, Speckle level suppression using an unbalanced nulling interferometer in a high-contrast imaging system, *Opt. Express*, **19**, 4957-4967.

Yoshida, A., Kitamura, Y., **Shimajiri, Y.**, **Kawabe, R.**: 2010, Dependence of the Turbulent Velocity Field on Gas Density in L1551, *ApJ*, **718**, 1019-1035.

Yoshikawa, T., Akiyama, M., Kajisawa, M., Alexander, D. M., Ohta, K., Suzuki, R., Tokoku, C., Uchimoto, Y. K., Konishi, M., Yamada, T., **Tanaka, I.**, **Omata, K.**, **Nishimura, T.**, Koekemoer, A. M., Brandt, N., Ichikawa, T.: 2010, MOIRCS Deep Survey. VI. Near-infrared Spectroscopy of K-Selected Star-forming Galaxies at $z\sim2$, *ApJ*, **718**, 112.

Younger, J. D., Fazio, G. G., Ashby, M. L. N., Civano, F., Elvis, M., Gurwell, M. A., Huang, J.-S., **Iono, D.**, Peck, A. B., Petitpas, G. R., Scott, K. S., Wilner, D. J., Wilson, G. W., Yun, M. S.: 2010, The Physical Scale of the Far-Infrared Emission in the Most Luminous Submillimeter Galaxies II: Evidence for Merger-Driven Star Formation, *MNRAS*, **407**, 1268-1276.

Yuma, S., Ohta, K., Yabe, K., Shimasaku, K., Yoshida, M., Ouchi, M., **Iwata, I.**, Sawicki, M.: 2010, Stellar Populations of Lyα Emitters at $z=4.86$: A Comparison to $z\sim5$ Lyman Break Galaxies, *ApJ*, **720**, 1016.

2. Publications of the National Astronomical Observatory of Japan

Tajitsu, A., **Aoki, W.**, **Kawanomoto, S.**, **Narita, N.**: 2010, Nonlinearity in the Detector used in the Subaru Telescope High Dispersion Spectrograph, *Publ. of the National Astron. Obs. of Japan*, **13**, 1-8.

Miyauchi-Isobe, N., Maehara, H., Nakajima, K.: 2010, Comprehensive Catalogue of Kiso Ultraviolet-Excess Galaxies, *Publ. of the National Astron. Obs. of Japan*, **13**, 9-56.

3. Report of the National Astronomical Observatory of Japan (in Japanese)

Ishizaki, H., **Agatsuma, K.**, **Tatsumi, D.**, Arai, K., **Izumi, K.**, **Takahashi, R.**: 2000, Dynamic Characteristics of an Inverted Pendulum Incorporated to the Seismic Attenuation System of TAMA300, *Rep. Nat. Astron. Obs. Japan*, **13**, 1-13.

Miyashita, K., **Sôma, M.**: 2000, An analysis of a lunar occultation of Mercury observed by video, *Rep. Nat. Astron. Obs. Japan*, 13, 15-22.

Houjyou, M., **Shinohara, N.**, **Sekiguchi, H.**: 2000, Radio Environment Survey and Interference Mitigation at the Nobeyama Solar Radio Obeservatory, *Rep. Nat. Astron. Obs. Japan*, **13**, 23-44.

Yamaguchi, Y., Tanikawa, K.: 2000, Non–Birkhoff Periodic Orbits of Farey Type and A Zone of Instability in the Standard Map, *Rep. Nat. Astron. Obs. Japan*, 13, 45-84.

Tanikawa, K., **Sôma, M.**: 2000, On Candidate Eclipses of a Supposed Eclipse in Myth 'Amano-Iwato', *Rep. Nat. Astron. Obs. Japan*, **13**, 85-99.

Tanikawa, K., Watanabe, M.: 2000, Example Records Which Fit in the Classification of Volumes of the Nihongi in the Seventh Century I., *Rep. Nat. Astron. Obs. Japan*, 13, 101-117.

4. Conference Proceedings

Akitaya, H., **Yamashita, T.**, **Ohshima, N.**, **Iye, M.**, Maihara, T., Tokoro, H., Takahashi, K.: 2010, Studies on evaluating and removing subsurface damage on the ground surface of CLEARCERAM-Z HS, Proc. SPIE 7739, Eds. E. Atad-Ettedgui, D. Lemke, 2E.

Aoki, K., Misawa, T.: 2010, Dramatic Change in the Spectrum of FeLoBAL SDSS J163255.46+420407.7, Proc. IAU Symp. 267, Eds. B. M. Peterson, R. S. Somerville, T. Storchi-Bergmann, 104.

Aoki, W.: 2010, Extremely Metal-Poor Stars in Dwarf Galaxies around the Milky Way, AIP Conf. Proc. 1269, Eds. I. Tanihata, T. Shima, H. J. Ong, A. Tamii, T. Kishimoto, H. Toki, T. Kajino, S. Kubono, 35-41.

Aoki, W., Beers, T. C., Honda, S., Carollo, S., **Ito, H.**, Lee, Y. S.: 2010, A systematic study of extremely metal-poor stars with SDSS/Subaru, PoS(NIC-XI)006, 006.

Aoki, W., Honda, S.: 2010, Enrichment of heavy elements in the Sextans dwarf Spheroidal Galaxy, PoS(NIC-XI)006, 078.

Bowell, E. L. G., et al. including **Watanabe, J.**: 2010, Division III: Planetary Systems Science, Transactions of the IAU, XXVII A, Ed. K. A. van der Hucht.

Boyd, R., **Kajino, T.**, Onaka, T.: 2010, The Stardust and the Molecules of Life - Why are the Amino Acids Left-Handed?, AIP Conf. Proc. 1269, Eds. I. Tanihata, T. Shima, H. J. Ong, A. Tamii, T. Kishimoto, H. Toki, T. Kajino, S. Kubono, 323-330.

Cheoun, M. K., Ha, E., **Kajino, T.**: 2010, Neutrino-Induced Reactions for Nucleosynthesis by the Quasi-particle RPA, AIP Conf. Proc. 1269, Eds. I. Tanihata, T. Shima, H. J. Ong, A. Tamii, T. Kishimoto, H. Toki, T. Kajino, S. Kubono, 303-308.

Conan, R., Bradley, C., Lardiere, O., Blain, C., Venn, K., Andersen, D., Simard, L., Veran, J.-P., Herriot, G., Loop, D., **Usuda, T.**, **Oya, S.**, **Hayano, Y.**, **Terada, H.**, Akiyama, M.: 2010, Raven: a harbinger of multi-object adaptive optics-based instruments at the Subaru Telescope, Proc. SPIE 7736, Eds. B. L. Ellerbroek, M. Hart, N. Hubin, P. L. Wizinowich, 77360T.

Egner, S., Ikeda, Y., **Watanabe, M.**, **Hayano, Y.**, **Golota, T.**, **Hattori, M.**, **Ito, M.**, **Minowa, Y.**, **Oya, S.**, **Saito, Y.**, **Takami, H.**, **Iye, M.**: 2010, Atmospheric dispersion correction for the Subaru AO system, Proc. SPIE 7736, Eds. B. L. Ellerbroek, M. Hart, N. Hubin, P. L. Wizinowich, 164.

Enya, K., et al. including **Yamashita, T.**, **Narita, N.**, **Tamura, M.**, **Nishikawa, J.**, **Hayano, H.**, **Oya, S.**, **Kokubo, E.**, **Matsuo, T.**, **Guyon, O.**: 2010, SPICA Coronagraph, ASP Conf. Ser. 430, Eds. V. Coudé du Foresto, M. G. Dawn, R. Ignasi, 284-290.

Enya, K., et al. including **Matsuo, T.**, **Yamashita, T.**, **Narita, N.**, **Nishikawa, J.**, **Tamura, M.**, **Hayano, Y.**, **Oya, S.**, **Kokubo, E.**: 2010, Coronagraph with SPICA, Proc. Conf. in the Spirit of Lyot 2010, Ed. A. Boccaletti, 76.

Feldt, M., Carson, J., Thalmann, C., Goto, M., Janson, M., McElwain, M., Henning, T., **Tamura, M.**, **SEEDS Team**: 2010, The coolest Companion to a Sun-like Star: News on Follow-up Observations of GJ758B, Proc. Conf. in the Spirit of Lyot 2010, Ed. A. Boccaletti, 19.

Fujii, Y., **Kroug, M.**, **Kaneko, K.**, **Gonzalez, A.**, **Uzawa, Y.**,

Kojima, T., **Kuroiwa, K.**, **Miyachi, A.**, **Makise, K.**, **Wang, Z.**, **Shan, W.**: 2010, Performance of the ALMA Band 10 SIS Receiver Prototype Model, *European Society for Applied Superconductivity*, **14**, ST202.

Fujimori, H., Aihara, H., Mineo, S., Miyatake, H., **Miyazaki, S.**, **Nakaya, H.**, Uchida, T.: 2010, Back-end Readout Electronics for Hyper Suprime-Cam, NSS N14-9, Eds. M. Pivovaroff.

Fukushima, T.: 2010, Time ephemeris and general relativistic scale factor, Highlights of Astronomy, 19, 219.

Fukushima, T.: 2010, Time ephemeris and general relativistic scale factor, Proc. IAU Symp. 261, 89-94.

Furusawa, H., Yasuda, N., **Okura, Y.**, **Nakata, F.**, Mineo, S., **Takata, T.**, Tanaka, M., Itoh, R., Katayama, N., **Komiyama, Y.**, **Miyazaki, S.**, **Utsumi, Y.**, Aihara, H., Uchida, T., Lupton, R. H.: 2010, A prototype of Hyper Suprime-Cam data analysis system, Proc. SPIE 7740, Eds. N. M. Radziwill, A. Bridger, 2I.

Garrel, V., **Guyon, O.**, Baudoz, P., **Martinache, F.**, Vogt, F., Yoshikawa, T., Yokochi, K., Cantalloube, F.: 2010, The Subaru Coronagraphic Extreme AO (SCExAO) system: visible imaging mode, Proc. SPIE 7736, Eds. E. Hart, H. Wizinowich, 65V.

Glendenning, B. E., Ibsen, J., **Kosugi, G.**, Raffi, G.: 2010, ALMA software management and deployment, Proc. SPIE 7740, Eds. N. M. Radziwill, A. Bridger, 1-6.

Golota, T., **Oya, S.**, **Egner, S.**, **Eldred, M.**, **Minowa, Y.**, **Takami, H.**, **Cook, D.**, **Hayano, Y.**, **Saito, Y.**, **Hattori, M.**, **Garrel, V.**, **Watanabe, M.**, **Ito, M.**: 2010, Software control and characterization aspects for image derotator of the AO188 system at Subaru, Proc. SPIE 7735, Eds. I. S. McLean, S. K. Ramsay, H. Takami, 33W.

Gouda, N., JASMINE working group: 2011, Series of JASMINE Missions, EAS Publications Series, 45, Eds. C. Turon, F. Meynadier, F. Arenou, 393-396.

Guyon, O., **Martinache, F.**, **Garrel, V.**, Vogt, F., **Yokochi, K.**, Yoshikawa, T.: 2010, The Subaru Coronagraphic Extreme AO (SCExAO) system: wavefront control and detection of exoplanets with coherent light modulation in the focal plane, Proc. SPIE 7736, Eds. E. Hart, H. Wizinowich, 24.

Hagino, M., **Hanaoka, Y.**, **Sakurai, T.**, Ichimoto, K.: 2011, Quantitative Comparison between the Polarization Data Taken with the Solar Flare Telescope and with the Hinode SOT Spectro-Polarimeter, ASP Conf. Ser. 437, Eds. J. R. Kuhn, S. V. Berdyugina, D. M. Harrington, S. Keil, H. Lin, T. Rimmele, B. J. Trujillo, 359-363.

Hanaoka, Y.: 2010, Synoptic Solar Observations Conducted by the Solar Observatory of the National Astronomical Observatory of Japan, Proc. Cawses II Kickoff Symp. in Japan, Scientific Committee on Solar-Terrestrial Physics in Japan, 95.

Hanaoka, Y., **Sakurai, T.**, **Shinoda, K.**, **Noguchi, M.**, **Miyashita, M.**, **Fukuda, T.**, **Suzuki, I.**, **Hagino, M.**, **Arai, T.**, Yamasaki, T., Takeyama, N.: 2011, Infrared Stokes Spectro-Polarimeter at the National Astronomical Observatory of Japan, ASP Conf. Ser. 437, Eds. J. R. Kuhn, S. V. Berdyugina, D. M. Harrington, S. Keil, H. Lin, T. Rimmele, B. J. Trujillo, 371-378.

Hashimoto, J., **Tamura, M.**, Muto, T., **Kudo, T.**, Fukagawa, M., **Fukue, T.**, Grady, C., Henning, T., Hodapp, K., Honda, M., Inutsuka, S., **Kokubo, E.**, Knapp, G., McElwain, M. W., Momose, M., Ohashi, N., Okamoto, Y. K., Takami, M., Turner, E. L., Wisniewski, J., Janson, M., **HiCIAO/AO188/SEEDS Members**: 2010, Fine Structures of Giant Planet Forming Regions around a Young Star of AB Aur, Proc. Conf. in the Spirit of Lyot 2010, Ed. A. Boccaletti, 32.

Hatsukade, B., Kohno, K., Aretxaga, I., Austermann, J. E., **Ezawa, H.**, Hughes, D. H., Ikarashi, S., **Iono, D.**, **Kawabe, R.**, **Matsuo, H.**, **Nakanishi, K.**, **Oshima, T.**, Perera, T., Scott, K. S., Shirahata, M., Takeuchi, T. T., **Tamura, Y.**, Tanaka, K., Tosaki, T., Wilson, G. W., Yun, M. S.: 2010, AzTEC/ASTE 1.1 mm Deep Survey: Number Counts and Clustering of Millimeter-Bright Galaxies, AIP Conf. Proc. 1279, Eds. N. Kawai, S. Nagataki, 324-326.

Hatsukade, B., Kohno, K., **Tamura, Y.**, **Nakanishi, K.**, **Iono, D.**, Wilson, G. W., Yun, M. S., Hughes, D. H., Matsuura, S., Shirahata, M., Takeuchi, T. T., Scott, K. S., Austermann, J. E., Perera, T., Aretxaga, I., Tanaka, K., Tosaki, T., **Matsuo, H.**, **Ezawa, H.**, **Kawabe, R.**, ADF-S team: 2010, AzTEC/ASTE 1.1-mm Survey of the AKARI Deep Field-South, ASP Conf. Ser. 418, Eds. T. Onaka, G. J. White, T. Nakagawa, I. Yamamura, 307-312.

Hatsutori, Y., **Kobayashi, Y.**, **Gouda, N.**, **Yano, T.**, **Murooka, J.**, Niwa, Y., Yamada, Y.: 2011, Performance Evaluation of Nano-JASMINE, EAS Publications Series, 45, Eds. C. Turon, F. Meynadier, F. Arenou, 397-400.

Hattori, T., **Aoki, K.**: 2010, GRB 100418A: Subaru late-time optical imaging and spectroscopy, GRB Coordinates Network, Circular Service 10794, Ed. B. I. Scott.

Hattori, M., **Colley, S.**, **Garrel, V.**, **Egner, S.**, **Golota, T.**, **Guyon, O.**, **Ito, M.**, **Minowa, Y.**, **Oya, S.**, **Saito, Y.**, **Watanabe, M.**, **Hayano, Y.**, **Takami, H.**, **Iye, M.**: 2010, Recent development in real-time control system of Subaru adaptive optics including laser guide star mode, Proc. SPIE 7736, Eds. B. L. Ellerbroek, M. Hart, N. Hubin, P. L. Wizinowich, 156.

Hayakawa, T., Chiba, S., **Kajino, T.**, Mathews, G. J.: 2010, Production ratio of meta-stable isomer in ^{180}Ta by neutrino-induced reactions, AIP Conf. Proc. 1235, 341-348.

Hayakawa, T., Chiba, S., **Kajino, T.**, Mathews, G. J.: 2010, Isomer residual ratio of odd-odd isotope ^{180}Ta in supernova nucleosynthesis, AIP Conf. Ser. 1238, Eds. H. Susa, M. Arnould, S. Gales, T. Motobayashi, C. Scheidenberger, H. Utsunomiya, 225-227.

Hayakawa, T., Shizuma, T., Chiba, S., **Kajino, T.**, Hatsukawa, Y., Iwamoto, N., Shinohara, N., Harada, H.: 2010, Thermal neutron capture cross-section to ^{113}Cd isomer for the study of s-process origin of ^{115}Sn, AIP Conf. Ser. 1238, Eds. H. Susa, M. Arnould, S. Gales, T. Motobayashi, C. Scheidenberger, H. Utsunomiya, 225-227.

Hayano, Y., **Takami, H.**, **Oya, S.**, **Hattori, M.**, **Saito, Y.**, **Watanabe, M.**, **Guyon, O.**, **Minowa, Y.**, **Egner, S. E.**, **Ito, M.**, **Garrel, V.**, **Colley, S.**, **Golota, T.**, **Iye, M.**: 2010, Commissioning status of Subaru laser guide star adaptive optics system, Proc. SPIE 7736, Eds. B. L. Ellerbroek, M. Hart, N. Hubin, P. L. Wizinowich, 21.

Hibi, Y., **Matsuo, H.**, Nagata. H., Ikeda, H., Fujiwara, M.: 2010, The Cryogenic Readout System with GaAs JFETs for Multi-pixel Cameras, Proc. SPIE 7854, Eds. C. Zhang, X.-C. Zhang, P. H. Siegel, L. He, S.-C. Shi, 1Z.

Honda, M., Inoue, A. K., Okamoto, Y. K., Kataza, H., Fukagawa, M., **Yamashita, T.**, **Fujiyoshi, T.**, **Tamura, M.**, **Hashimoto, J.**, Miyata, T., Sako, S., Sakon, I., Fujiwara, H., Kamizuka, T., Onaka, T.: 2010, Pre-transitional disk nature of the AB Aur disk, Proc. Conf. in the Spirit of Lyot 2010, Ed. A. Boccaletti, 36.

Honda, S., **Aoki, W.**, Beers, T. C., Takada-Hidai, M.: 2010, Abundance analysis of the Zinc enhanced metal-poor star BS 16920-017, AIP Conf. Proc. 1269, Eds. I. Tanihata, T. Shima, H. J. Ong, A. Tamii, T. Kishimoto, H. Toki, T. Kajino, S. Kubono, 366-368.

Ikeda, N., Kitamura, Y., Yoshida, A., Tatei, H., **Onodera, S.**, **Momose, R.**: 2010, FAZZ, a FITS Cube/Image Browsing and Analyzing Too in IDL, ASP Conf. Ser. 434, Eds. Y. Mizumoto, K.-I. Morita, M. Ohishi, 297-300.

Ikeda, Y., Kobayashi, N., Kuzmenko, P. J., Little, S. L.,**Yasui, C.**, Kondo, S., Mito, H., **Nakanishi, K.**, Sarugaku, Y.: 2010, Fabrication and current optical performance of a large diamond-machined ZnSe immersion grating, Proc. SPIE 7739, Eds. E. Atad-Ettedgui, D. Lemke, 4G.

Imanishi, M.: 2010, Luminous Buried AGNs in Ultraluminous Infrared Galaxies, AIP Conf. Proc. 1240, Eds. V. P. Debattista, C, C. Popescu, 72-75.

Ito, H., **Aoki, W.**, Satoshi, H., Beers, T. C., Tominaga, N.: 2010, A very low upper limit for a Be abundance of a carbon-enhanced metal-poor star, Proc. IAU Symp. 268, Eds. C. Charbonnel, M. Tosi, F. Primas, C. Chiappini, 337-338.

Ito, H., **Kino, M.**, Kawakatu, K., Yamada, S.: 2010, Non-thermal emission shocked shell driven by powerful AGN jets, *Int. J. of Modern Phys. D*, **19**, 893-899.

Ito, M., **Hayano, Y.**, **Saito, Y.**, **Takami, H.**, **Iye, M.**, **Hattori, M.**, **Oya, S.**, **Watanabe, M.**, Akagawa, K., **Colley, S. A.**, **Golota, T. I.**, **Guyon, O.**: 2010, The characteristics of laser-transmission and guide star's brightness for Subaru LGS/AO188 system, Proc. SPIE 7736, Eds. B. L. Ellerbroek, M. Hart, N. Hubin, P. L. Wizinowich, 169.

Itoh, S., **Agata, H.**, **Nagai, T.**, **Nakayama, H.**, **Naito, S.**, **Hirai, A.**: 2010, What is our "Science Culture Promotion Unit Through Astronomical Images"?, Immersive Scientific Visualization, Eds. M. Okyudo, T. Ebisuzaki, 15-17.

Jenniskens, P., **Sato, M.**, **Watanabe, J.**, Trigo-Rodriguez, J. M., Madiedo, J. M., Pujols, P., de, J. A., Alonso-Azcarate, J., Zamorano, J.: 2010, Orionid Meteors 2010, Central Bureau Electronic Telegrams.

Jeschke, E., **Inagaki, T.**: 2010, Lessons Learned Deploying a Second Generation Observation Control System for Subaru Telescope, Proc. SPIE 7740, Eds. N. M. Radziwill, A. Bridger.

Jeschke, E., **Inagaki, T.**: 2010, Designing a High-Availability Cluster for the Subaru Telescope Second Generation Observation Control System, Proc. SPIE 7740, Eds. N. M. Radziwill, A. Bridger.

Kajino, T., Harikae, S., Yoshida, T., **Nakamura, K.**, **Aoki, W.**: 2010, R-process in Supernovae and Gamma-Ray Bursts, AIP Conf. Proc. 1235, 242-246.

Kamata, Y., et al. including **Nakaya, H.**, **Miyazaki, S.**, **Uraguchi, F.**: 2010, Characterization and performance of hyper Suprime-Cam CCD, Proc. SPIE 7742, Eds. A. Holland, D. Dorn, 62.

Kaneko, H., **Kuno, N.**, **Iono, D.**, Tosaki, T., **Sawada, T.**, Nakanishi, H., **Hirota, A.**: 2010, Molecular Gas in the Early Stage of Interacting Galaxies: The NGC 4567/8 Pair, ASP Conf. Ser. 423, Eds. B. J. Smith, N. Bastian, S. J. U. Higdon, J. L. Higdon, 26-31.

Katsukawa, Y., Masada, Y., Shimizu, T., Sakai, S., Ichimoto, K.: 2010, Pointing stability of Hinode and requirements for the next solar mission Solar-C, Proc. of Int. Conf. on Space Optics 2010, http://congrex.nl/ICSO/Papers/Session%2011b/FCXNL-10A02-1987998-1-icso_paper_katsukawa.pdf.

Katsukawa, Y., SOLAR-C Working Group: 2011, Chromospheric Diagnostics in the Next Japanese Solar Mission SOLAR-C, ASP Conf. Ser. 437, Eds. J. R. Kuhn, S. V. Berdyugina, D. M. Harrington, S. Keil, H. Lin, T. Rimmele, B. J. Trujillo, 281-286.

Kobayashi, Y., **Yano, T.**, **Gouda, N.**, Niwa, Y., Murooka, J., Yamada, Y., Sako, N., Nakasuka, S.: 2010, Nano-JASMINE: current status and data output, Proc. SPIE 7731, Eds. J. M. Oschmann Jr., M. C. Clampin, H. A. MacEwen, 3Z.

Kobayashi, Y., **Yano, T.**, **Hatsutori, Y.**, **Gouda, N.**, Murooka, J., Niwa, Y., Yamada, Y.: 2011, Nano-JASMINE: Simulation of Data Outputs, EAS Publications Series, 45, Eds. C. Turon, F. Meynadier, F. Arenou, 401-404.

Komiya, Y., Suda, T., Fujimoto, M. Y.: 2010, Near field cosmology with binary, high mass IMF, and hierarchical galaxy formation, AIP Conf. Ser. 1238, Eds. H. Susa, M. Arnould, S. Gales, T. Motobayashi, C. Scheidenberger, H. Utsunomiya, 126-129.

Komiya, Y., Suda, T., Fujimoto, M. Y.: 2010, EMP Stars and Hierarchical Model of the Galactic Chemical Evolution, AIP Conf. Proc. 1269, Eds. I. Tanihata, T. Shima, H. J. Ong, A. Tamii, T. Kishimoto, H. Toki, T. Kajino, S. Kubono, 360-362.

Komiyama, Y., Aihara, H., Fujimori, H., **Furusawa, H.**, **Kamata, Y.**, Karoji, H., **Kawanomoto, S.**, Mineo, S., Miyatake, H., **Miyazaki, S.**, **Morokuma, T.**, **Nakaya, H.**, Nariai, K., **Obuchi, Y.**, **Okura, Y.**, **Tanaka, Y.**, Uchida, T., **Uraguchi, F.**, **Utsumi, Y.**, Endo, M., Ezaki, Y., Matsuda, T., Miwa, Y., Yokota, H., Wang, S.-Y., Liaw, E. J., Chen, H.-Y., Chiu, C.-F., Jeng, D.-Z.: 2010, Hyper Suprime-Cam: camera design, Proc. SPIE 7735, Eds. I. S. McLean, S. K. Ramsay, H. Takami.

Kotani, T., **Miyazaki, A.**, Tsuboi, M., Endo, W., **Fujisawa, K.**, Kawai, N., **Kuno, N.**, **Nakanishi, K.**, Yamaoka, K., Yonekura, Y.: 2011, Cyg X-3 is Flaring in Radio, The Astronomer's Telegram, #32130.

Kuno, N., Tosaki, T., **Onodera, S.**, Muraoka, K., **Kaneko, H.**, **Sawada, T.**, **Nakanishi, K.**, **Komugi, S.**, **Tamura, Y.**, Kohno, K., **Kawabe, R.**, Arimoto, N., Okamoto, S.: 2010, NRO Legacy Project: Survey of Giant Molecular Clouds in M33, Highlights of Astronomy, 15, Ed. I. Corbett, 416-416.

Kuroda, D., **Hanayama, H.**, **Miyaji, T.**, **Watanabe, J.**, **Yanagisawa, K.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100504A: optical upper limits at IAO, GRB Coordinates Network, Circular Service 10740.

Kuroda, D., **Hanayama, H.**, **Miyaji, T.**, **Watanabe, J.**, **Yanagisawa, K.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100901A: optical observations at IAO, GRB Coordinates Network, Circular Service 11205.

Kuroda, D., **Hanayama, H.**, **Miyaji, T.**, **Watanabe, J.**, **Yanagisawa, K.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB10901A: murikabushi telescope observation at 3 days after the burst, GRB Coordinates Network, Circular Service 11212.

Kuroda, D., **Hanayama, H.**, **Miyaji, T.**, **Watanabe, J.**, **Yanagisawa, K.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100901A: IAO optical upper limits at 4 days after the burst, GRB Coordinates Network, Circular Service 11258.

Kuroda, D., **Hanayama, H.**, **Miyaji, T.**, **Watanabe, J.**, **Yanagisawa, K.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100902A: optical upper limits at IAO, GRB Coordinates Network, Circular Service 11206.

Kuroda, D., **Hanayama, H.**, **Miyaji, T.**, **Watanabe, J.**, **Yanagisawa, K.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100905A: optical upper limits at IAO, GRB Coordinates Network, Circular Service 11225.

Kuroda, D., **Hanayama, H.**, **Miyaji, T.**, **Watanabe, J.**, **Yanagisawa, K.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100906A: optical observations at IAO, GRB Coordinates Network, Circular Service 11249.

Kuroda, D., **Hanayama, H.**, **Miyaji, T.**, **Watanabe, J.**, **Yanagisawa, K.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100909A: Mitsume ishigakijima optical upper limits, GRB Coordinates Network, Circular Service 11273.

Kuroda, D., **Hanayama, H.**, **Miyaji, T.**, **Watanabe, J.**, **Yanagisawa, K.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100915A: Mitsume ishigakijima optical upper limits, GRB Coordinates Network, Circular Service 11287.

Kuroda, D., **Hanayama, H.**, **Miyaji, T.**, **Watanabe, J.**, **Yanagisawa, K.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB101219A: MITSuME Ishigakijima Optical upper limits, GRB Coordinates Network, Circular Service 11479.

Kuroda, D., **Hanayama, H.**, **Miyaji, T.**, **Watanabe, J.**, **Yanagisawa, K.**, Yoshida, M., Ohta, K., Kawai, N.: 2011, GRB110205A: MITSuME Ishigakijima Optical Observation, GRB Coordinates Network, Circular Service 11652.

Kuroda, D., **Hanayama, H.**, **Miyaji, T.**, **Watanabe, J.**, **Yanagisawa, K.**, Yoshida, M., Ohta, K., Kawai, N.: 2011, GRB110305A: MITSuME Ishigakijima Optical upper limits, GRB Coordinates Network, Circular Service 11780.

Kuroda, D., **Hanayama, H.**, **Miyaji, T.**, **Yanaisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, **Watanabe, J.**, Ali, G. B., Haroon, A., Essam, A., Ismal, M., Kawabata, K. S., Yoshida, M., Ohta, K., Yatsu, Y., Nakajima, H., Enomoto, T., Kawakami, K., Tokoyoda, K., Kawai, N.: 2010, Multi-band optical monitoring of GRB100925A/MAXI J1659-152, The First Year of MAXI: Monitoring Variable X-ray Sources, Eds. K. Ebisawa, N. Kawai.

Kuroda, D., **Hanayama, H.**, **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, **Miyaji, T.**, **Watanabe, J.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100925A/MAXI J1659-152 Mitsume ishigakijima and okayama optical observation, GRB Coordinates Network, Circular Service 11306.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Nagayama, S.**, **Toda, H.**, Yoshida, M., Kawai, N.: 2010, GRB100420A: Mitsume optical upper limits, GRB Coordinates Network, Circular Service 10642.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB101224A: Mitsume okayama optical upper limits, GRB Coordinates Network, Circular Service 11487.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB101017A: Mitsume okayama optical upper limits, GRB Coordinates Network, Circular Service 11351.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100906A: errata of Mitsume okayama about observation time, GRB Coordinates Network, Circular Service 11241.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100906A: Mitsume okayama optical observation, GRB Coordinates Network, Circular Service 11240.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100905A: Mitsume okayama optical upper limits, GRB Coordinates Network, Circular Service 11224.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100901A: Mitsume okayama optical observation at 1 day after the burst, GRB Coordinates Network, Circular Service 11189.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100901A: errata of Mitsume okayama about reference catalog, GRB Coordinates Network, Circular Service 11186.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100901A: Mitsume okayama optical observation, GRB Coordinates Network, Circular Service 11172.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100816A: Mitsume optical upper limits, GRB Coordinates Network, Circular Service 11126.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100807A: Mitsume optical upper limits, GRB Coordinates Network, Circular Service 11075.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100802A: Mitsume optical upper limits, GRB Coordinates Network, Circular Service 11041.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100725B: Mitsume optical upper limits, GRB Coordinates Network, Circular Service 10997.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100424A: Mitsume optical upper limits, GRB Coordinates Network, Circular Service 10679.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2010, GRB100423A: Mitsume optical upper limits, GRB Coordinates Network, Circular Service 10678.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2011, GRB110312A: Mitsume okayama optical upper limits, GRB Coordinates

Network, Circular Service 11789.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2011, GRB110213A: Mitsume okayama optical observation, GRB Coordinates Network, Circular Service 11719.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2011, GRB110212A: Mitsume okayama optical upper limits, GRB Coordinates Network, Circular Service 11711.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2011, GRB110205A: Mitsume okayama optical observation, GRB Coordinates Network, Circular Service 11651.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2011, GRB110201A: Mitsume okayama optical upper limits, GRB Coordinates Network, Circular Service 11626.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2011, GRB110128A: Mitsume okayama optical upper limits, GRB Coordinates Network, Circular Service 11618.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2011, GRB110119A: Mitsume okayama optical upper limits, GRB Coordinates Network, Circular Service 11585.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2011, GRB 110106A: Mitsume okayama optical upper limits, GRB Coordinates Network, Circular Service 11535.

Kuroda, D., **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Kawai, N.: 2011, GRB110102A: Mitsume okayama optical observation, GRB Coordinates Network, Circular Service 11513.

Kuroda, K., **LCGT Collaboration**: 2010, Cryogenic Advanced Gravitational Wave Detector (LCGT), Proc. of the 9th Asia-Pacific Int. Conf., Eds. J. Luo, Z.-B. Zhou, H.-C. Yeh, J.-P. Hsu, 48-67.

Kusakabe, M., **Kajino, T.**, Yoshida, T., Mathews, G. J.: 2010, Signature of Long-lived Relic Particles on Primordial Light Element Abundances in Big Bang Nucleosynthesis, AIP Conf. Proc. 1269, Eds. I. Tanihata, T. Shima, H. J. Ong, A. Tamii, T. Kishimoto, H. Toki, T. Kajino, S. Kubono, 63-68.

Landi, E., J. C. Raymond, J. C., Miralles, M. P., **Hara, H.**: 2010, Physical Conditions in a CME from Hinode, STEREO, and SOHO Observations, ASP Conf. Ser. 428, Eds. S. R. Cranmer, T. Hoeksema, J. L. Kohl, 201-205.

Larkin, J. E., Moore, A. M., Barton, E. J., Bauman, B., Bui, K., Canfield, J., Cramton, D., Delacroix, A., Fletcher, M., Hale, D., Loop, D., Niehaus, C., Phillips, A. C., Reshetov, V., Simard, L., Smith, R., Suzuki, R., **Usuda, T.**, Wright, S. A.: 2010, The infrared imaging and spectrograph (IRIS) for TMT: instrument overview, Proc. SPIE 7735, Eds. I. S. McLean, S. K. Ramsay, H. Takami, 29.

Lee, S., et al. including **Pyo, T.-S.**: 2010, GMTNIRS (Giant Magellan Telescope near-infrared spectrograph): design concept, Proc. SPIE 7735, Eds. I. S. McLean, S. K. Ramsay, H. Takami, 87-95.

Lee, S., Itoh, R., Katayama, N., **Furusawa, H.**, Aihara, H., Mineo, S.: 2010, A common real time framework for SuperKEKB and Hyper Suprime-Cam at Subaru telescope, *J. Phys.: Conf. Ser.*, **219**, 22012-22020.

Lisenfeld, U., Espada, D., Leon, S., Lerdes-Montenegro, L., **Kuno, N.**, Sato, N.: 2010, Molecular Gas Properties in the Most Isolated Galaxies, ASP Conf. Ser. 421, Eds. L. Verdes-Montenegro, A. del Olmo, J. W. Sulentic, 262.

Machida, M. N., Omukai, K., Matsumoto, T.: 2010, Magneto-hydrodynamics of Population III Star Formation, AIP Conf. Proc. 1294, Eds. D. Whalen., V. Bromm., N. Yoshida, 56-61.

Martinache, F., **Guyon, O.**: 2010, The Subaru Coronagraphic Extreme AO Project, Pathways Towards Habitable Planets, Eds. V. Coude du Foresto, D. Gelino, I. Ribas, 497-498.

Maruyama, T., Yasutake, N., **Kajino, T.**, Cheoun, M. K., Ryu, C. Y.: 2010, Asymmetric Neutrino Reaction from Magnetized Proto-Neutron Stars in fully Relativistic Framework including Hyperons, AIP Conf. Proc. 1269, Eds. I. Tanihata, T. Shima, H. J. Ong, A. Tamii, T. Kishimoto, H. Toki, T. Kajino, S. Kubono, 406-408.

Matsuo, H., **Hibi, Y.**, Nagata, H., Ikeda, H., Fujiwara, M.: 2010, SISCAM 32-ch Cryogenic Readout Module with GaAs-JFET ASICs, Proc. SPIE 7741, Eds. W. S. Holland, J. Zmuidzinas, 2V.

Matsuo, H., Shi, S.-C., Yao, Q.-J., Luo, Y., **Matsuo, T.**, Ohta, I. S.: 2010, A design study on terahertz interferometry in Antarctica, Proc. SPIE 7854, Eds. C. Zhang, X.-C. Zhang, P. H. Siegel, L. He, S.-C. Shi, 10.

Matsuo, T., **Tamura, M.**: 2010, Second-earth imager for TMT (SEIT): a proposal and concept Description, Proc. SPIE 7735, Eds. I. S. McLean, S. K. Ramsay, H. Takami, 84.

Matsuo, T., Traub, W. A., Hattori, M., **Tamura, M.**, Shao, M.: 2010, New concept for direct detection and spectra of exoplanets, Proc. SPIE 7734, Eds. W. C. Danchi, F. Delplancke, J. K. Rajagopal, 2K.

Matsuo, T., Traub, W. A., Hattori, M., **Tamura, M.**, Shao, M.: 2010, New Concept for Direct Detection and Spectra of Exoplanets, Proc. Conf. in the Spirit of Lyot 2010, Ed. A. Boccaletti, 78.

Matsuo, T., Traub, W. A., **Tamura, M.**, Hattori, M.: 2010, Spectral Imaging with Nulling Interferometer, ASP Conf. Ser. 430, Eds. V. Coudé du Foresto, M. G. Dawn, R. Ignasi, 499.

Matsuo, T., Traub, W. A., **Tamura, M.**, Hattori, M.: 2010, Multiple Aperture Imaging and its Application to Exo-Earth Imager, ASP Conf. Ser. 430, Eds. V. Coudé du Foresto, M. G. Dawn, R. Ignasi, 501.

Mineo, S., Aihara, H., Itoh, R., Katayama, N., **Yasuda, N.**, **Furusawa, H.**, **Okura, Y.**, **Miyazaki, S.**, Loomis, C., Lupton, R. H.: 2010, Development of an analysis framework for HSC and Belle II, Proc. SPIE 7740, Eds. N. M. Radziwill, A. Bridger., 1P.

Minowa, Y., **Hayano, Y.**, **Oya, S.**, **Watanabe, M.**, **Hattori, M.**, **Guyon, O.**, **Egner, S.**, **Saito, Y.**, **Ito, M.**, **Takami, H.**, **Garrel, V.**, **Colley, S.**, **Golota, T.**, **Iye, M.**: 2010, Performance of Subaru adaptive optics system AO188, Proc. SPIE 7736, Eds. B. L. Ellerbroek, M. Hart, N. Hubin, P. L. Wizinowich, 122.

Miura, N., Yokoyama, F., Nefu, M., Kuwamura, S., Baba, N., **Hanaoka, Y.**, Ueno, S., Nakatani, Y., Nagata, S., Kitai, R., Ichimoto, K., **Takami, H.**: 2010, Optical setup and wavefront sensor for solar adaptive optics at the Domeless Solar Telescope, Hida Observatory, Proc. SPIE 7736, Eds. B. L. Ellerbroek, M.

Hart, N. Hubin, P. L. Wizinowich, 54.

Morita, K.-I., **Kurono, Y.**, **Kamazaki, T.**: 2010, Optimizing Spatial Frequency Data Weights for High Precision Imaging with ALMA, ASP Conf. Ser. 434, Eds. Y. Mizumoto, K.-I. Morita, M. Ohishi, 337-340.

Murakami, N., **Guyon, O.**, **Martinache, F.**, **Matsuo., T.**, **Yokochi, K.**, **Nishikawa, J.**, **Tamura, M.**, Kurokawa, T., Baba, N., Vogt, F., **Garrel, V.**, Yoshikawa, T.: 2010, An eight-octant phase-mask coronagraph for the Subaru coronagraphic extreme AO (SCExAO) system: system design and expected performance, Proc. SPIE 7735, Eds. I. S. McLean, S. K. Ramsay, H. Takami, 33.

Murakami, N., Inabe, T., Komatsu, T., **Nishikawa, J.**, Hashimoto, N., Kurihara, M., Baba, N., **Tamura, M.**: 2010, Polarization-interferometric eight-octant phase-mask coronagraph using ferroelectric liquid crystal for exoplanet detection, Proc. SPIE 7731, Eds. J. M. Oschmann Jr., M. C. Clampin, H. A. MacEwen, 4E.

Murakami, N., **Nishikawa, J.**, **Yokochi, K.**, **Tamura, M.**, Baba, N., Hashimoto, N., Abe, L.: 2010, An eight-octant phase-mask coronagraph for the Subaru coronagraphic extreme AO (SCExAO) system: system design and expected performance, ASP Conf. Ser. 430, Eds. V. Coudé du Foresto, M. G. Dawn, R. Ignasi, 510-512.

Nakajima, H., **Kuroda, D.**, **Yanagisawa, K.**, **Shimizu, Y.**, **Toda, H.**, **Nagayama, S.**, Yoshida, M., Ohta, K., Yatsu, Y., Enomoto, T., Kawakami K., Tokoyoda, K., Ohkawa, T., Kawai, N.: 2011, GRB 110112A: Mitsume akeno and okayama optical upper limits, GRB Coordinates Network, Circular Service 11566.

Nakamura, K., Yoshida, T., Shigeyama, T., **Kajino, T.**: 2010, Lithium, beryllium, and boron production in core-collapse supernovae, Proc. IAU Symp. 268, Eds. C. Charbonnel, M. Tosi, F. Primas, C. Chiappini, 463-468.

Nakamura, K., Yoshida, T., Shigeyama, T., **Kajino, T.**: 2010, Light elements from core-collapse supernovae: the neutrino-process and spallation reactions, AIP Conf. Proc. 1269, Eds. I. Tanihata, T. Shima, H. J. Ong, A. Tamii, T. Kishimoto, H. Toki, T. Kajino, S. Kubono, 309-314.

Nakamura, R., Hashimoto, M., Fujimoto, S., **Nishimura, N.**, Sato, K.: 2010, Constraints on the heavy elements production in inhomogeneous Big-Bang nucleosynthesis from light-element observations, AIP Conf. Proc. 1269, Eds. I. Tanihata, T. Shima, H. J. Ong, A. Tamii, T. Kishimoto, H. Toki, T. Kajino, S. Kubono, 378-380.

Nakaya, H., Uchida, T., Miyatake, H., Fujimori, H., Mineo, S., Aihara, H., **Furusawa, H.**, **Kamata, Y.**, Karoji, H., **Kawanomoto, S.**, **Komiyama, Y.**, **Miyazaki, S.**, **Morokuma, T.**, **Obuchi, Y.**, **Okura, Y.**, Tanaka, M., Tanaka, Y., **Uraguchi, F.**, **Utsumi, Y.**: 2010, Hyper Suprime-Cam: development of the CCD readout electronics, Proc. SPIE 7735, Eds. I. S. McLean, S. K. Ramsay, H. Takami, 52.

Nakazato, T., **Sugimoto, K.**, **Kawasaki, W.**, **Kosugi, G.**, Tsutsumi, T.: 2010, Current Status of Single-Dish Data Analysis Software for ALMA, ASP Conf. Ser., 434, Eds. Y. Mizumoto, K.-I. Morita, M. Ohishi, 83.

Narita. N.: 2011, Good Combination of the Rossiter-McLaughlin Measurements and Direct Imaging Observations, EPJ Web of Conf. Col. 11, Eds. F. Bouchy, R. Diaz, C. Moutou, id.05004.

Niino, Y., Choi, J.-H., **Kobayashi, M. A. R.**, Nagamine, K., Totani, T., Zhang, B.: 2010, Metallicity of Gamma-Ray Burst Progenitors: Connection between Star Formation and Gamma-Ray Burst Production, AIP Conf. Proc. 1269, Eds. I. Tanihata, T. Shima, H. J. Ong, A. Tamii, T. Kishimoto, H. Toki, T. Kajino, S. Kubono, 345-347.

Niino, Y., Choi, J.-H., **Kobayashi, M. A.R.**, Nagamine, K., Totani, T., Zhang B.: 2010, Luminosity Distribution of Gamma-ray Burst Host Galaxies at Redshift $z=1$ in Cosmological Simulation, AIP Conf. Proc. 1279, Eds. N. Kawai, S. Nagataki, 231-233.

Nishikawa, J., **Yokochi, K.**, Murakami, N., Abe, L., Kotani, T., **Tamura, M.**, Kurokawa, T., Tavrov, A. V., Takeda, M.: 2010, A coronagraph system with unbalanced nulling interferometer: progress of wavefront correction, ASP Conf. Ser. 430, Eds. V. Coudé du Foresto, M. G. Dawn, R. Ignasi, 513-514.

Nishikawa, J., **Yokochi, K.**, Murakami, N., Abe, L., Kotani, T., **Tamura, M.**, Kurokawa, T., Tavrov, A. V., Takeda, M., Murakami, H.: 2010, A coronagraph system with unbalanced nulling interferometer: progress of wavefront correction, Proc. SPIE 7731, Eds. J. M. Oschmann Jr., M. C. Clampin, H. A. MacEwen, 4O.

Nishimura, N., **Takiwaki, T.**, Hashimoto, M., Sato, K.: 2010, *R*-process Nucleosynthesis in Magnetically Dominated Core-Collapse Supernovae, AIP Conf. Proc. 1269, Eds. I. Tanihata, T. Shima, H. J. Ong, A. Tamii, T. Kishimoto, H. Toki, T. Kajino, S. Kubono, 131-136.

Niwa, Y., **Yano, T.**, **Araki, H.**, **Gouda, N.**, **Kobayashi, Y.**, **Tazawa, S.**, **Hanada H.**, Yamada, Y.: 2010, CCD centroiding analysis for Nano-JASMINE observation data, Proc. SPIE 7731, Eds. J. M. Oschmann Jr., M. C. Clampin, H. A. MacEwen, 41.

Noda, T., Hashimoto, M. **Yasutake, N.**, **Maruyama, T.**, Tatsumi, T., Fujimoto, M.: 2010, Cooling of Compact Stars with Quark-Hadron Mixed Phase in the Colour Superconductive State, AIP Conf. Proc. 1269, Eds. I. Tanihata, T. Shima, H. J. Ong, A. Tamii, T. Kishimoto, H. Toki, T. Kajino, S. Kubono, 384-386.

Ohishi, M., **Shirasaki, Y.**, **Komiya, Y.**, **Mizumoto, Y.**, **Yasuda, N.**, **Tanaka, M.**: 2010, Lessons Learned during the Development and Operation of Virtual Observatory, ASP Conf. Ser. 434, Eds. Y. Mizumoto, K.-I. Morita, M. Ohishi, 73-80.

Okamoto, Y. K., et al. including **Fujiyoshi, T.**, **Imanishi, M.**, **Yamashita, T.**: 2010, The science driver for a mid-infrared instrument for the TMT, Proc. SPIE 7735, Eds. I. S. McLean, S. K. Ramsay, H. Takami, 5O.

Okoshi, K., Nagashima, M., **Gouda, N.**, **Minowa, Y.**: 2010, HI-selected Galaxies As a Probe of Quasar Absorption Systems, Proc. IAU Symp. 262, Eds. G. R. Bruzual, S. Charlot, 402-403.

Omiya, M., Han, I., **Izumiura, H.**, Lee, B.-C., Sato, B., Kim, K.-M., Yoon., T. S., **Kambe, E.**, Yoshida, M., Masuda, S., Toyota, E., Urakawa, S., Takada-Hidai, M.: 2011, Korean-Japanese Planet Search Program: Substellar Companions around Intermediate-Mass Giants, AIP Conf. Proc. 1331, Eds. S. Schuh, H., Drechsel, U. Heber, 122-129.

Oya, S., **Hattori, M.**, **Minowa, Y.**, **Negishi, S.**, **Tomono, D.**, **Terada, H.**, **Pyo, T.-S.**, **Watanabe, M.**, **Ito, M.**, **Saito, Y.**, **Egner, S.**, **Hayano, Y.**, **Takami, H.**, **Iye, M.**, **Guyon, O.**, **Garrel, V.**, **Colley, S.**, **Golota, T.**: 2010, Tip/tilt offload of Subaru AO188 by telescope secondary mirror, Proc. SPIE 7736, Eds. B. L. Ellerbroek, M. Hart, N. Hubin, P. L. Wizinowich, 128-136.

Ozaki, S., **Iwata, I.**, **Kambe, E.**, Yoshida, M., **Okita, K.**, Iwamuro, F., Sugai, H. Ohta, K.: 2010, Development of the prototype integral field unit for prompt follow-up spectroscopy of gamma-ray bursts, Proc. SPIE 7735, Eds. I. S. McLean, S. K. Ramsay, H. Takami, 50.

Packham, C. C., et al. including **Imanishi, M.**, **Izumiura, H.**, **Yamashita, T.**: 2011, Michi: A MIR Instrument Concept for the TMT, Bulletin of AAS, 43, #217, #157.03.

Pehlivan, Y., **Kajino, T.**, Balantekin, A. B., Yoshida, T., **Maruyama, T.**: 2010, On the Neutrino Self Refraction Problem from a Many-Body Perspective, AIP Conf. Proc. 1269, Eds. I. Tanihata, T. Shima, H. J. Ong, A. Tamii, T. Kishimoto, H. Toki, T. Kajino, S. Kubono, 189-194.

Pehlivan, Y., **Kajino, T.**, Balantekin, A. B., Mathews, G. J., Kusakabe, M.: 2010, Photodisintegration at High Temperature, AIP Conf. Proc. 1269, Eds. I. Tanihata, T. Shima, H. J. Ong, A. Tamii, T. Kishimoto, H. Toki, T. Kajino, S. Kubono, 397-399.

Robson, I. E., et al. including **Sekiguchi, K.**: 2010, Commission 55: Communicating Astronomy with the Public, Transactions of the IAU, XXVII B, 274-277.

Saito, R., et al. including **Tamura, M.**: 2010, VISTA Variables in the Vía Láctea (VVV): Current Status and First Results, *The Messenger*, **141**, 24-28.

Saito, Y., **Hayano, Y.**, **Ito, M.**, **Minowa, Y.**, **Egner, S.**, **Oya, S.**, **Watanabe, M.**, **Hattori, M.**, **Garrel, V.**, Akagawa, K., **Guyon, O.**, **Colley, S.**, **Golota, T.**, Saito, N., Takazawa, A., **Ito, M.**, **Takami, H.**, Wada, S., **Iye, M.**: 2010, The performance of the laser guide star system for the Subaru Telescope, Proc. SPIE 7736, Eds. B. L. Ellerbroek, M. Hart, N. Hubin, P. L. Wizinowich, 171.

Sato, S., **Kawamura, S.**, Nishizawa, A., Chen, Y.: 2010, Noise cancellation properties of displacement noise free interferometer, *J. Phys.: Conf. Ser.*, **228**, 012026.

Sato, S., **Torii, Y.**, Wakabayashi, Y., **Ejiri, Y.**, **Suzuki, R.**, **Ueda, A.**, **Kawamura, S.**, Araya, A., Ando, M., **Obuchi, Y.**, **Okada, N.**: 2010, Test-mass module for DECIGO Pathfinder, *J. Phys.: Conf. Ser.*, **228**, 012046.

Sekiguchi, Y.: 2010, Formation of Black hole-Disk System via PopIII stellar core collapse in full general relativity, AIP Conf. Proc. 1279, Eds. N. Kawai, S. Nagataki, 93-96.

Sekiguchi, Y.: 2010, Fully General Relativistic Simulations of Formation of Black Hole-Accretion Disk System in Collapsar, Proc. of the workshop on Physics of Compact Objects, Eds. K. Uryu, S. Yoshida, S. Yoshida, N. Masuda, K. Taniguchi, S. Karino, 140-149.

Sekiguchi, Y.: 2011, Black hole and accretion disk formation in the collapsar model, Proc. of the 20th workshop on General Relativity and Gravitation in Japan, Eds. M. Shibata, M., Sasaki, T. Tanaka, J. Soda, T. Shiromizu, N. Seto, 63.

Selam, S. O., Yilmaz, M., **Izumiura, H.**, Bikmaev, I., Sato, B., **Kambe, E.**, Keskin, V.: 2010, Precise Radial Velocity Measurements: Key to Discover Low-mass Companions and Exoplanets Around Stars, ASP Conf. Ser. 435, Eds. A., Prša, M. Zejda, 413.

Shibasaki, K., **Narukage, N.**, Yoshimura, K.: 2011, Imaging Observations of Coronal Magnetic Field by Nobeyama Radioheliograph, ASP Conf. Ser. 437, Eds. J. R. Kuhn, S. V. Berdyugina, D. M. Harrington, S. Keil, H. Lin, T. Rimmele, B. J. Trujillo, 433-435.

Shigeyama, T., Nakamura, K., **Tsujimoto, T.**, Moriya, T.: 2010, GRB Nucleosynthesis in Dwarf Galaxies, AIP Conf. Proc. 1279, Eds. N. Kawai, S. Nagataki, 415-417.

Shirasaki, Y., Tanaka, M., **Ohishi, M.**, **Mizumoto, Y.**, **Takata, T.**, **Yasuda, N.**: 2010, AGN and Galaxy Clustering at $z = 0.3$–3.0 Using the Japanese Virtual Observatory, Proc. IAU Symp. 267, Eds. B. M. Peterson, R. S. Somerville, T. Storchi-Bergmann, 267.

Shirasaki, Y., **Ohishi, M.**, **Mizumoto, Y.**, **Takata, T.**, Tanaka, M., **Yasuda, N.**: 2010, Environment Study of AGNs at $z = 0.3$ to 3.0 Using the Japanese Virtual Observatory, ASP Conf. Ser. 434, Eds. Y. Mizumoto, K.-I. Morita, M. Ohishi, 402-405.

Sivaramakrishnan, A., et al. including **Martinache, F.**: 2010, Planetary system and star formation science with non-redundant masking on JWST, Proc. SPIE 7731, Eds. J. M. Oschmann Jr., M. C. Clampin, H. A. MacEwen, 3W.

Sôma, M., Tanikawa, K.: 2011, ΔT around AD 520 from Chinese Records of Eclipses and Occultations, Proc. of the 4th Symp. on "History of Astronomy", Eds. M. Sôma, K. Tanikawa, 1-4.

Sotani, H.: 2010, Stellar oscillations in TeVeS, *J. Phys.: Conf. Ser.*, **229**, Eds. R. Lazkoz, R. Vera, 012069.

Sotani, H., Kokkotas, K. D.: 2010, Polar oscillations in magnetars, *J. Phys.: Conf. Ser.*, **229**, Eds. R. Lazkoz, R. Vera, 012079.

Suda, T., **Komiya, Y.**, Habe, A., Yamada, S., Katsuta, Y., Nishimura, T., Ishizuka, C., Fujimoto, M. Y.: 2010, Pan Binary Scenario for the Origin of Extremely Metal-Poor Stars in the Galactic Halo, ASP Conf. Ser. 435, Eds. A. Prša, M. Zejda, 360-362.

Suematsu, Y., **Katsukawa, Y.**, Shimizu, T., Ichimoto, K., Horiuchi, T., Matsumoto, Y., Takeyama, N.: 2010, Optical and Thermal Design of 1.5-m Aperture Solar UV Visible and IR Observing Telescope for Solar-C Mission, Proc. of Int. Conf. of Space Optics 2010, Eds. N. Karafolas, C. Kalamida, Session 4b, pp. 1-4.

Suzuki, R., **Kudo, T.**, **Hashimoto, J.**, Carson, J., **Egner, S.**, Goto, M., **Hattori, M.**, **Hayano, Y.**, Hodapp, K., **Ito, M.**, **Iye, M.**, Jacobson, S., **Kandori, R.**, **Kusakabe, N.**, **Kuzuhara, M.**, **Matsuo, T.**, McElwain, M., **Morino, J.-I.**, **Oya, S.**, **Saito, Y.**, Shelton, R., Stahlberger, V., **Suto, H.**, **Takami, H.**, Thalmann, C., Watanabe, M., Yamada, H., **Tamura, M.**: 2010, Performance characterization of the HiCIAO instrument for the Subaru Telescope, Proc. SPIE 7735, Eds. I. S. McLean, S. K. Ramsay, H. Takami, 30.

Suzuki, R., **Usuda, T.**, Crampton, D., Larkin, J., Moore, A., Phillips, A., Simard, L.: 2010, The infrared imaging spectrograph (IRIS) for TMT: imager design, Proc. SPIE 7735, Eds. I. S. McLean, S. K. Ramsay, H. Takami, 5S.

Takahashi H. R., **Kotake K.**, **Yasutake N.**: 2011, Stability MRI-Turbulent Accretion Disks, The First Year of MAXI: Monitoring Variable X-ray Sources, Eds. K. Ebisawa, N. Kawai, online available at http://maxi.riken.jp/FirstYear, id.9.

Takahashi, H. R., Matsumoto, J., **Masada, Y.**, **Kudoh, T.**: 2010, Numerical Study of Relativistic Magnetic Reconnections, AIP Conf. Proc. 1279, 427-429.

Takahashi, H., **Matsuo, H.**, **Nakanishi, K.**: 2010, Spectroscopic Imaging Study of Nearby Spiral Galaxies: Introduction of

Observations with AKARI, NRO and ASTE, ASP Conf. Ser., 418, Eds. T. Onaka, G. J. White, T. Nakagawa, I. Yamamura, 491-494.

Takahashi, S., **Takano, S.**, **Iono, D.**, **Kuno, N.**: 2010, Doppler shift Correction for 2SB Receiver of the 45m Telescope at the Nobeyama Radio Observatory, ASP Conf. Ser. 434, Eds. Y. Mizumoto, K.-I. Morita, M. Ohishi, 425-428.

Takato, N., **Usuda, T.**: 2010, Instrumentation at the Subaru Telescope, Proc. SPIE 7735, Eds. I. S. McLean, S. K. Ramsay, H. Takami, 4.

Takiwaki, T., Harikae, S., **Kotake K.**: 2010, Neutrino Pair Annihilation in Collapsars, AIP Conf. Proc. 1279, Eds. N. Kawai, S. Nagataki, 430-432.

Tamura, M., **SEEDS Team**: 2010, First results from SEEDS, Proc. Conf. in the Spirit of Lyot 2010, Ed. A. Boccaletti, 15.

Tanaka, M., Kawabata, K. S., **Hattori, T.**, **Aoki, K.**, **Iye, M.**, Maeda, K., Mazzali, P. A., Nomoto, K., Pian, E., Sasaki, T., Yamanaka, M.: 2010, Multi-Dimensional Explosion Geometry of Supernovae: Spectropolarimetric Study with Subaru, AIP Conf. Proc. 1279, Eds. N. Kawai, S. Nagataki, 433-435.

Tavrov, A., Korablev, O., Ksanfomaliti, L., Gnedykh, V., Rodin, A., **Nishikawa, J.**, **Tamura, M.**, Takeda, M., Kurokawa, T.: 2010, A 400-3500 nm spectroscopy through a common-path interfero coronagraph instrument on 600 mm telescope on RS ISS, Proc. Conf. in the Spirit of Lyot 2010, Ed. A. Boccaletti, 82.

Thalmann, C., Grady, C. A., Goto, M., Wisniewski, J. P., Janson, M., Henning, T., Fukagawa, M., Honda, M., Mulders, G. D., Min, M., Moro-Martin, A., McElwain, M. W., Hodapp, K. W., Carson, J., **Tamura, M.**, **SEEDS Team**: 2010, Ongoing planet formation around LkCa 15?, Proc. Conf. in the Spirit of Lyot 2010, Ed. A. Boccaletti, 33.

Tokunaga, A. T., Packham, C., Okamoto, Y. K., Kataza, H., Richter, M., Carr, J., Chun, M., Telesco, C., Honda, M., Najita, J., Onaka, T., Sakon, I., **Yamashita, T.**: 2010, Design concepts for a mid-infrared instrument for the Thirty-Meter Telescope, Proc. SPIE 7735, Eds. I. S. McLean, S. K. Ramsay, H. Takami, 2C.

Tsujimoto, T.: 2010, Galaxy Formation through Winds, Infall, and Merger: Learning from Galactic Archaeology, AIP Conf. Proc. 1240, Eds. V. P. Debattista, C, C. Popescu, 175-176.

Tsujimoto, T.: 2011, Science brought by JASMINE data, EAS Publications Series, 45, Eds. C. Turon, F. Meynadier, F. Arenou, 445-448

Tsujimoto, T., Bland-Hawthorn, J.: 2010, Chemical Evolution of D in the Local Disk, Proc. IAU Symp. 268, Eds. C. Charbonnel, M. Tosi, F. Primas, C. Chiappini, 499-500.

Ueda, H., **Gouda, N.**, **Yano, T.**, Koyama, H., Sakagami, M.: 2010, A New Approach to the Construction of Dynamical Structure of our Galaxy, Highlights of Astronomy, 15, Ed. I. Corbett, 202.

Ukita, N., **Ezawa, H.**, **Onodera, S.**, **Saito, M.**: 2010, Wind-induced pointing errors and surface deformation of a 10-m submillimeter antenna, Proc. SPIE 7733, Eds. L. M. Stepp, R. Gilmozzi, H. J. Hall, 1D.

Vogt, F., **Martinache, F.**, **Guyon, O.**, Yoshikawa, T., **Yokochi, K.**, **Garrel, V.**, **Matsuo, T.**: 2010, The Subaru Coronagraphic Extreme AO (SCExAO) system: implementation and performance of the Coronagraphic Low Order Wavefront Sensor, Proc. SPIE 7736, Eds. E. Hart, H. Wizinowich, 12.

Wakabayashi, Y., **Obuchi, Y.**, **Okada, N.**, **Torii, Y.**, **Ejiri, Y.**, **Suzuki, R.**, **Ueda, A.**, **Kawamura, S.**, Araya, A., Ando, M., Sato, S., Sugamoto, A.: 2010, Structural design and analysis of test mass module for DECIGO Pathfinder, J. Phys.: Conf. Ser., 228, 012047.

Watanabe, J., Jenniskens, P., Spurny, P., Borovi'ka, J., Campbell-Brown, M., Consolmagno, G., Jopek, T., Vaubaillon, J., Williams, I P., Zhu, J.: 2010, Commission 22: Meters, Meteorites and Interplanetary Dust, Transactions of the IAU, XXVII A, Ed. K. A. van der Hucht.

Watanabe, M., **Ito, M.**, **Oya, S.**, **Hayano, Y.**, **Minowa, Y.**, **Hattori, M.**, **Saito, Y.**, **Egner, S.**, **Takami, H.**, **Iye, M.**, **Guyon, O.**, **Garrel, V.**, **Colley, S.**, **Golota, T.**: 2010, Visible low-order wavefront sensor for the Subaru LGSAO system, Proc. SPIE 7736, Eds. B. L. Ellerbroek, M. Hart, N. Hubin, P. L. Wizinowich, 183.

Wisniewski, J., Fukagawa, M., Grady, C., **Hashimoto, J.**, **Kudo, T.**, Munetake, M., Okamoto, Y., **Tamura, M.**, Hodapp, K., **SEEDS Team**: 2010, SEEDS J-band Polarimetric Imagery of the AB Aur Protoplanetary Disk, Proc. Conf. in the Spirit of Lyot 2010, Ed. A. Boccaletti, 36.

Yamada, T., et al. including **Imanishi, M.**, **Iwata, I.**, **Kobayashi, M. A. R.**, **Kodama, T.**, **Komiyama, Y.**, **Tsuneta, S.**: 2010, WISH: wide-field imaging surveyor at high redshift, Proc. SPIE 7731, Eds. J. M. Oschmann Jr., M. C. Clampin, H. A. MacEwen, 1Q.

Yamada, Y., **Gouda, N.**, Lammers, U.: 2011, Nano-JASMINE: use of AGIS for the next astrometric satellite, EAS Publications Series, 45, Eds. C. Turon, F. Meynadier, F. Arenou, 135-140.

Yamazaki, D., Ichiki, K., **Kajino, T.**, Mathews, G. J.: 2011, Primordial Magnetic Field Effects on the CMB and Large Scale Structure, Advances in Astronomy, 586590.

Yanagisawa, K., **Kuroda, D.**, Yoshida, M., **Shimizu, Y.**, **Nagayama, S.**, **Toda, H.**, Ohta, K., Kawai, N.: 2010, Six years of GRB follow up with MITSuME Okayama Telescope, AIP Conf. Proc. 1279, Eds. N. Kawai, S. Nagataki, 466-468.

Yano, T., **Araki, H.**, **Hanada, H.**, **Tazawa, S.**, **Gouda, N.**, **Kobayashi, Y.**, Yamada, Y., Niwa, Y.: 2010, Centroiding Experiment for Determining the Positions of Stars with High Precision, ASP Conf. Ser. 434, Eds. Y. Mizumoto, K.-I. Morita, M. Ohishi, 151.

Yano, T., **Gouda, N.**, **Kobayashi, Y.**, **Tsujimoto, T.**, **Hatsutori, Y.**, **Murooka, J.**, Niwa, Y., Yamada, Y.: 2011, Current Status of Astrometry Satellite missions in Japan: JASMINE project series, EAS Publications Series, 45, Eds. C. Turon, F. Meynadier, F. Arenou, 449-452.

Yasutake, N., Maruyama, T., Tatsumi, T.: 2010, Finite-size effects on hot hadron-quark mixed phase including hyperons, AIP Conf. Proc. 1269, Eds. I. Tanihata, T. Shima, H. J. Ong, A. Tamii, T. Kishimoto, H. Toki, T. Kajino, S. Kubono, 381-383.

Yatsu, Y., Nakajima, H., Enomoo, T., Tokoyoda, K., Kawakami, K., Kawai, N., Asano, K., Shimokawabe, T., Mori, Y. A., Endo, H., **Kuroda, D.**, **Yanagisawa, K.**, **Nagayama, S.**, **Shimizu, Y.**, **Toda, H.**, **Hanayama, H.**, Yoshida, M., Ohta, K.: 2010, Optical observations of the very early phase GRB afterglows with MITSuME, The First Year of MAXI: Monitoring Variable X-ray Sources, Eds. K. Ebisawa, N. Kawai.

Yoshida, F.: 2011, The project “Stars of Asia”: Asian Myths and Legends of Stars and the Universe, Proc. of the 8th East Asian Meeting on Astron. Symp., 86.

Yoshida, M., **Yanagisawa, K.**, **Kuroda, D.**, Ohta, K., Kawai, N.:

2010, Near-Infrared Photometry of the afterglow of GRB 090423, AIP Conf. Proc. 1279, Eds. N. Kawai, S. Nagataki, 469-471.

Yuk, I.-S., et al. including **Pyo, T.-S.**: 2010, Preliminary design of IGRINS (Immersion GRating INfrared Spectrograph), Proc. SPIE 7735, Eds. I. S. McLean, S. K. Ramsay, H. Takami, 54-43.

5. Publications in English

Nakagawa, A., Takahashi, K., **Hagiwara, Y.**, Nakanishi, H.: 2011, Proceedings book "SKA-JAPAN 2010 WORKSHOP", SKA-Japan Workshop Organizing Members, Kagoshima, Japan.

Nakata, F., **Yagi, M.**, **Komiyama, Y.**, Shinogi, S., **Yoshida, F.**, Marsden, B. G.: 2010, 2009 KO30, 2009 KN30, 2009 KL30, 2009 KK30, Minor Planet Electronic Circ.

Tanihata, I., et al. including **Kajino, T.**: 2010, Origin of Matter and Evolution of Galaxies, AIP , New York.

6. Conference Presentations

Agata, H.: 2010, Report of IYA2009 in Japan, 8th EAMA (East Asian Meeting on Astronomy) Symp., (Shanghai, China, Oct. 10-15, 2010).

Agata, H.: 2011, Introduction to Astronomy on NAOJ, You are Galileo!' workshop, (Mataram, Indonesia, Feb. 27, 2011).

Agata, H.: 2011, Introduction to Astronomy & Astronomical Education on NAOJ, You are Galileo!' workshop, (Tomohon, Indonesia, Mar. 2, 2011).

Agatsuma, K., **Mori, T.**, **Ballmer, S.**, Sakata, S., Reid, S., Miyakawa, O., Numata, K., Furusawa, A., **Kawamura, S.**: 2010, Status of QND experiment in NAOJ, LSC (LIGO Scientific Collaboration)-Virgo Meeting, (Cracow, Poland, Sep. 20-24, 2010).

Aikawa, Y.: 2010, Hydrocarbon chemistry in star-forming regions and protoplanetary disks, The Methane Balance - Formation and Destruction Processes on Planets, their Satellites and in the Interstellar Medium, (Bern, Switzerland, Nov. 16-18, 2010).

Akiyama, K.: 2010, Multi-Epoch VERA observations of Sagittarius A*, Towards a root of AGN jets: Recent progress, (Mitaka, Japan, Dec. 14-15, 2010).

Akutsu, T., DECIGO Working Group: 2010, DECIGO and DECIGO Pathfinder, 19th Int. Conf. on General Relativity and Gravitation (GR19), (Mexico City, Mexico, Jul. 5-9, 2010).

Anan, T., Ichimoto, K., Ueno, S., Kimura, G., Nakatani, Y., Kaneda, N., **Hagino, M.**, **Suzuki, I.**: 2010, Developments of the Multi-Wavelength Polarimeter of the Domeless Solar Telescope at the Hida Observatory, 6th Solar Polarization Workshop, (Maui, HI, USA, May 31-June 4, 2010).

Aoki, W.: 2010, Galactic Archaeology with SuMIRe PFS, The observational pursuit of dark energy after Astro2010, (Pasadena, CA, USA, Oct. 7-8, 2010).

Aoki, W., Beers, T.C., Honda, S., Carollo, S., Ito, H., Lee, Y. S.: 2010, A systematic study of extremely metal-poor stars with SDSS/Subaru, Nuclei in the Cosmos XI, (Heidlberg, Germany, Jul. 19-23, 2010).

Aoki, W., Honda, S.: 2010, Enrichment of heavy elements in the Sextans dwarf Spheroidal Galaxy, Nuclei in the Cosmos XI, (Heidlberg, Germany, Jul. 19-23, 2010).

Araki, H., **Sasaki, S.**, **Hanada, H.**, **Noda, H.**, Kunimori, H., **Kikuchi, F.**, **Matsumoto, K.**, Iwata, T., Kawano, N., Funazaki, K., RISE Group.: 2010, Investigations of In Situ Lunar Geodetic Experiments in Japan for the Study of the Interior of the Moon, EPSC (European Planetary Sciences Conf.), (Roma, Italy, Sep. 20-24, 2010).

Araki, H., **Sasaki, S.**, **Ishihara, Y.**, **Noda, H.**, **Hanada, H.**, **Matsumoto, K.**, **Kikuchi, F.**, **Goossens, S.**, Namiki, N., Iwata, T.: 2010, The First Global Topography and Gravimetry of the Moon by KAGUYA, EPSC (European Planetary Sciences Conf.), (Roma, Italy, Sep. 20-24, 2010).

Araki, H., **Tazawa, S.**, **Noda, H.**, **Ishihara, Y.**, **Goossens, S.**, **Sasaki, S.**: 2011, The second version of the Lunar topographic data sets by KAGUYA-LALT, The 5th KAGUYA (SELENE) Science Working Team Meeting, (Tokyo, Japan, Jan. 17-19, 2011).

Araki, M., Koshikawa, N., Yamabe, H., Umeki, H., Tsukiyama, K., **Takano, S.**, Kuze, N.: 2010, Spectral Lines of Carbon Chain Molecule in a Star Forming Region L1527 between 29 and 90 GHz, Workshop on Interstellar Matter 2010, (Sapporo, Japan, Sept. 13-15, 2010).

Ballmer, S.: 2010, Thoughts on optimizing coating thermal noise, Gravitational-Wave Advanced Detector Workshop 2010(GWADW2010), (Kyoto, Japan, May 16-21, 2010).

Berger, T., **Okamoto, J.**, Labrosse, N.: 2010, Diagnostics of prominence structure, dynamics, and radiation with Hinode SOT & EIS, Hinode-IV: unsolved problems and recent insights, (Mondello, Palermo, Italy, Oct. 11-15, 2010).

Deguchi, S.: 2010, $HOCO^+$ toward Sgr B2 Complex, Workshop on Interstellar Matter 2010, (Sapporo, Japan, Sept. 13-15, 2010).

Enya, K., et al. including **Yamashita, T.**, **Narita, N.**, **Tamura, M.**, **Nishikawa, J.**, **Hayano, Y.**, **Oya, S.**, **Kokubo, E.**, **Guyon, O.**: 2010, SPICA Capability for Studying Transiting Exoplanets, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Fujii, Y., **Uzawa, Y.**, **Kaneko, K.**, **Kroug, M.**, **Gonzalez, A.**, **Kuroiwa, K.**, **Miyachi, A.**, **Ogawa, H.**, **Makise, K.**, **Wang, Z.**, **Wang, M.**, **Shan, W.**: 2010, Development of the 787–950 GHz ALMA Band 10 Cartridge, The 11th Workshop on Submillimeter-Wave Receiver Technologies in Eastern Asia, (Nagoya, Japan, Nov. 14-16, 2010).

Fujiwara, K., Tsuiki, A., Kamiyoshi, S., Utsunomiya, S., Yasuda, S., Sato, Y., **Gouda, N.**, **Kobayashi, Y.**, **Yano, T.**, **Hatsutori, Y.**, Niwa, Y., Yamada, Y.: 2010, Preliminary Design of High Precision Tip-Tilt Mirror Control System for the small JASMINE satellite, 11th Annual Summer School on Adaptive Optics, (CA, USA, Aug. 8-13, 2010).

Fukue, T., **Tamura, M.**, **Kandori, R.**, **Kusakabe, N.**, Hough, J. H., Lucas, P. W., Bailey, J., Whittet, D. C. B., **Nakajima, Y.**, **Hashimoto, J.**, Nagata, T.: 2010, Near-Infrared Image of Circular Polarization in the Orion Nebula, Workshop on Interstellar Matter 2010, (Sapporo, Japan, Sept. 13-15, 2010).

Fukue, T., **Tamura, M.**, **Kandori, R.**, **Kusakabe, N.**, Hough, J. H., Lucas, P. W., Bailey, J., Whittet, D. C. B., **Nakajima, Y.**, **Hashimoto, J.**, Nagata, T.: 2010, Circular Polarimetry of the Orion Nebula by SIRPOL, AOGS 2010, (Hyderabad, India, Jul. 5-9, 2010）.

Furuya, K., **Aikawa, Y.**, Sakai, N., Yamamoto, S.: 2010, Carbon Isotope and Isotopomer Fractionation in Cold Dense Cloud Cores, Workshop on Interstellar Matter 2010, (Sapporo, Japan, Sept. 13-15, 2010).

Gao, Yu., Zhang, H., Kuzanyan, K., **Xu, H.**, Sokoloff, D.: 2010, Polarity Rule for Vector Magnetic Fields in the Solar Photosphere, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Giroletti, M., Paragi, Z., Bignall, H., Foschini, L., Blanchard, J., Colomer, F., Doi, A., Hong, X., Kadler, M., **Kino, M.**, van Langevelde, H. J., Nagai, H., Phillips, C., Sekido, M., Szomoru, A., Tzioumis, A. K.: 2010, The first scientific experiment using Global eVLBI observations: a multiwavelength campaign on the gamma-ray Narrow-Line Seyfert 1 PMN J0948+0022, The 10th European VLBI Network Symposium: VLBI and the New Generation of Radio Arrays, (Manchester, UK, Sep. 20-24, 2010).

Gonzalez, A., **Uzawa, Y.**, **Fujii, Y.**, **Kaneko, K.**, **Kroug, M.**, **Kuroiwa, K.**, **Miyachi, A.**: 2010, Beam Performance Characterization of ALMA Band 10 Cartridge, The 11th Workshop on Submillimeter-Wave Receiver Technologies in Eastern Asia, (Nagoya, Japan, Nov. 14-16, 2010).

Goossens, S., **Matsumoto, K.**, **Ishihara, Y.**, Liu, Q., **Kikuchi, F.**, **Hanada, H.**, **Noda, H.**, Namiki, N., Iwata, T.: 2010, SELENE Orbit Determination And Gravity Field Model Evaluation, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Goossens, S., **Matsumoto, K.**, **Kikuchi, F.**, Liu, Q., **Hanada, H.**, Lemoine, F. G., Rowlands, D. D., **Ishihara, Y.**, Yan, J., **Araki, H.**, **Noda, H.**, Namiki, N., Iwata, T.: 2010, Analysis of Multi-Satellite Tracking Data of the Kaguya Satellites for Orbit and Gravity Field Determination, AGU Fall Meeting, (San Francisco, CA, USA, Dec. 13-17, 2010).

Goossens, S., **Matsumoto, K.**, Liu, Q., **Kikuchi, F.**, **Hanada, H.**, **Ishihara, Y.**, **Noda, H.**, Kawano, N., Lemoine, F. G., Rowlands, D. D., Namiki, N., Iwata, T., **Sasaki, S.**, Yan, J.: 2011, Overview of Kaguya lunar gravity field determination results, The 5th KAGUYA (SELENE) Science Working Team Meeting, (Tokyo, Japan, Jan. 17-19, 2011).

Gouda, N., JASMINE working group: 2010, Series of JASMINE Missions, ELSA conference 2010 GAIA: At the Frontiers of Astrometry, (Sèvres, France, Jun. 7-11, 2010).

Hada, K.: 2010, Nailing down the black hole location in M87, Towards a root of AGN jets: Recent progress, (Mitaka, Japan, Dec. 14-15, 2010).

Hagino, M., **Hanaoka, Y.**, **Sakurai, T.**, Ichimoto, K.: 2010, Quantitative Comparison between the Polarization Data Taken with the Solar Flare Telescope and with the Hinode SOT Spectro-Polarimeter, 6th Solar Polarization Workshop, (Maui, HI, USA, May 31-June 4, 2010).

Hagiwara, Y.: 2010, Ground radio telescope support for VSOP-2: An overview, East Asia VLBI Workshop 2010, (Kagoshima, Japan, Apr. 22-24, 2010).

Hagiwara, Y.: 2010, EVN Observations of active galaxy NGC 6240, The 10th European VLBI Network Symposium: VLBI and the New Generation of Radio Arrays, (Manchester, UK, Sep. 20-24, 2010).

Hagiwara, Y.: 2010, VLBI observations of double nuclei of an active galaxy NGC 6240, Towards a root of AGN jets: Recent progress, (Mitaka, Japan, Dec. 14-15, 2010).

Hagiwara, Y.: 2011, Science: VLBI (Extragalactic), East-Asia Interferometry Winter School, (Mitaka, Japan, Feb. 7-11, 2011).

Hamana, T.: 2010, Searching for clusters with weak lensing and HSC survey, CL J2010: from Massive Galaxy Formation to Dark Energy, (Kashiwa, Japan, Jun. 28-Jul. 2, 2010).

Hanada, H., **Noda, H.**, **Kikuchi, F.**, **Sasaki, S.**, Iwata, T., Kunimori, H., Funazaki, K., **Araki, H.**, **Matsumoto, K.**, **Tazawa, S.**, **Tsuruta, S.**: 2010, Development of selenodetic instruments for Japanese lunar explorer SELENE-2, The first Moscow Solar System Symp. (1MS3), (Moscow, Russia, Oct. 11-15, 2010).

Hanada, H., Ping, J., Funazaki, K., Kawano, N., Petrova, N., **Araki, H.**, **Tazawa, S.**, **Tsuruta, S.**, **Noda, H.**, **Asari, K.**, **Sasaki, S.**, Li, Z., Su, X., Satoh, A., Taniguchi, H., Kikuchi, M., Takahashi, T., Yamazaki, A., Murata, K., Iwata, T.: 2010, Development of a photographic zenith tube for observation of the lunar rotation and the deflection of the vertical, IAG symp. on terrestrial gravimetry, (Saint Petersburg, Russia, Jun. 22-25, 2010).

Hanaoka, Y.: 2010, Scientific and Educational Applications of a Small Coelostat/Spectrograph System, 1st Latin American FMT Workshop, (Ica, Peru, Nov. 22-26, 2010).

Hanaoka, Y., Kikuta, Y., Nakazawa, J., Ohnishi, K., Shiota, K.: 2010, Brightness of the white light corona measured at the total solar eclipses in 2008 and 2009, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Hanayama, H.: 2010, Generation Process of Seed Magnetic Fields with Biermann Mechanism in Primordial Supernova Remnants, Japan SKA Int. Workshop 2010, (Mitaka, Japan, Nov. 4-5, 2010).

Hanayama, H., **Miyaji, T.**: 2010, Ishigakijima Astronomical Observatory and Murikabushi 105cm Telescope, An Ishigaki Int. Conf. on Evolving Theory for Planet Formation, (Ishigaki, Japan, Jun. 20-26, 2010).

Hara, H.: 2010, Coronal Plasma Motions at the Site of Coronal Heating in Active Region Loops, AGU, 2010 Meeting of the Americas, (Iguassu, Brazil, Aug. 9-12, 2010).

Hara, H.: 2010, Spectroscopic Observations of Magnetic Reconnection in the Solar Corona, Mgnetic Reconnection 2010, (Nara, Japan, Dec. 6-9, 2010).

Hara, H.: 2010, Flows in active regions revealed from Hinode EIS Observations, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Hara, H.: 2010, Plasma Heating and Velocity Fields nearby Magnetic Reconnection Site Revealed from an EUV Emission-line Spectroscopy, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Hara, H.: 2010, Magnetic Structures Associated with Unresolved Fast Coronal Upflows in Plage Regions, Hinode-IV: unsolved problems and recent insights, (Mondello, Palermo, Italy, Oct. 11-15, 2010).

Hashimoto, K., **Watanabe, J.**, **Sato, M.**: 2010, Identification of optical component of North Toroidal Source of sporadic meteors and its origin, Meteoroids 2010, An Int. Conf. on Minor Bodies in the Solar System, (Breckenridge, CO, USA, May 24-28, 2010).

Hashimoto, T., Ohta, K., **Aoki, K.**, **Tanaka, I.**, Yabe, K., Kawai, N., **Aoki, W.**, **Furusawa, H.**, **Hattori, T.**, **Iye, M.**, Kawabata, K. S., Kobayashi, N., **Komiyama, Y.**, **Kosugi, G.**, **Minowa, Y.**, **Mizumoto, Y.**, Niino, Y., Nomoto, K., **Noumaru, J.**, **Ogasawara, R.**, **Pyo, T.-S.**, Sakamoto, T., **Sekiguchi, K.**, **Shirasaki, Y.**, Suzuki, M., **Tajitsu, A.**, **Takata, T.**, Tamagawa, T., **Terada, H.**, Totani, T., **Watanabe, J.**, Yamada, T., Yoshida, A.: 2010, "Dark" GRB 080325 in a dusty massive galaxy at z~2, 26th IAP Annual Colloquium "Progenitors and environments of stellar explosions", (Paris, France, Jun. 28-Jul. 2, 2010).

Hashimoto, T., Ohta, K., **Aoki, K.**, **Tanaka, I.**, Yabe, K., Kawai, N., **Aoki, W.**, **Furusawa, H.**, **Hattori, T.**, **Iye, M.**, Kawabata, K. S., Kobayashi, N., **Komiyama, Y.**, **Kosugi, G.**, **Minowa, Y.**, **Mizumoto, Y.**, Niino, Y., Nomoto, K., **Noumaru, J.**, **Ogasawara, R.**, **Pyo, T.-S.**, Sakamoto, T., **Sekiguchi, K.**, **Shirasaki, Y.**, Suzuki, M., **Tajitsu, A.**, **Takata, T.**, Tamagawa, T., **Terada, H.**, Totani, T., **Watanabe, J.**, Yamada, T., Yoshida, A.: 2010, "Dark" GRB 080325 in a Dusty Massive Galaxy at $z \sim 2$, Deciphering the Ancient Universe with Gamma-Ray Bursts, (Kyoto, Japan, Apr. 19-23, 2010).

Hatsutori, Y., **Kobayashi, Y.**, **Gouda, N.**, **Yano, T.**, **Murooka, J.**, Niwa, Y., Yamada, Y.: 2010, Performance Evaluation of Nano-JASMINE, ELSA conference 2010 GAIA: At the Frontiers of Astrometry, (Sèvres, France, Jun. 7-11, 2010).

Hayashi, M., **Kodama, T.**, Koyama, Y., **Tadaki, K.**: 2010, A wide-field survey for [OII] emission in and around a cluster at $z = 1.46$, CL J2010: from Massive Galaxy Formation to Dark Energy, (Kashiwa, Japan, Jun. 28-Jul. 2, 2010).

Hayashi, T.: 2010, Multi-frequency polarimetry of radio-loud broad absorption quasars, Towards a root of AGN jets: Recent progress, (Mitaka, Japan, Dec. 14-15, 2010).

Hayashi, T.: 2010, Multi-wavelength polarimetry of radio-loud broad absorption quasars, Japan SKA Int. Workshop 2010, (Mitaka, Japan, Nov. 4-5, 2010).

Hibi, Y., **Matsuo, H.**, Nagata. H., Ikeda, H., Fujiwara, M.: 2010, The Cryogenic Readout System with GaAs JFETs for Multi-pixel Cameras, SPIE Conf., Infrared, Millimeter Wave, and Terahertz Technologies, (Beijing, China, Oct. 18-20, 2010).

Hibi, Y.: 2010, The Cryogenic Readout System and the Cryogenic OP-Amp With GaAs-JFETs, The 11th Workshop on Submillimeter-Wave Receiver Technologies in Eastern Asia, (Nagoya, Japan, Nov. 14-16, 2010).

Hirota, T.: 2010, Development of astrometry analysis software; VEDA, East Asia VLBI Workshop 2010, (Kagoshima, Japan, Apr. 22-24, 2010).

Hirota, T.: 2010, Astrometry of H_2O maser sources in nearby star-forming regions with VERA, The 10th European VLBI Network Symposium: VLBI and the New Generation of Radio Arrays, (Manchester, UK, Sep. 20-24, 2010).

Hirota, T.: 2010, VLBI Observations of Galactic radio sources, Japan SKA Int. Workshop 2010, (Mitaka, Japan, Nov. 4-5, 2010).

Hirota, T.: 2011, Proposal preparation, East-Asia Interferometry Winter School, (Mitaka, Japan, Feb. 7-11, 2011).

Hong, P. K., Sugita, S., Okamura, N., Sekine, Y., **Terada, H.**, **Takatoh, N.**, **Hayano, Y.**, Fuse, T., Kawakita, H., Wooden, D. H., Young, E. F., Lucey, P. G., **Furusho, R.**, **Watanabe, J.**, Haruyama, J., Nakamura, R., Kurosawa, K., Hamura, T., Kadono, T.: 2010, Hot Bands Observation of Water in Ejecta Plume of LCROSS Impact Using the Subaru Telescope, 41st Lunar and Planetary Science Conf., (Woodlands, TX, USA, Mar. 1-5, 2010).

Honma, M.: 2010, The structure of the Milky Way Galaxy traced with VERA, Spiral Structure in the Milky Way: Confronting Observations and Theory, (Bahia Inglesa, Chile, Nov. 7-10, 2010).

Honma, M.: 2010, sub-mm VLBI observations of super massive black holes and East Asian VLBI Network, East Asia VLBI Workshop 2010, (Kagoshima, Japan, Apr. 22-24, 2010).

Honma, M.: 2010, mm/sub-mm VLBI toward the BH event horizon, Towards a root of AGN jets: Recent progress, (Mitaka, Japan, Dec. 14-15, 2010).

Honma, M.: 2010, VERA Key Science Projects (original title in Korea), 2010 KVN and TRAO Radio Workshop, (Seoul, Korea, Aug. 16-18, 2010).

Honma, M.: 2011, VERA and the Japan – Korea collaboration, Future of the VLBA, (Charlottesville, USA, Jan. 27-28, 2011).

Honma, M.: 2011, Interferometry, East-Asia Interferometry Winter School, (Mitaka, Japan, Feb. 7-11, 2011).

Ichihashi, Y., **Nakayama, H.**, Awazu, S., Shimobaba, T., Masuda, N., Ito, T.: 2010, Real-Time Reconstruction System Using Multi Graphics Processing Units for 3D holographic display, SISA2010, (Manila, Philipine, Sep. 8, 2010).

Ichihashi, Y., **Nakayama, H.**, Awazu, S., Shimobaba, T., Masuda, N., Ito, T.: 2010, Real-Time Reconstruction System Using High-Performance Computer for Electroholography, ICIS2010, (Yamagata, Japan, Aug. 20, 2010).

Iguchi, S., **Saito, M.**: 2010, Next Generation Millimeter/Sub-millimeter Array to Search for 2nd Earh, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Ikeda, Y., Kobayashi, N., Kuzmenko, P. J., Little, S. L.,**Yasui, C.**, Kondo, S., Mito, H., **Nakanishi, K.**, Sarugaku, Y.: 2010, Fabrication and current optical performance of a large diamond-machined ZnSe immersion grating, SPIE Astronomical Instrumentation, (San Diego, CA, USA, Jun. 27-Jul. 2, 2010).

Imanishi, M.: 2010, The AGN-starburst connections in nearby luminous infrared galaxies, Extrene starbursts in the local universe, (Granada, Spain, Jun. 21-25, 2010).

Imanishi, M.: 2011, High-redshift QSO study with HSC/PFS, DENET 2011 Subaru HSC workshop, (Taipei, Taiwan, Mar. 7-8, 2011).

Inoue, H., **Noguchi, T.**, Kohno, K.: 2010, SIS junction using as a microwave noise source, Applied Superconductivity Conf., (Washington DC, USA, Aug. 1-6, 2010).

Ishihara, Y., et al.: 2011, Did the Moscoviense Basin Has Been Formed by Souble-Impact?, The 5th KAGUYA (SELENE) Science Working Team Meeting, (Tokyo, Japan, Jan. 17-19, 2011).

Ishihara, Y., Morota, T., Nakamura, R., **Goossens, S.**, **Sasaki, S.**: 2011, Was the Moscoviense Basin Formed by Double-Impact?, 42nd Lunar and Planetary Science Conf., (Woodsland, TX, USA, Mar. 7-11, 2011).

Ishikawa, R.: 2010, Ultra deep exposure observations of quiet Sun magnetic fields, Hinode-IV: unsolved problems and recent insights, (Mondello, Palermo, Italy, Oct. 11 - 15, 2010).

Ishikawa, R., et al.: 2010, A Sounding rocket experiment for spectropolrimetric observation with Ly-alpha line at 121.6 nm (CLASP), 6th Solar Polarization Workshop, (Maui, HI, USA, May 31-June 4, 2010).

Ishikawa, R.: 2010, The properties and origin of transient horizontal magnetic fields, 6th Solar Polarization Workshop, (Maui, HI, USA, May 31-June 4, 2010).

Ishitsu, N., Inutsuka, S., Sekiya, M.: 2010, Dust diffusion by the streaming instability in a protoplanetary disk, An Ishigaki Int. Conf. on Evolving Theory for Planet Formation, (Ishigaki, Japan, Jun. 20-26, 2010).

Ishiyama, T.: 2010, Variation of the Subhalo Abundance in Dark Matter Halos, CL J2010: from Massive Galaxy Formation to Dark Energy, (Kashiwa, Japan, Jun. 28-Jul. 2, 2010).

Ishiyama, T.: 2010, Bias-free survey of subhalos in dark matter halos, Evolution of galaxies, their central black holes and their large-scale environment, (Potsdam, Germany, Sep. 20-24, 2010).

Ishiyama, T.: 2010, High Resolution Simulations of Small Scale Structures of Dark Matter Halos, The 4th East Asian Numerical Astrophysics Meeting, (Taipei, Taiwan, Nov. 2-5, 2010).

Ito, T.: 2010, Comparison of seeing between Maidanak and Nyukasa, Maidanak Users Meeting 2010, (Tashkent, Uzbekistan, June 21-25, 2010).

Ito, T., Higuchi, A.: 2010, Impact probability of the Oort cloud comets on planets, AOGS 2010, (Hyderabad, India, Jul. 5-9, 2010）.

Ito, T., Malhotra, R.: 2010, Asymmetric cratering due to a steady-state NEA flux on the Moon, AOGS 2010, (Hyderabad, India, Jul. 5-9, 2010).

Iwai, K., Masuda, S., Miyoshi, Y., **Shimojo, M.**, Misawa, H., Tsuchiya, F., Morioka, A.: 2010, Relationship between solar radio type-I noise storm and Coronal Mass Ejection, AGU Fall Meeting, (San Francisco, CA, USA, Dec. 13-17, 2010).

Iwata, T., **Hanada, H.**, **Noda, H.**, **Kikuchi, F.**, Harada, Y.: 2010, Lunar, Martian, and Jovian geodesy, and science observation using VLBI and astrometrical technology, The first Moscow Solar System Symp. (1MS3), (Moscow, Russia, Oct. 11-15, 2010).

Izumiura, H., Ueta, T., Yamamura, I., Nakada, Y., Matsunagata, N., Ita, Y., Matsuura, M., Fukushi, H., Mito, H., Tanabe, T., Sorahana, T., Hashimoto, O.: 2010, Symmetric and asymmetric circumstellar dust shells in evolved stars revealed by AKARI, Asymmetric Planetary Nebulae 5, (Bowness-on-Windermere, England, Jun. 20-25, 2010).

Kajino, T.: 2010, Nuclear Weak Interactions and Supernova Neutrino- and R-Processes, 3rd Int. Conf. on Frontiers In Nuclear Structure, Astrophysics and Reactions, (Rhodos, Greece, Aug. 23-27, 2010).

Kajino, T.: 2010, Supernova neutrinos, nucleosynthesis, and neutrino oscillation, Symp. at Joint Institute for Nuclear Astrophysics, (East Lansing, USA, Apr. 18-20, 2010).

Kajino, T.: 2010, Supernova neutrino process and nuclear structure, Workshop on Nuclear Astrophysics, (Tokyo, Japan, Jun. 26, 2010).

Kajino, T.: 2010, Nuclear astrophysics - theory, Workshop on the Nuclear Physics and Nuclear Astrophysics, (Seoul, Korea, Oct. 26-27, 2010).

Kajino, T.: 2010, Nucleosynthesis and neutrinos, Int. Symp. on New Faces of Atomic Nuclei, (Okinawa, Japan, Nov. 15-17, 2010).

Kajino, T.: 2010, Similarity between $3a \rightarrow C^{12}+g$ and $2a+n \rightarrow Be^{9}+g$ rates and their implication in SN *r*-process, RNC Workshop on Impact of Triple-Alpha Reaction Rate on Stellar Evolution and Nucleosynthesis, (Nishina, Japan, Dec. 17-18, 2010).

Kajino, T.: 2010, $C^{12}(a,g)O^{16}$ reaction in massive stars - Implication in gamma-ray line astronomy of A^{l26} and Fe^{60}, 3rd Institute of Origin of Matter and Evolution of Galaxies, (Tokyo, Japan, Nov. 1, 2010).

Kajino, T.: 2010, Nucleosynthesis in Gamma-Ray Bursts and Extremely Metal-Deficient Halo Stars, 24th Int. Nuclear Physics Conf., (Vancouver, Canada, Jul. 7 - 9, 2010).

Kajino, T.: 2011, Supernova Nucleosynthesis, Neutrino Oscillation, and Nuclear Weak Interactions, French-Japanese Symposium on Nuclear Structure Problems, (Wako, Japan, Jan. 5-8, 2011).

Kajino, T.: 2011, Origin and Evolution of the Universe; from the Big-Bang to the Element Genesis, Sokendai Asian Winter School on Science of Structure Formation - Light, Energy, Material, and Space, (Toki, Japan, Feb. 15-18, 2011).

Kambe, E.: 2010, Status Report on Commissioning Observations with the Fiber-link of 188-cm Telescope and HIDES, China-Japan collaboration project meeting, (Xinglong, China, Nov. 25, 2010).

Kameya, O.: 2010, Pulsar study using the SKA, Japan SKA Int. Workshop 2010, (Mitaka, Japan, Nov. 4-5, 2010).

Kameya, O., **Tatsuzawa, K.**, **Okayasu, R.**, Chikada, Y., **Kawabe, R.**, Yamamoto, S., **Kawaguchi, N.**: 2010, Interference Caused by 79GHz High Resolution Radars for Automotive Applications –an estimation of co-existence between Radio Astronomy and 79GHz SRRs– NOBEYAMA 45m Radio Telescope, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Kano, R.: 2010, Multi-thermal Structures Above a Polar Region Observed with XRT and EIS, 2010 XRT Team Meeting, (Bozeman, MT, USA, Jun. 16-18, 2010).

Kano, R.: 2010, Super-hot component in non-flaring active regions, Hinode-IV: unsolved problems and recent insights, (Mondello, Palermo, Italy, Oct. 11-15, 2010).

Kashikawa, N.: 2010, Probing EoRwith LAE surveys, The first galaxies, QSOs & GRBs, (Penn State University, PA, USA, Jun. 7-11, 2010).

Kashikawa, N.: 2011, Concluding the census of LAEs at the reionization epoch w/Subaru+Keck, Subaru Users Meeting, (Mitaka, Japan, Jan. 19-20, 2011).

Kashikawa, N.: 2011, Current status and activities in Japan: Future Instrument Plan, TMT Science and Instrument WS, (Victoria, Canada, Mar. 28-30).

Katase, T., Kimura, K., Muraoka, K., **Onishi, T.**, **Ogawa, H.**, **Nakajima, T.**, **Kuno, N.**, **Kawabe, R.**: 2010, Development of a New 2×2 Multi Beams Receiver for Nobeyama 45m Radio Telescope, The 11th Workshop on Submillimeter-Wave Receiver Technologies in Eastern Asia, (Nagoya, Japan, Nov. 14-16, 2010).

Kato, Y., Steiner, O., Steffen, M., **Suematsu, Y.**: 2010, Excitation of acoustic waves in network magnetic elements, IAU Symp. 273, (Ventura, CA, USA, Aug. 2226, 2010).

Kato, Y., Steiner, O., Steffen, M., **Suematsu, Y.**: 2010, Excitation of Slow-Mode Waves in Network Magnetic Element, Hinode-IV: unsolved problems and recent insights, (Mondello, Palermo, Italy, Oct. 11-15, 2010).

Katsukawa, Y., Asensio Ramos, A., Trujillo Bueno J.: 2010, Hanle-Zeeman Diagnostics of Active Region Filaments in He I 10830A, Hinode-IV: unsolved problems and recent insights, (Mondello, Palermo, Italy, Oct. 11-15, 2010).

Katsukawa, Y., Masada, Y., Shimizu, T., Sakai, S., Ichimoto, K.: 2010, Pointing stability of Hinode and requirements for the next solar mission Solar-C, Int. Conf. on Space Optics, (Rhodes, Greece, Oct. 4-8, 2010).

Katsukawa, Y., Orozco Suarez, D.: 2010, Power spectral analysis of magnetized turbulence on the solar surface, Mgnetic Reconnection 2010, (Nara, Japan, Dec. 6-9, 2010).

Katsukawa, Y., SOLAR-C WG: 2010, Chromospheric Diagnostics in the Next Japanese Solar Mission SOLAR-C, 6th Solar Polarization Workshop, (Maui, HI, USA, May 31-June 4, 2010).

Katsukawa, Y.: 2010, Prospects for High-Resolution Solar Observations, 太陽フレア望遠鏡20周年記念研究会「太陽観測装置の新展開」, (Mitaka, Japan, Jul. 26-27, 2010).

Kawaguchi, N.: 2010, Raw Vlbi Data Buffer in use for efficient correlation processing by KJJVC, East Asia VLBI Workshop 2010, (Kagoshima, Japan, Apr. 22-24, 2010).

Kawaguchi, N.: 2010, Ultra wideband VLBI technologies for precise astrometry and geodesy, East Asia VLBI Workshop 2010, (Kagoshima, Japan, Apr. 22-24, 2010).

Kawaguchi, N.: 2010, Technical Interests on the SKA, Japan SKA Int. Workshop 2010, (Mitaka, Japan, Nov. 4-5, 2010).

Kawaguchi, N.: 2010, Report from Mizusawa VLBI Observatory, 8th EAMA (East Asian Meeting on Astronomy) Symp., (Shanghai, China, Oct. 10-15, 2010).

Kawaguchi, N., **Kono, Y.**, **Oyama, T.**: 2010, High Speed A/D Converter for Homodyne Detection of a Wideband Signal, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Kawamura, S., et al. including **Agatsuma, K.**, **Akutsu, T.**, **Chen, D.**, **Ejiri, Y.**, **Fujimoto, M.**, **Fukushima, M.**, **Hayama, K.**, **Ishizaki, H.**, **Izumi, K.**, **Kotake, K.**, **Nakamura, K.**, **Nishida, E.**, **Obuchi, Y.**, **Ohishi, N.**, **Okada, N.**, **Suzuki, R.**, **Takahashi, R.**, **Torii, Y.**, **Ueda, A.**, **Yamazaki, T.**: 2010, The Japanese Space Gravitational Wave Antenna DECIGO, 8th int. LISA Symp., (Stanford, CA, USA, Jun. 28-Jul. 2, 2010).

Kawamura, S.: 2011, Design of LCGT, Workshop between KGWG and LCGT, (Seoul, Korea, Jan. 22, 2011).

Kawata, D., et al.: 2010, Transient spiral arms and chemodynamics of the Galactic disk, GCDS survey science, (Nice, France, Nov. 2-4, 2010).

Kida, S., Daishido, T., Tanaka, T., Aoki, T., Asuma, K., **Niinuma, K.**, Akamatsu, H., Imai, A., Miyata, H.: 2010, Radio Variability of Fermi Large Area Telescope Bright Source 0FGL J1847.8+3223, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Kijima, M.: 2010, Application of geodetic-VLBI data to obtain longterm light-curves, East Asia VLBI Workshop 2010, (Kagoshima, Japan, Apr. 22-24, 2010).

Kijima, M.: 2010, The application of the VLBI archive data to drawing light curves for AGN sciences, Towards a root of AGN jets: Recent progress, (Mitaka, Japan, Dec. 14-15, 2010).

Kikuchi, F., **Hanada, H.**, **Noda, H.**, **Sasaki, S.**, Iwata, T.: 2010, The study of lunar rotation by Japanese lunar landing missions, European Geosciences Union General Assembly, (Vienna, Austria, May 2-7, 2010).

Kikuchi, F., **Matsumoto, K.**, Iwata, T., **Hanada, H.**, **Asari, K.**, Liu, Q., **Goossens, S.**, **Kono, Y.**, Takeuchi, H., Kawano, N., **Sasaki, S.**: 2010, Application of VLBI Technique for Lunar and Planetary Mission, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Kim, M. K.: 2010, Water masers associated with outflows in Orion-KL, East Asia VLBI Workshop 2010, (Kagoshima, Japan, Apr. 22-24, 2010).

Kimura, K., Katase, T. Muraoka, K., **Onishi, T.**, **Ogawa, H.**, **Nakajima, T.**, **Kuno, N.**, **Kawabe, R.**: 2010, Optical Design of a New 4 Multi-Beam 100-GHz Band Receiver for The NRO 45-m Radio Telescope, The 11th Workshop on Submillimeter-Wave Receiver Technologies in Eastern Asia, (Nagoya, Japan, Nov. 14-16, 2010).

Kino, M.: 2010, Hadronic emission from mini radio lobes, Towards a root of AGN jets: Recent progress, (Mitaka, Japan, Dec. 14-15, 2010).

Kino, M.: 2010, AGN science with SKA, Japan SKA Int. Workshop 2010, (Mitaka, Japan, Nov. 4-5, 2010).

Kino, M., Asano, K.: 2010, Hadronic gamma-ray emission from extragalactic mini radio lobes, Fermi meets Jansky-AGN at Radio and Gamma-rays, (Bonn, Germany, Jun. 21-23, 2010).

Kobayashi, H.: 2010, Recent results of VERA, East Asia VLBI Workshop 2010, (Kagoshima, Japan, Apr. 22-24, 2010).

Kobayashi, H.: 2010, Operation plan of EAVN, East Asia VLBI Workshop 2010, (Kagoshima, Japan, Apr. 22-24, 2010).

Kobayashi, H.: 2011, Japanese VLBI Programs, the East Asia VLBI Network and Space VLBI:VSOP-2, Future of the VLBA, (Charlottesville, USA, Jan. 27-28, 2011).

Kobayashi, H., Kim, B.-G., Shen, Z.-G.: 2010, EAST-ASIAN VLBI NETWORK, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Kobayashi, H., **Miyazaki, A.**, **Kawaguchi, N.**, **Sawada-Satoh, S.**, **East Asia VLBI consortium**: 2010, Activities of East Asian VLBI network, 8th EAMA (East Asian Meeting on Astronomy) Symp., (Shanghai, China, Oct. 10-15, 2010).

Kobayashi, K., **Tsuneta, S.**, Trujillo Bueno, J., Cirtain, J. W., **Bando, T.**, **Kano, R.**, **Hara, H.**, Fujimura, D., **Ueda, K.**, **Ishikawa, R.**, Watanabe, H., Ichimoto, K., Sakao, T., de Pontieu, B., Carlsson, M., Casini, R.: 2010, The Chromospheric Lyman Alpha SpectroPolarimeter (CLASP), AGU Fall Meeting, (San Francisco, CA, USA, Dec. 13-17, 2010).

Kobayashi, M. A. R.: 2010, A model prediction to the physical quantities of high-z Lyman-alpha emitters, Evolution of galaxies, their central black holes and their large-scale environment, (Potsdam, Germany, Sep. 20-24, 2010).

Kobayashi, Y., **Yano, T.**, **Gouda, N.**, Niwa, Y., **Murooka, J.**, Yamada, Y., Sako, N., Nakasuka, S.: 2010, Nano-JASMINE: current status and data output, SPIE Astronomical Instrumentation, (San Diego, CA, USA, Jun. 27-Jul. 2, 2010).

Kobayashi, Y., **Yano, T.**, **Hatsutori, Y.**, **Gouda, N.**, **Murooka, J.**, Niwa, Y., Yamada, Y.: 2011, Nano-JASMINE: Simulation of Data Outputs, ELSA conference 2010 GAIA: At the Frontiers of Astrometry, (Sèvres, France, Jun. 7-11, 2010).

Kodama, T.: 2010, Panoramic Views of Cluster Evolution with Subaru, CL J2010: from Massive Galaxy Formation to Dark Energy, (Kashiwa, Japan, Jun. 28-Jul. 2, 2010).

Kodama, T.: 2010, Star Formation History and its Environmental Dependence, FMOS science meeting, (Oxford, UK, Jul. 30, 2010).

Kodama, T.: 2010, Panoramic Views of Galaxy Cluster Evolution, Galaxy Formation Forum , (Seoul, Korea, Jun. 2, 2010).

Kokubo, E.: 2010, Planetesimal Dynamics and Accretion, An Ishigaki Int. Conf. on Evolving Theory for Planet Formation, (Ishigaki, Japan, Jun. 20-26, 2010).

Komiya, Y., Suda, T., Fujimoto, M. Y.: 2011, IMF of Extremely Metal-Poor Starsand Formation of the Milky Way, CPS 7th Int. School of Planetary Sciences: Theory of Stellar Evolution and Its Applications, (Kobe, Japan, Jan. 10-15, 2010).

Komugi, S.: 2010, The AKARI Far-Infrared Surveyor (FIS): All-Sky Diffuse Map, Tracing the Ancestry of Galaxies on the Land of our Ancestors, (Ouagadougou, Burkina Faso, Dec. 13-17, 2010).

Komugi, S.: 2010, Cold Dust and its Heating Sources in M33, Tracing the Ancestry of Galaxies on the Land of our Ancestors, (Ouagadougou, Burkina Faso, Dec. 13-17, 2010).

Kotake, K.: 2010, Gravitational waves from successful vs. failed supernova explosions, Korean Physical Society Meeting (special session on compact objects), (Pyonchong, Korea, Oct. 20-22, 2010).

Kotake, K.: 2010, Multidimensional modeliing of core-collapse supernovae, 35th Workshop on Gravitation and Numerical Relativity, (Seoul, Korea, Oct. 22, 2010).

Kotake, K.: 2010, Topics in Failed Supernovae, Spanish relativity meeting, (Granada, Spain, Sep. 6-10, 2010).

Kotake, K.: 2010, Gravitational waves from core-collapse supernovae, Lecture at summer school on numerical relativity and gravitation, (Pohang, Korea, Sep. 26-30, 2010).

Kouzuma, S., Nakagawa, A., Nakanishi, H., **Kawaguchi, N.**, Ujihara, H., Ohta, I.: 2010, Experimental Text on a Tapered Slot Antenna Used in an Ultra Wideband Receiver, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Koyama, S.: 2010, Discovery of Parsec Scale Structure in Kiloparsec Size Knot of 3C 380, Towards a root of AGN jets: Recent progress, (Mitaka, Japan, Dec. 14-15, 2010).

Kroug, M., **Kuroiwa, K.**, **Fujii, Y.**, **Miyachi, A.**, **Gonzalez, A.**, **Noguchi, T.**, **Uzawa, Y.**, Makise, K., Wang, Z., Shan, W., Shi, S.: 2010, SIS Mixers for the 790–950 GHz Band, The 11th Workshop on Submillimeter-Wave Receiver Technologies in Eastern Asia, (Nagoya, Japan, Nov. 14-16, 2010).

Kubo, M.: 2010, Diffusion and decay of sunspots, Hinode-IV: unsolved problems and recent insights, (Mondello, Palermo, Italy, Oct. 11-15, 2010).

Kubo, M., Low, B. C., Lites, B. W.: 2010, Unresolved Magnetic Flux Removal Process in the Photosphere, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Kudoh, T., Basu, S.: 2010, Formation of collapsing cores in magnetically subcritical clouds : three-dimensional simulations, Magnetic Fields: Core Collapse to Young Stellar Objects, (London, ON, Canada, May 17-19, 2010).

Kudoh, T., Basu, S.: 2011, Formation of Collapsing Cores in Subcritical Magnetic Clouds: Three-dimensional MHD Simulations with Ambipolar Diffusion, Winter School and Workshop on Star Formation, (Mitaka, Japan, Feb. 21-25, 2011).

Kuroda, D., et al. including **Hanayama, H.**, **Miyaji, T.**, **Yanagisawa, K.**: 2010, Multi-band optical monitoring of GRB100925A/ MAXI J1659-152, The First Year of MAXI: Monitoring Variable X-ray Sources, (Tokyo, Japan, Nov. 30-Dec. 2).

Kuroda, D., **Yanagisawa, K.**, Yoshida, M., **Shimizu, Y.**, **Nagayama, S.**, **Toda, H.**, Ohta, K., Yatsu, Y., Kawai, N.: 2011, The development of an automatic reduction system for Gamma-Ray Burst afterglow, An int. conf. on remotely operated, automated, or robotic ground based telescopes, (Waikoloa, HI, USA, Feb. 28-Mar. 3, 2011).

Kuroiwa, K., Makise, K., Kojima, T., **Fujii, Y.**, **Kroug, M.**, **Miyachi, A.**, **Uzawa, Y.**, Wang, Z., **Ogawa, H.**: 2010, Development of Superconducting NbTiN Waveguides for the Terahertz SIS Mixers, Applied Superconductivity Conf., (Washington DC, USA, Aug. 1-6, 2010).

Kuroiwa, K., Makise, K., Kojima, T., **Fujii, Y.**, **Kroug, M.**, **Miyachi, A.**, **Uzawa, Y.**, Wang, Z., **Ogawa, H.**: 2010, Performance of Superconducting NbTiN Waveguide for Terahertz SIS Mixer, The 11th Workshop on Submillimeter-Wave Receiver Technologies in Eastern Asia, (Nagoya, Japan, Nov. 14-16, 2010).

Kusakabe, M., **Kajino, T.**, Yoshida, T., Mathews, G. J.: 2010, SUSY-Catalyzed Big-Bang Nucleosynthesis as a Solution of Lithium Problems, 24th Int. Nuclear Physics Conf., (Vancouver, Canada, Jul. 7-9, 2010).

Kuzuhara, M.: 2011, The Widest-Separation Substellar Companion Candidate to a Binary T Tauri Star, Star Formation Across Space and Time Frontier Science with the LBT and Other Large Telescopes, (Tucson, AZ, USA, Mar 31-Apr 2, 2011).

Lee, M. G., Lim, S., Park, H. S., Hwang, H. S., **Hwang, N.**: 2010, Wandering Globular Clusters: the First Dwarf Galaxies in the Universe?, A Universe of Dwarf Galaxies, (Lyon, France, Jun. 14-18, 2010).

Lim, S., **Hwang, N.**, Lee, M. G.: 2010, Old Halo Star Clusters in Nearby Starburst Galaxy M82, A Universe of Dwarf Galaxies, (Lyon, France, Jun. 14-18, 2010).

Ly, C., Malkan, M. A., Ross, N., Ota, K., **Kashikawa, N.**, **Iye, M.**: 2011, The Stellar Population Completeness of Narrow-band Emission-line Surveys, 217th AAS Meeting, (Seattle, WA, USA, Jan. 9-13, 2011).

Machida, M. N.: 2010, Recent Developments in Simulations of Low-mass Star Formation, IAU Symp. 270: Computational star formation, (Barcelona, Spain, May 31-Jun. 4, 2010).

Machida, M. N.: 2010, The Origin of the Circumstellar Disk and Formation of Gaseous Disk by Gravitational Instability, The 4th East Asian Numerical Astrophysics Meeting, (Taipei, Taiwan, Nov. 2-5, 2010).

Makino, J.: 2010, GRAPE and GRAPE-DR, MODEST-10, (Beijing, China, Aug. 30-Sep. 3, 2010).

Makino, J.: 2010, GRAPE and GRAPE-DR, GPU Solutions to Multiscale Problems in Science and Engineering Workshop, (Harbin, China, Jul. 27-29, 2010).

Makino, J.: 2010, GRAPE-accelerators, IAU Symp. 270: Computational star formation, (Barcelona, Spain, May 31-Jun. 4, 2010).

Makise, K., Takeda, M., Terai, H., **Uzawa, Y.**, Wang, Z.: 2010, Characterization of NbTiN thin films deposited on various substrates, Applied Superconductivity Conf., (Washington DC, USA, Aug. 1-6, 2010).

Manabe, S.: 2010, Requirement on antenna positions accuracy for annual parallax determination with VERA and KVN, East Asia VLBI Workshop 2010, (Kagoshima, Japan, Apr. 22-24, 2010).

Martinache, F.: 2010, Behind the coronagraphic mask, Lyot Conf. 2010, (Paris, France, Oct. 25-29, 2010).

Maruyama, T., **Kajino, T.**, **Yasutake, N.**, Cheoun, M. K., Ryu, C. Y.: 2010, Asymmetric Neutrino Reaction from Magnetized Proto-Neutron Stars in Fully Relativisitc Framework Including Hyperons, Int. Nuclear Physics Conf. (INPC10), (University of British Columbia, USA, Jul. 4-9, 2010).

Maruyama, T., **Kajino, T.**, **Yasutake, N.**, Cheoun, M. K., Ryu, C. Y.: 2010, Asymmetric Neutrino Reaction from Magnetized Proto-Neutron Stars in fully Relativisitc Framework including Hyperons, The 11th Asia Pacific Physics Conf. (APPC11) , (Shanghai, China, Nov. 16, 2010).

Maruyama, T., **Kajino, T.**, **Yasutake, N.**, Cheoun, M. K., Ryu, C. Y.: 2010, Asymmetric Neutrino Reaction from Magnetized Proto-Neutron Stars in fully Relativisitc Framework including Hyperons, 3rd Int. Conf. on Frontiers In Nuclear Structure, Astrophysics and Reactions, (Rhodos, Greece, Aug. 23-27, 2010).

Maruyama, T., **Kajino, T.**, **Yasutake, N.**, Cheoun, M. K., Ryu, C. Y.: 2011, Asymmetric Neutrino Reaction in Magnetized Proto-Neutron Stars in Fully Relativistic Approach, Workshop on Hadron Nuclear Physics 2011, (Pohang, Korea, Feb. 21-24, 2011).

Masuda, S., **Shimojo, M.**, Watanabe, K., Minoshima, T., Yaji, K.: 2010, Hard X-ray and microwave sources located around the apex of a solar flare loop, AGU Fall Meeting, (San Francisco, CA, USA, Dec. 13-17, 2010).

Matsui, H., **Saitoh, T. R.**, **Makino, J.**, **Wada, K.**, **Tomisaka, K.**, **Kokubo, E.**, Daisaka, H., Okamoto, T., Yoshida, N.: 2010, Formation of Hypermassive Star Clusters and Mass Supply to Galactic Center in Merging Galaxies, Central Massive Objects: The Stellar Nuclei - Black Hole Connection, (Garching, Germany, Jun. 22-25, 2010).

Matsumoto, K., **Goossens, S.**, **Kikuchi, F.**, Liu, Q., **Ishihara, Y.**, **Hanada, H.**: 2010, An Improved Lunar Gravity Field Model Using Same-Beam VLBI Data, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Matsumoto, K., **Noda, H.**, **Kikuchi, F.**, **Kono, Y.**, **Tsuruta, S.**, **Hanada, H.**, **Goossens, S.**, **Ishihara, Y.**, **Sasaki, S.**, Iwata, T., **Araki, H.**, Katayama, M., **Tazawa, S.**, Kunimori, H., Otsubo, T., Funazaki, K., Sato, A., Taniguchi, H., Yamazaki A.: 2011, Selenodetic mission instruments proposed for SELENE-2: VLBI and LLR, The 5th KAGUYA (SELENE) Science Working Team Meeting, (Tokyo, Japan, Jan. 17-19, 2011).

Matsumoto, N.: 2010, Astrometric observations of 6.7GHz methanol masers toward W3(OH) with JVN, East Asia VLBI Workshop 2010, (Kagoshima, Japan, Apr. 22-24, 2010).

Matsuo, H., **Hibi, Y.**, Nagata, H., Ikeda, H., Fujiwara, M.: 2010, Development of Cryogenics Integrated Circuits for Super-conducting Terahertz Camera, The 10th Taiwan-Japan Microelectronics Int. Symp., (Hsinchu, Taiwan, Oct. 27-28, 2010).

Matsuo, H., **Hibi, Y.**, Nagata, H., Ikeda, H., Fujiwara, M.: 2010, SISCAM 32-ch cryogenic readout module with GaAs-JFET ASICs, SPIE Astronomical Instrumentation, (San Diego, CA, USA, Jun. 27-Jul. 2, 2010).

Matsuo, H., **Hibi, Y.**, Nagata, H., Ikeda, H., Fujiwara, M.: 2010, GaAs-JFET cryogenic readout module for superconducting THz imaging arrays, Ninth International Workshop in Low Temperature Electronics, (Guaruja, Brazil, Jun. 21-23, 2010).

Matsuo, H., Shi, S.-C., Yao, Q.-J., Luo, Y., **Matsuo, T.**, Ohta, I. S.: 2010, A design study on terahertz interferometry in Antarctica, SPIE Conf., Infrared, Millimeter Wave, and Terahertz Technologies, (Beijing, China, Oct. 18-20, 2010).

Matsuo, H.: 2010, A Study on Antarctica Terahertz Interferometer, The 11th Workshop on Submillimeter-Wave Receiver Technologies in Eastern Asia, (Nagoya, Japan, Nov. 14-16, 2010).

Matsuo, H.: 2010, Technical Challenges in Terahertz Astronomy, 4th Korean Workshop on Astronomical Instrumentations, (Daejeon, Korea, Sep. 8, 2010).

Matsuo, H.: 2010, Measurements of atmospheric transmission using Fourier transform spectrometers in far-infrared and submillimeter waves, Comprehensive characterization of astronomical sites, (Kislovodsk, Russia, Oct. 4-9, 2010).

Matsuo, H.: 2010, Far-infrared Interferometry for Atomic Fine-Structure Line Observations, Astronomy & Astrophysics in Antarctica, (Xi'an, China, Aug. 18-21, 2010).

Matsuo, T., Kotani, T., Murakami, N., **Tamura, M.**: 2010, Second-Earth Imager for TMT (SEIT), TMT Science and Instrument WS, (Victoria, Canada, Mar. 28-30).

Matsuo, T., Fukagawa, M., Kotani, T., Itoh, Y., **Tamura, M.**, Nakagawa, T., Enya, K.: 2010, Direct Detection and Spectral Characterization of Outer Planets with SPICA Coronagraph Instrument, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Matsuo, T., **Tamura, M.**: 2010, Second-Earth Imager for TMT (SEIT), SPIE Astronomical Instrumentation, (San Diego, CA, USA, Jun. 27-Jul. 2, 2010).

Matsuo, T., Traub, W. A., Hattori, M. **Tamura, M.**: 2010, New Concept for Direct Detection and Spectra of Exoplanets, SPIE Astronomical Instrumentation, (San Diego, CA, USA, Jun. 27-Jul. 2, 2010).

Matsuo, T., Traub, W. A., Hattori, M. **Tamura, M.**: 2010, New Concept for Direct Detection and Spectra of Exoplanets, Lyot Conf. 2010, (Paris, France, Oct. 25-29, 2010).

Meyer, B. S.: 2010, Presolar Grains and Galactic Mergers, Workshop on Nuclear Astrophysics at the University of Tokyo, (Tokyo, Japan, Jun. 15, 2010).

Meyer, B. S.: 2010, Nuclear Physics in Type Ia Supernovae and FUN Calcium-Aluminum-rich Inclusions in Meteorites, Workshop on Nuclear Astrophysics, (Tokyo, Japan, Jun. 26, 2010).

Meyer, B. S.: 2010, Presolar Grains and Galactic Mergers, Workshop on Presolar Grains and Supernovae, (Sapporo, Japan, Jul. 6, 2010).

Meyer, B. S.: 2010, Dense Type Ia Supernovae and Isotopic Anomalies in FUN Inclusions and Hibonite Grains in Meteorites, Workshop on Presolar Grains and Supernovae, (Sapporo, Japan, Jul. 6, 2011).

Meyer, B. S.: 2010, Nuclear Dynamics of the r-Process of Nucleosythesis: From the Ground Up, OMEG Institute, (Saitama, Japan, Jul. 15, 2010).

Meyer, B. S.: 2010, Nuclear Dynamics of the r-Process of Nucleosynthesis and Production of the Third Abundance Peak , Symp. on Nuclear Astrophysics, (Ibaraki, Japan, Jul. 20, 2010).

Minezaki, T., Sakata, Y., Yoshii, Y., **Morokuma, T.**, Koshida, S., Sameshima, H., Aoki, T., **Kobayashi, Y.**: 2010, The spectral variability of UV-optical continuum emission of Active Galactic Nuclei, The First Year of MAXI: Monitoring Variable X-ray Sources, (Tokyo, Japan, Nov. 30-Dec. 2).

Miura, R., **Okumura, S. K.**, Tosaki, T., **Tamura, Y.**, **Kurono, Y.**, **Kuno, N.**, **Nakanishi, K.**, **Sakamoto, S.**, Hasegawa, T., **Kawabe, R.**: 2010, Sequential Star Formation in the Giant H II Region NGC 604, Molecules in Galaxies, (Oxford, UK, Jul. 26-30, 2010).

Miyazaki, A.: 2010, Ammonia multi-transition survey in the Galactic center region with the Nobeyama, Star formation under extreme conditions: the Galactic center, (Besancon, France, Dec. 6-9, 2010).

Miyazaki, A.: 2010, First phase of the East Asia VLBI Network, East Asia VLBI Workshop 2010, (Kagoshima, Japan, Apr. 22-24, 2010).

Miyazaki, A., **Sawada-Satoh, S.**, **Kobayashi, H.**, **Kawaguchi, N.**, Lee, S.-S., Sohn, B. W., KVN group, Shen, Z.-Q., Ling, Q.-B., SHAO VLBI group: 2010, Present Status of First Phase East Asia VLBI Network, 8th EAMA (East Asian Meeting on Astronomy) Symp., (Shanghai, China, Oct. 10-15, 2010).

Miyazaki, S.: 2010, Subaru Wide Field Survey to Probe Dark Matter Distribution and Nature of Dark Energy, COSMO/CosPA, (Tokyo, Japan, Sep. 27-Oct. 1, 2010).

Miyazaki, S.: 2010, Hyper Suprime-Cam, COSMOS Meeting, (Honolulu, HI, USA, Jun. 7-10, 2010).

Miyoshi, M., et al. including **Furuya, R. S.**, **Niinuma, K.**, **Hagiwara, Y.**, **Kawaguchi, N.**: 2010, A First Black Hole Imager at Andes, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Miyoshi, M., et al. including **Furuya, R. S.**, **Kawaguchi, N.**, **Niinuma, K.**: 2010, A first black hole imager at Andes, East Asia VLBI Workshop 2010, (Kagoshima, Japan, Apr. 22-24, 2010).

Mizuno, N.: 2010, New Views of the Molecular Clouds and Star Formation in the Magellanic System, "Magellanic Clouds" splinter meeting of the Annual Meeting of Astronomische Gesellschaft, (Bonn, Germany, Sep. 14-15, 2010).

Moritani, Y., Nogami, D., Okazaki, A. T., **Imada, A.**, **Kambe, E.**, Honda, S., Hashimoto, O., Ichikawa, K.: 2010, Optical Spectroscopic observations of the Be/X-Ray binary A0535+262/V725 Tau during the giant outburst in 2009, The First Year of MAXI: Monitoring Variable X-ray Sources, (Tokyo, Japan, Nov. 30-Dec. 2).

Murakami, N., **Guyon, O.**, **Martinache, F.**, **Matsuo, T.**, **Yokochi, K.**, **Nishikawa, J.**, **Tamura, M.**, Kurokawa, T., Baba, N., Vogt, F., **Garrel, V.**, Yoshikawa, T.: 2010, An eight-octant phase-mask coronagraph for the Subaru coronagraphic extreme AO (SCExAO) system: system design and expected performance, SPIE Astronomical Instrumentation, (San Diego, CA, USA, Jun. 27-Jul. 2, 2010).

Murakami, N., Inabe, T., Komatsu, T., **Nishikawa, J.**, Hashimoto, N., Kurihara, M., Baba, N., **Tamura, M.**: 2010, Polarization-interferometric eight-octant phase-mask coronagraph using ferroelectric liquid crystal for exoplanet detection, SPIE Astronomical Instrumentation, (San Diego, CA, USA, Jun. 27-Jul. 2, 2010).

Nagai, H., Suzuki, K., Asada, K., **Kino, M.**, Kameno, S., Doi, A., Inoue, M., Bach, U.: 2010, VLBI Monitoring of 3C 84 in Gamma-ray Active Phase, Fermi meets Jansky-AGN at Radio and Gamma-rays, (Bonn, Germany, Jun. 21-23, 2010).

Nagashima, K., Zhao, J., Kosovichev, A. G., **Sekii, T.**: 2010, Helioseismology Study of Subsurface Dynamics in the Polar Regions of the Sun, AGU Fall Meeting, (San Francisco, CA, USA, Dec. 13-17, 2010).

Naito, S.: 2011, Tokyo International Science Festival, The Int. Public Science Events Conf., (Washington DC, USA, Feb. 16-17, 2011).

Nakajima, T., **Iwashita, H.**, **Miyazawa, C.**, **Kuno, N.**, **Kawabe, R.**, Katase, T., Nishimura, A., Kimura, K., **Ogawa, H.**, Sakai, T., **Asayama. S.**, **Noguchi, T.**, 45-m members: 2010, The New Observation System for the NRO 45-m Millimeter Wave Telescope, The 11th Workshop on Submillimeter-Wave Receiver Technologies in Eastern Asia, (Nagoya, Japan, Nov. 14-16, 2010).

Nakajima, T., **Iwashita, H.**, **Miyazawa, C.**, **Kuno, N.**, **Kawabe, R.**, Sakai, T., Kohno, K., Katase, T., Nishimura, A., Kimura, K., **Ogawa, H.**, **Asayma, S.**, **Tamura, T.**, **Noguchi, T.**: 2010, 100-GHz Band Sideband-Separating Receivers for NRO 45-m Telescope, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Nakajima, T., **Takano, S.**, Kohno, K., Inoue, H., the line survey team: 2010, Line Survey Project of External Galaxies with NRO 45-m Telescope, Workshop on Interstellar Matter 2010, (Sapporo, Japan, Sept. 13-15, 2010).

Nakamura, F.: 2010, Theory of Cluster Formation: Effects of Magnetic Fields, IAU Symp. 270: Computational star formation, (Barcelona, Spain, May 31-Jun. 4, 2010).

Nakamura, F.: 2010, A Significant Role of Magnetic Field and Protostellar Turbulence on the Formation and Evolution of Dense Cores in Clustered vs. Distributed Star Formation, MPIA Conference Series at Ringberg, The Early Phase of Star Formation III, (Tegernge, Germany, Jun. 14-18, 2010).

Nakamura, F.: 2010, Effects of Magnetic Fields and Protostellar Outflow Feedback on the Characteristic Mass of the IMF, The Origin of Stellar Masses, (Tenerife, Spain, Oct. 18-22, 2010).

Nakamura, F.: 2010, Outflow Feedback Regulated Massive Star Formation in Parsec-Scale Cluster Forming Clumps, The 4th East Asian Numerical Astrophysics Meeting, (Taipei, Taiwan, Nov. 2-5, 2010).

Nakamura, F., Li, Z.-Y.: 2011, Clustered Star Formation in Magnetic Clouds, Winter School and Workshop on Star Formation, (Mitaka, Japan, Feb. 21-25, 2011).

Nakamura, F., Li, Z.-Y., Wang, P., Abel, T.: 2010, Outflow-regulated Massive Star Formation in PC-Scale Cluster Forming Clumps, Great Barriers in High Mass Star Formation, (Townsville, Australia, Sep. 13-17, 2010).

Nakamura, K., Hayakawa, T., Cheoun, M. K., **Kajino, T.**, Mathews, G. J.: 2011, The neutrino process in core-collapse supernovae, From quarks to supernovae, (Izuatagawa, Japan, Nov. 28-30, 2010).

Nakamura, K., Hayakawa, T., Cheoun, M. K., **Kajino, T.**, Mathews, G. J.: 2011, Radioactive Nuclei in Core-collapse Supernovae, Astronomy with Radioactivities, (Victoria, Australia, Mar. 1-3, 2011).

Nakamura, K., Yoshida, T., Shigeyama, T., **Kajino, T.**: 2010, The neutrino-process and light element production, Nuclei in the Csomos -11, (Heidelberg, Germany, Jul. 19-23, 2010).

Nakanishi, H., **Hagiwara, Y.**, Takahashi, K.: 2010, Summary of Discussion, Japan SKA Int. Workshop 2010, (Mitaka, Japan, Nov. 4-5, 2010).

Nakanishi, H., Takahashi, K., Yamamoto, S., Kawakatsu, N., **Kameya, O.**, Hirashita, H., **Imai, H.**: 2010, Observation of the Universe with Ultra Wideband Receiver and SKA, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Namekata, D., Habe. A.: 2010, Evolution of a Circumnuclear Disk and Gas Supply to the Galactic Center, The Fourth East Asia Numerical Astrophysical Meeting, (Taipei, Taiwan, Nov. 2-5, 2010).

Narita, N.: 2010, SPICA for Transiting Exoplanets: Which SPICA instruments are useful?, SPICA Science Workshop, (Mitaka, Tokyo, Dec. 16-17, 2010).

Narita, N.: 2010, Good Combination of Rossiter-McLaughlin Measurements and Direct Imaging Observations, Detection and dynamics of transiting exoplanets, (Observatoire de Haute-Provence, France, Aug. 23-27, 2010).

Narita, N.: 2010, Subaru Measurements of Spin-Orbit Alignment Angles of Transiting Exoplanets, End-of-Term Hawaii Open Meeting on Exoplanets, (Honolulu, HI, USA, May 27-28, 2010).

Narita, N.: 2010, Subaru Measurements of the Rossiter-McLaughlin Effect and Direct Imaging Observations for Transiting Planetary Systems, IAU Symp. 276: The Astrophysics of Planetary Systems: Formation, Structure, and Dynamical Evolution, (Torino, Italy, Oct. 11-15, 2010).

Narita, N.: 2011, Japanese Research Plan for Exploring New Worlds with TMT, TMT Science and Instrument WS, (Victoria, Canada, Mar. 28-30).

Narita, N., et al. including **Yamashita, T.**, **Tamura, M.**, **Nishikawa, J.**, **Hayano, Y.**, **Oya, S.**, **Kokubo, E.**, **Guyon, O.**: 2010, SPICA coronagraph for the detection and characterization of exo-planets, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Narukage, N., **Kano, R.**, Sakao, T.: 2010, Temperature and Emission Measure Properties of Coronal Structures across the Whole Sun Observed with Hinode/X-Ray Telescope, Hinode-IV: unsolved problems and recent insights, (Mondello, Palermo, Italy, Oct. 11-15, 2010).

Narukage, N.: 2010, Property of solar coronal structures based on temperature and emission measure derived with Hinode/X-Ray Telescope, 2010 XRT Team Meeting, (Bozeman, MT, USA, Jun. 16-18, 2010).

Naruse, M., **Sekimoto, Y.**, **Noguchi, T.**, **Uzawa, Y.**, **Nitta, T.**: 2010, Development of a sub-millimeter camera with superconducting resonators, The 11th Workshop on Submillimeter-Wave Receiver Technologies in Eastern Asia, (Nagoya, Japan, Nov. 14-16, 2010).

Niinuma, K.: 2010, The Quick Follow-up Observation of the Largest X-ray Flare from the TeV blazar Mrk 421, Towards a root of AGN jets: Recent progress, (Mitaka, Japan, Dec. 14-15, 2010).

Niinuma, K., **Kino, M.**, **Hada, K.**, Asada, K., **Koyama, S.**, **Oyama, T.**, **Kawaguchi, N.**, Nagai, H., Isobe, N., Hara, T.: 2010, Quick Follow-up Observation of the Largest X-ray Flare from the TeV blazar Mrk 421, The First Year of MAXI: Monitoring Variable X-ray Sources, (Tokyo, Japan, Nov. 30-Dec. 2).

Nishikawa, J., **Yokochi, K.**, Murakami, N., Abe, L., Kotani, T., **Tamura, M.**, Kurokawa, T., Tavrov, A. V., Takeda, M., Murakami, H.: 2010, A coronagraph system with unbalanced nulling interferometer: progress of wavefront correction, SPIE Astronomical Instrumentation, (San Diego, CA, USA, Jun. 27-Jul. 2, 2010).

Nishimura, A., Sakaguchi, T., Tsuji, H., Kunizane, M., Minowa, M., Katase, T., Kizawa, J., Matsumoto, K., Abe, Y., Kimura, K., Muraoka, K., **Onishi, T.**, **Ogawa, H.**, Dobashi, K., Handa, T., **Nakajima, T.**, **Kuno, N.**: 2010, The 1.85 m Mm-Submm Telescope for Large Scale Molecular Cloud Survey, The 11th Workshop on Submillimeter-Wave Receiver Technologies in Eastern Asia, (Nagoya, Japan, Nov. 14-16, 2010).

Nishimura, A., Tsuji, H., Sakaguchi, T., Yashima, S., Kunizane, M., Minowa, M., Kimura, K., Abe, Y., Muraoka, K., **Onishi, T.**, **Ogawa, H.**, Dobashi, K., Handa, T., **Nakajima, T.**: 2010, The 1.85 m mm-submm Telescope for Large Molecular Cloud Survey, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Nishimura, N.: 2010, R-process Nucleosynthesis in the Long-Term Simulation of Magnetically Dominated Core-Collapse Supernovae, EMMI workshop: Neutron Matter in Astrophysics: From Neutron Stars to the *r*-Process, (Darmstadt, Germany, Jul. 15-18, 2010).

Nishimura, N., **Sekiguchi, Y.**: 2010, NSE Weak Interaction Rates for Core-Collapse Simulations, From Quarks to Supernovae, (Shizuoka, Japan, Nov. 28-30, 2010).

Nishimura, N., **Takiwaki, T.**, Hashimoto, M., Sato, K.: 2010, R-process Nucleosynthesis in Magnetically Dominated Core-Collapse Supernovae, Nuclei in the Csomos -11, (Heidelberg, Germany, Jul. 19-23, 2010).

Niwa, Y., **Yano, T.**, **Araki, H.**, **Gouda, N.**, **Kobayashi, Y.**, **Tazawa, S.**, **Hanada H.**, Yamada, Y.: 2010, CCD centroiding analysis for Nano-JASMINE observation data, SPIE Astronomical Instrumentation, (San Diego, CA, USA, Jun. 27-Jul. 2, 2010).

Noguchi, T., Suzuki, T., **Tamura, T.**: 2010, Subgap tunneling current at low temperature in Nb/Al-AlN/Nb SIS junctions, Applied Superconductivity Conf., (Washington DC, USA, Aug. 1-6, 2010).

Noguchi, T.: 2010, Imaginary Part of the Superconducting Gap Energy and Its Influence on Low-Temperature Devices, The 11th Workshop on Submillimeter-Wave Receiver Technologies in Eastern Asia, (Nagoya, Japan, Nov. 14-16, 2010).

Oe, M.: 2010, RXFR: enhancement architecture for astronomical observation systems, 2010 Northeastern Asian Symp. on ICT, (Xian, China, Sep. 15-17, 2010).

Oe, M.: 2010, IOT activities in Japan, ETSI INT10, (Sophia

Antipolis, France, Sep. 7-9, 2010).

Oguri, M.: 2010, The shape of massive dark matter halos from gravitational lensing, CL J2010+0628: from Massive Galaxy Formation to Dark Energy, (Chiba, Japan, Jun. 28-Jul. 2, 2010).

Oguri, M.: 2010, Quasar lensing as a cosmological probe, String Theory and Cosmology, (Daejeon, Korea, Sep. 30-Oct. 2, 2010).

Oguri, M.: 2010, Stacked weak lensing as a dark energy probe, The observational pursuit of dark energy after Astro2010, (Pasadena, CA, USA, Oct. 7-8, 2010).

Oguri, M.: 2011, Weak lensing cosmology, DENET 2011 Subaru HSC workshop, (Taipei, Taiwan, Mar. 7-8, 2011).

Oh, S.-J., Roh, D.-G., Yeom, J.-H., Chung, H.-S., Park, S.-Y., **Kobayashi, H.**, **Kawaguchi, N.**, **Oyama, T.**, Kawakami, K.: 2010, FX-Based VLBI Correlator Development by KOREA-JAPAN Joint Collaboration for East-Asian VLBI Network, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Ohishi, M.: 2010, Impact to the Radio Astronomy by the Interference Caused by the Solar Power Satellite Systems, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Ohishi, M.: 2010, Data Intensive Astronomy by means of Virtual Observatories, 8th EAMA (East Asian Meeting on Astronomy) Symp., (Shanghai, China, Oct. 10-15, 2010).

Ohishi, M.: 2010, Evolution of Life-Related Matter in the Universe, Japan Geoscience Union 2010, (Chiba, Japan, May 23-28, 2010).

Ohishi, M., Kitagawa M., Misawa H., Tsuchiya F.: 2010, Impact of the PLT Disturbance against Radio Astronomy in the HF Band, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Ohsuga, K.: 2010, Radiation-magnetohydrodynamic simulations of black hole accretion flow and outflow, Accretion and Outflow in Black Hole Systems, (Kathmandu, Nepal, Oct. 11-15, 2010).

Ohsuga, K.: 2010, Radiation MHD Simulations of Black Hole Accretion Flow and Outflow, Relativistic Whirlwind, (Trieste, Italy, May 31-Jun. 4, 2010).

Ohsuga, K.: 2010, Two-dimensional Global Radiation-Magnetohydrodynamic Simulations of Black Hole Accretion Flow and Outflow, The 4th East Asian Numerical Astrophysics Meeting, (Taipei, Taiwan, Nov. 2-5, 2010).

Okamoto, T. J.: 2010, Emergence of twisted flux in prominence observations, Hinode-IV: unsolved problems and recent insights, (Mondello, Palermo, Italy, Oct. 11 - 15, 2010).

Okamoto, T. J., **Tsuneta, S.**, Berger, T. E.: 2010, A rising cool column associated with formation of prominence and coronal cavity, AGU Fall Meeting, (San Francisco, CA, USA, Dec. 13-17, 2010).

Okumura, S. K.: 2010, Radio Science & Technology— II, Backends, 3rd Summer School in Spectrum Management for Radio Astronomy, (Mitaka, Japan, May 31-Jun. 4, 2010).

Okumura, S. K.: 2011, Correlator, backend, digital process, East-Asia Interefometry Winter School 2011, (Mitaka, Japan, Feb. 7-11, 2011).

Okumura, S. K., Chikada, Y., **Kamazaki, K.**, Okuda, T., **Kurono, Y.**, **Iguchi, S.**: 2010, Atacama Compact Array Correlator for Atacama Large Millimeter/submillimeter Array, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Oshima, A., **GRAPES-3 collaboration**: 2010, Angular resolution of GRAPES-3 experiment, Workshop on cosmic ray physics 2010, (Tamil Nadu, India, Dec. 14-16, 2010).

Oshima, A.: 2010, Visualization of CORSIKA EAS (Development of EAS in the atmosphere), CORSIKA school 2010, (Tamil Nadu, India, Dec. 17-20, 2010).

Oshino, S., **Makino, J.**: 2010, The effect of initial mass of planetesimals to the planet formation process, 2010 Western Pacific Geophysics Meeting, (Taipei, Taiwan, Jun. 22-25, 2010).

Oshino, S., **Makino, J.**: 2010, The effect of initial mass of planetesimals to the planet formation process, AOGS 2010, (Hyderabad, India, Jul. 5-9, 2010).

Oyama, T.: 2010, Development of software correlator, East Asia VLBI Workshop 2010, (Kagoshima, Japan, Apr. 22-24, 2010).

Petrova, N., **Hanada, H.**, Abdulmyanov, T., Petrova, A.: 2010, Determination of Lunar physical libration from polar observations in the project ILOM (Japan), EPSC (European Planetary Sciences Conf.), (Roma, Italy, Sep. 20-24, 2010).

Reznikova, V. E.: 2010, Observation of the slow magnetoacoustic mode in the flaring loop, CESRA2010, (La Roche en Ardenne, Belgium, Jun. 15-19, 2010).

Reznikova, V. E.: 2010, Observation and interpretation of QPP with a drift of period, All-Russian Conf. "Solar and Solar-Terrestrial Physics – 2010", (Saint-Petersburg, GAO RAS, Russia, Oct. 3-9, 2010).

Reznikova, V. E., Melnikov, V. F.: 2010, Dynamics of the system of microwave flaring loops in the two-ribbon flare, All-Russian Conf. "Solar and Solar-Terrestrial Physics – 2010", (Saint-Petersburg, GAO RAS, Russia, Oct. 3-9, 2010).

Reznikova, V. E., Melnikov, V. F., Pyatakov, N. P., **Shibasaki, K.**: 2010, Diagnostics of an acceleration site location and pitch-angle anisotropy of energetic electrons in the flare observed in microwaves, CESRA2010, (La Roche en Ardenne, Belgium, Jun. 15-19, 2010).

Reznikova, V. E., Melnikov, V. F., **Shibasaki, K.**, Ji, H.: 2010, Topology dynamics of the flaring loop system on 2005 August 22 observed in microwaves and hard X-rays, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Reznikova, V. E., Melnikov, V. F., **Shibasaki, K.**, Ji, H.: 2010, Dynamics of the flaring loop system, CESRA2010, (La Roche en Ardenne, Belgium, Jun. 15-19, 2010).

Saito, M., **Inatani, J.**, **Nakanishi, K.**, **Naoi, T.**, **Yamada, M.**, **Saito, H.**, **Ikenoue, B.**, **Kato, Y.**, **Morita, K.-I.**, **Mizuno, N.**, **Iguchi, S.**: 2010, Atacama Compact Array Antenna, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Saito, M.: 2010, ALMA for Interstellar Matter, Workshop on Interstellar Matter 2010, (Sapporo, Japan, Sept. 13-15, 2010).

Saitoh, T. R., Daisaka, H., **Kokubo, E.**, **Makino, J.**, Okamoto, T., **Tomisaka, K.**, **Wada, K.**, Yoshida, N.: 2010, Shock-induced star cluster formation in colliding galaxies, IAU Symp. 270: Computational star formation, (Barcelona, Spain, May 31-Jun. 4, 2010).

Sakaguchi, T., Nishimura, A., Katase, T., Tsuji, H., Kunizane, K., Minowa, M., Kizawa, J., Matsumoto, K., Abe, Y., Kimura, K., Muraoka, K., **Onishi, T.**, **Ogawa, H.**, Dobashi, K., Handa, T., **Nakajima, T.**, **Kuno, N.**: 2010, Performance of 1.85m Radio Telescope, The 11th Workshop on Submillimeter-Wave Receiver

Technologies in Eastern Asia, (Nagoya, Japan, Nov. 14-16, 2010).

Sakao, T., **Kano, R.**, **Narukage, N.**, **Shimojo, M.**, Sako, N.: 2010, Eruptive events observed with Hinode XRT, Hinode-IV: unsolved problems and recent insights, (Mondello, Palermo, Italy, Oct. 11-15, 2010).

Sako, N., **Shimojo, M.**, Kitabayashi, T.: 2010, Statistical study of the polar X-ray jets, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Sakurai, T., **Hanaoka, Y.**, **Shinoda, K.**, **Noguchi, M.**, **Miyashita, M.**, **Fukuda, T.**, **Suzuki, I.**, **Hagino, M.**, **Arai, T.**, Yamasaki, T., Takeyama, N.: 2010, Infrared Stokes Spectro-Polarimeter at the National Astronomical Observatory of Japan, 6th Solar Polarization Workshop, (Maui, HI, USA, May 31-June 4, 2010).

Sakurai, T.: 2010, Studies of the Solar Corona by Relocating the Coronagraph of Norkura Observatory to a High Mountain Site in East Asia, The 4th EACOA Meeting, (Jeju, Korea, May 10-12, 2010).

Sakurai, T.: 2010, Twenty Years of Solar Flare Telescope, 太陽フレア望遠鏡20周年記念研究会「太陽観測装置の新展開」, (Mitaka, Japan, Jul. 26-27, 2010).

Sakurai, T.: 2011, Helioseismology, Solar Dynamo, and Magnetic Helicity, Progress in Solar/Stellar Physics with Helio- and Astero-Seismology, (Hakone, Japan, Mar. 14-17, 2011).

Sakurai, T.: 2011, The First Four Years of Hinode, The First Asia-Pacific Solar Physics Meeting, (Bangalore, India, Mar. 21-24, 2011).

Sasada, M., et al., including **Kuroda, D.**, **Yanagisawa, K.**, **Imada, A.**: 2010, Multi-wavelength photometric and polarimetric observations of the outburst of 3C 454.3 in Dec. 2009, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Sasaki, S., KAGUYA Gravity/Topography Team.: 2010, The first precise global gravity and topography of the Moon by KAGUYA (SELENE) mission, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Sasaki, S., et al.: 2010, Topography and Crustal Thickness of the Moon by KAGUYA (SELENE) Selenodesy Observation, European Geosciences Union General Assembly, (Vienna, Austria, May. 2-7, 2010).

Sasaki, S., et al.: 2010, Jupiter Magnetospheric Orbiter and Trojan Asteroid Explorer in EJSM (Europa Jupiter System Mission), European Geosciences Union General Assembly, (Vienna, Austria, May. 2-7, 2010).

Sasaki, S., et al.: 2010, Summary of KAGUYA laser altimeter LALT, BepiColombo Geodesy/Geophysics WG Workshop, (DLR Berlin, Germany, Jul. 1-2, 2010).

Sasaki, S., et al.: 2010, The First Accurate Global Gravity and Topography of the MOON by KAGUYA (SELENE) and Implication for Lunar Basin Evolution, AOGS 2010, (Hyderabad, India, Jul. 5-9, 2010）.

Sasaki, S., et al.: 2010, In situ measurements of lunar rotation and gravity for the study of the interior of the Moon, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Sasaki, S., et al.: 2010, Jupiter Magnetospheric Orbiter and Trojan Asteroid Explorer in EJSM, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Sasaki, S., et al.: 2010, Space weathering on Mercury: Simulation of plagioclase weathering, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Sasaki, S., et al.: 2010, The First Precise Global Gravity, Topography and Crustal Thickness of the Moon by Kaguya (SELENE), Int. Symp. of the Science and Utilization of the Moon, (Tokyo, Japan, Sep. 7-9, 2010).

Sasaki, S., et al.: 2011, Structure of South-Pole Aitken Basin of the Moon from KAGUYA (SELENE) Gravity/Topography, The 5th KAGUYA (SELENE) Science Working Team Meeting, (Tokyo, Japan, Jan. 17-19, 2011).

Sasaki, S., Hiroi, T., Helbert, J.: 2010, Space Weathering on Mercury: Laboratory Simulation of Plagioclase Weathering, AOGS 2010, (Hyderabad, India, Jul. 5-9, 2010).

Sasaki, S., **Ishihara, Y.**, **Goossens, S.**, **Matsumoto, K.**, **Araki, H.**, **Hanada, H.**, **Kikuchi, F.**, **Noda, H.**, Iwata, T., Ohtake, M.: 2011, Lunar South Pole-Aitken Basin from Kaguya (SELENE) Gravity/Topography, 42nd Lunar and Planetary Science Conf., (Woodsland, TX, USA, Mar. 7-11, 2011).

Sasaki, S., MDM Team.: 2010, Measurement of Dust Environment around Mercury by MDM (Mercury Dust Monitor) on Board MMO Bepi Colombo Exploring Magnetosphere-Exospshere Coupling at Mercury, A Joint MESSENGER-BepiColombo Workshop, (Boulder, USA, Nov. 3, 2010).

Sasaki, S., Namiki, N., **Hanada, H.**, **Araki, H.**, Imamura, T., Iwata, T., RSAT/VRAD/RS Group.: 2010, Multi-satellite mission KAGUYA (SELENE), EPSC (European Planetary Sciences Conf.), (Roma, Italy, Sep. 20-24, 2010).

Sato, M.: 2010, Distance and location of the Sagittarius arm traced by trigonometric parallaxes of massive star-forming regions, Spiral Structure in the Milky Way: Confronting Observations and Theory, (Bahia Inglesa, Chile, Nov. 7-10, 2010).

Sato, M., **Watanabe, J.**: 2010, Orionids in recent years:Simulations and observed activities, Meteoroids 2010, An Int. Conf. on Minor Bodies in the Solar System, (Breckenridge, CO, USA, May 24-28, 2010).

Sato, M., **Watanabe, J.**, **NAOJ Campagin Team**: 2010, Meteor shower activity derived from "Meteor Watching Public-Campagin" in Japan, Meteoroids 2010, An Int. Conf. on Minor Bodies in the Solar System, (Breckenridge, CO, USA, May 24-28, 2010).

Sawada-Satoh, S.: 2010, JVN Analysis and Display for Effects of Source Structure (JADESS), East Asia VLBI Workshop 2010, (Kagoshima, Japan, Apr. 22-24, 2010).

Sawada-Satoh, S.: 2010, Progress Reports of KVN+VERA Test Observations, 2010 KVN and TRAO Radio Workshop, (Seoul, Korea, Aug. 16-18, 2010).

Sawada-Satoh, S.: 2010, Preliminary Imaging of KVN+VERA test observations, 8th EAMA (East Asian Meeting on Astronomy) Symp., (Shanghai, China, Oct. 10-15, 2010).

Sawada-Satoh, S.: 2010, Methanol Maser Outflows of UCHII Region S269, Great Barriers in High Mass Star Formation, (Townsville, Australia, Sep. 13-17, 2010).

Sekiguchi, K., Kaifu, N.: 2010, Strategy of Future Regional Cooperation in Astronomy, 8th EAMA (East Asian Meeting on Astronomy) Symp., (Shanghai, China, Oct. 10-15, 2010).

Sekiguchi, K.: 2010, Report from EACOA, 8th EAMA (East Asian

Meeting on Astronomy) Symp., (Shanghai, China, Oct. 10-15, 2010).

Sekiguchi, Y.: 2010, Formation of Black hole-Disk System via PopIII stellar core collapse in full general relativity, Deciphering the Ancient Universe with Gamma-Ray Bursts, (Kyoto, Japan, Apr. 19-23, 2010).

Sekiguchi, Y.: 2010, Collapse of rotating very massive stellar core to a black hole and a disk, Spanish relativity meeting, (Granada, Spain, Sep. 6-10, 2010).

Sekiguchi, Y.: 2010, Black hole and accretion disk formation in the collapsar model, The 20th workshop on General relativity and Gravitation, (Kyoto, Japan, Sep. 21-25, 2010).

Sekiguchi, Y.: 2010, Formation and evolution of black hole and accretion disk in collapsar, Accretion and Outflow in Black Hole Systems, (Kathmandu, Nepal, Oct. 11-15, 2010).

Sekiguchi, Y.: 2010, Formation and evolution of black hole and disk in collapsar, The Fourth East Asia Numerical Astrophysical Meeting, (Taipei, Taiwan, Nov. 2-5, 2010).

Sekiguchi, Y.: 2010, Formation and evolution of black hole and accretion disk in collapsar, From Quarks to Supernovae, (Shizuoka, Japan, Nov. 28-30, 2010).

Sekiguchi, Y.: 2011, Formation and evolution of a black hole and an accretion disk in Type III collapsars, The Prompt Activity of Gamma-Ray Bursts: their Progenitors, Engines, and Radiation Mechanisms, (Nothr Carolina, USA, Mar. 5-7, 2011).

Sekii, T.: 2010, High-latitude solar dynamics/Helioseismology in high latitude regions, Hinode-IV: unsolved problems and recent insights, (Mondello, Palermo, Italy, Oct. 11-15, 2010).

Sekii, T., Hartlep, T., Zhao, J., Nagashima, K., Kosovichev, A. G.: 2010, Initial study of stereo-helioseismology, AGU Fall Meeting, (San Francisco, CA, USA, Dec. 13-17, 2010).

Shibasaki, K.: 2010, The quiet sun at radio wavelengths, CESRA2010, (La Roche en Ardenne, Belgium, Jun. 15-19, 2010).

Shibasaki, K., **Narukage, N.**, Yoshimura, K.: 2010, Imaging observations of coronal magnetic field by the Nobeyama Radioheliograph, 6th Solar Polarization Workshop, (Maui, HI, USA, May 31-June 4, 2010).

Shibasaki, K.: 2010, Imaging observations of coronal magnetic field by Nobeyama Radioheliograph, 6th Solar Polarization Workshop, (Maui, HI, USA, May 31-June 4, 2010).

Shibasaki, K.: 2010, Long-Term Radio Imaging Observations of the Sun by Nobeyama Radioheliograph, 太陽フレア望遠鏡20周年記念研究会「太陽観測装置の新展開」, (Mitaka, Japan, Jul. 26-27, 2010).

Shimobaba, T., **Nakayama, H.**, Masuda, N., Takada, N., **Ito, T.**: 2010, 24 mega pixels phase electroholography, IDW'10, (Fukuoka, Japan, Dec. 1-3, 2010).

Shimojo, M.: 2010, The variations of prominence activities during solar cycle, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Shimojo, M.: 2010, The Evolution of the Magnetic Field Distribution Investigated Based on the Prominence Activities, XRT Team Meeting, (Montana, USA, Jun. 17-18, 2010).

Shimojo, M.: 2010, Prospects for Solar Data Analysis -The Sun Seen by Computer Vision-, 太陽フレア望遠鏡20周年記念研究会「太陽観測装置の新展開」, (Mitaka, Japan, Jul. 26-27, 2010).

Shirasaki, Y.: 2010, Study of QSO environment using the Japanese Virtual Observatory of Japan (JVO), 8th EAMA (East Asian Meeting on Astronomy) Symp., (Shanghai, China, Oct. 10-15, 2010).

Shirasaki, Y., **Komiya, Y.**, **Ohishi, M.**, **Mizumoto, Y.**, Ishihara, Y., Yanaka, Y., Tsutsumi, J., Hiyama, T., Nakamoto, H., Sakamoto, M.: 2010, Current Status of the Japanese Virtual Observatory Portal, Astronomical Data Analysis Software and Systems XX, (Boston, MA, USA, Nov. 7-11, 2010).

Sofue, Y., Machida, M., **Kudoh, T.**: 2010, Primordial Origin of Composite Magnetic Configurations in Spiral Galaxies, Japan SKA Int. Workshop 2010, (Mitaka, Japan, Nov. 4-5, 2010).

Sôma, M., Tanikawa, K.: 2010, Investigation of the Earth's Rotation using Ancient Chinese Occultation Records, 7th Int. Conf. on Oriental Astronomy (ICOA-7), (Tokyo, Japan, Sep. 6-10, 2010).

Sotani, H.: 2010, Slowly Rotating Relativistic Stars in TeVeS, Spanish relativity meeting, (Granada, Spain, Sep. 6-10, 2010).

Sotani, H., Kokkotas, K. D.: 2010, Non-axisymmetric Torsional Oscillations of Relativistic Stars, Spanish relativity meeting, (Granada, Spain, Sep. 6-10, 2010).

Suematsu, Y.: 2010, On the Relation of Bright Point Appearance with Small-Scale Jets Formation in the Chromosphere, Hinode-IV: unsolved problems and recent insights, (Mondello, Palermo, Italy, Oct. 11-15, 2010).

Suematsu, Y.: 2010, Data Analysis of H-alpha Full Disk and Hinode Observations, 1st Latin American FMT Workshop, (Ica, Peru, Nov. 22-26, 2010).

Suematsu, Y.: 2010, Recent Progresses in Two-Dimensional Spectroscopy, 太陽フレア望遠鏡20周年記念研究会「太陽観測装置の新展開」, (Mitaka, Japan, Jul. 26-27, 2010).

Suematsu, Y., Yatini, C. Y.: 2010, Sunspot Motions and Flare Activity, 太陽フレア望遠鏡20周年記念研究会「太陽観測装置の新展開」, (Mitaka, Japan, Jul. 26-27, 2010).

Suematsu, Y., Yatini, C. Y.: 2010, Sunspot Proper Motion and Flare Onset Prediction, AGU Fall Meeting, (San Francisco, CA, USA, Dec. 13-17, 2010).

Suematsu, Y., **Katsukawa, Y.**, Shimizu, T., Ichimoto, K., Horiuchi, T., Matsumoto, Y., Takeyama, N.: 2010, Optical and Thermal Design of 1.5-m Aperture Solar UV Visible and IR Observing Telescope for Solar-C Mission, Int. Conf. on Space Optics, (Rhodes, Greece, Oct. 4-8, 2010).

Sugiyama, K., **Fujisawa, K.**, Wajima, K., **Honma, M.**, **Sawada-Satoh, S.**, Murata, Y., Mochizuki, N., Doi, A.: 2010, Infall Motions of the 6.7 GHz Methanol Masers in the High-Mass Star-forming Region Cepheus A, Great Barriers in High Mass Star Formation, (Townsville, Australia, Sep. 13-17, 2010).

Tachihara, K.: 2010, Origin of the Interstellar Turbulence and Its Role in Star Formation, The impact of Herschel Surveys on ALMA Early Science, (Garching, Germany, Nov. 16-19, 2010).

Tachihara, K., **Takahashi, H.**: 2010, Introduction of instruments in Gunma Astronomical Observatory and transit observation at GAO, YETI/TTV/Mammut f2f workshop on "Young Planetary Systems", (Jena, Germany, Nov. 15-17, 2010).

Takada, N., **Nakayama, H.**, Awazu, S., Ichihashi, Y., Shimobaba, T., Masuda, N., Ito, T.: 2010, A real-time color electrohorographic reconstruction system using multi graphics processing unit, IDW'10, (Fukuoka, Japan, Dec. 1-3, 2010).

Takahashi H. R.: 2011, Relativistic Magnetohydrodynamic Simulation of Magnetic Reconnection, Mgnetic Reconnection 2010, (Nara, Japan, Dec. 6-9, 2010).

Takahashi H. R., **Masada Y.**: 2011, Stability MRI-Turbulent Accretion Disks, The First Year of MAXI: Monitoring Variable X-ray Sources, (Tokyo, Japan, Nov. 30-Dec. 2).

Takahashi H. R., Matsumoto J., **Masada Y.**, **Kudoh T.**: 2010, Numerical Study of Relativistic Magnetic Reconnection, Deciphering the Ancient Universe with Gamma-Ray Bursts, (Kyoto, Japan, Apr. 19-23, 2010).

Takahashi H. R., Matsumoto J., **Masada Y.**, **Kudoh T.**: 2010, Relativistic Magnetohydrodynamic Simulation of Sweet-Parker type Magnetic Reconnection, The Fourth East Asia Numerical Astrophysical Meeting, (Taipei, Taiwan, Nov. 2-5, 2010).

Takahashi, R.: 2010, Behavior of an inverted pendulum in the Kamioka mine, Gravitational-Wave Advanced Detector Workshop 2010 (GWADW2010), (Kyoto, Japan, May 16-21, 2010).

Takahashi. R., Saito, Y., Suzuki, T.: 2010, Vacuum System for the Large-Scale Cryogenic Gravitational Wave Telescope (LCGT), AVS 57th Int. Symp. & Exhibition, (Albuquerque, NM, USA, Oct. 17-22, 2010).

Takano, S., et al. including **Hirota, T.**, **Nakajima, T.**, **Ohishi, M.**, **Umemoto, T.**: 2010, Nobeyama 45 m Telescope Legacy Project: Line Survey (II), Workshop on Interstellar Matter 2010, (Sapporo, Japan, Sept. 13-15, 2010).

Takiwaki T.: 2010, Special Relativistic Simulrations of Magnetically-dominatyed Jets in Collapsing Massive Star, The 4th East Asian Numerical Astrophysics Meeting, (Taipei, Taiwan, Nov. 2-5, 2010).

Takiwaki T.: 2010, Neutrino Pair Annihilation in Collapsars, Deciphering the Ancient Universe with Gamma-Ray Bursts, (Kyoto, Japan, Apr. 19-23, 2010).

Tamura, M.: 2010, Strategic Exploration of Exoplanets and Disks with Subaru (SEEDS), An Ishigaki Int. Conf. on Evolving Theory for Planet Formation, (Ishigaki, Japan, Jun. 20-26, 2010).

Tamura, M.: 2010, Strategic Exploration of Exoplanets and Disks with Subaru (SEEDS), Princeton SEEDS Workshop, (Princeton, USA, Jul. 5-9, 2010).

Tamura, M.: 2010, First Results from SEEDS, Lyot Conf. 2010, (Paris, France, Oct. 25-29, 2010).

Tamura, M.: 2010, SIRPOL: Wide-Field NIR Polarimetry of Star Forming Regions, IRSF Workshop, (Nagoya, Japan, Nov. 16-18, 2010).

Tamura, Y., Kazama, T., **Jike, T.**, **Manabe, S.**, **Asari, K.**: 2010, Collocated Geodetic Observations with a Superconducting Gravimeter, VLBI and GPS in NAOJ Mizusawa, Second Asian SG Workshop, (Taipei, Taiwan, Jun. 21-22, 2010).

Tanikawa, K., **Sôma, M.**: 2010, How were eclipses memorized when there were no astronomers?, 7th Int. Conf. on Oriental Astronomy (ICOA-7), (Tokyo, Japan, Sep. 6-10, 2010).

Tatsumi, D.: 2010, TAMA300, Gravitational-Wave Advanced Detector Workshop 2010(GWADW2010), (Kyoto, Japan, May 16-21, 2010).

Tomida, K., **Machida, M. N.**, **Saigo, K.**, **Tomisaka, K.**, Matsumoto, T.: 2011, First Cores in Very Low-Mass Molecular Cloud Cores, Winter School and Workshop on Star Formation, (Mitaka, Japan, Feb. 21-25, 2011).

Tomida, K., **Tomisaka, K.**, Matsumoto, T., **Kawabe, R.**, **Machida, M. N.**, **Saigo, K.**: 2010, Numerical Models of the First Cores: Comparison with Observed Candidates, The Origin of Stellar Masses, (Tenerife, Spain, Oct. 18-22, 2010).

Tomida, K., **Tomisaka, K.**, Matsumoto, T., **Machida, M. N.**, **Saigo, K.**: 2010, Formation, Evolution and Observability of low-mass First cores, Frontiers in Computational Astrophysics: Particle and Flames in Radiative and Magnetic Flows, (Lyon, France, Oct. 11-15, 2010).

Tomida, K., **Tomisaka, K.**, Matsumoto, T., **Machida, M. N.**, **Saigo, K.**, **Ohsuga, K.**: 2010, RMHD simulations of low-mass star formation, The 4th East Asian Numerical Astrophysics Meeting, (Taipei, Taiwan, Nov. 2-5, 2010).

Tomida, K., **Tomisaka, K.**, Matsumoto, T., **Ohsuga, K.**, **Machida, M. N.**, **Saigo, K.**: 2010, RMHD simulation of Proto-stellar Collapse, IAU Symp. 270: Computational star formation, (Barcelona, Spain, May 31-Jun. 4, 2010).

Tomida, K., **Tomisaka, K.**, Matsumoto, T., **Ohsuga, K.**, **Machida, M. N.**, **Saigo, K.**: 2010, Nested-Grid RMHD Simulation of Proto-stellar Collapse, The Early Phase of Star Formation 2010 (EPoS 2010), (Schloss Ringberg, Germany, Jun. 14-18, 2010).

Tomisaka, K.: 2011, Origin of Molecular Outflow Determined from Thermal Dust Polarization, Winter School and Workshop on Star Formation, (Mitaka, Japan, Feb. 21-25, 2011).

Tsuji, H., Nishimura, A., Sakaguchi, T., Katase, T., Kizawa, J., Kunizane, M., Matsumoto, K., Minowa, M., Kimura, K., Abe, Y., Muraoka, K., **Onishi, T.**, **Ogawa, H.**, Dobashi, K., Handa, T., **Nakajima, T.**, **Kuno, N.**: 2010, Status of 1.85m Radio Telescope, The 11th Workshop on Submillimeter-Wave Receiver Technologies in Eastern Asia, (Nagoya, Japan, Nov. 14-16, 2010).

Tsujimoto, T.: 2010, Science brought by JASMINE data, ELSA conference 2010 GAIA: At the Frontiers of Astrometry, (Sèvres, France, Jun. 7-11, 2010).

Tsujimoto, T., Bekki, K.: 2010, Diagnosis of the IMF in the Universe Using the C, N Abundances, Why Galaxies Care About AGB Stars II, (Wien, Austria, Aug. 16-20, 2010).

Tsukamoto, Y.: 2010, The self gravity effect on the orbital stability of Twotinos, WPGM2010, (Taipei, Taiwan, Jun. 21-25, 2010).

Tsukamoto, Y.: 2010, The self gravity effect on the orbital stability of Twotinos, AOGS 2010, (Hyderabad, India, Jul. 5-9, 2010）.

Tsuneta, S.: 2010, Polar fields: are they today well determined?, Hinode-IV: unsolved problems and recent insights, (Mondello, Palermo, Italy, Oct. 11-15, 2010).

Tsuneta, S.: 2010, Solar Magnetism as revealed by Hinode satellite, IAU Symp. 271: Astrophysical Dynamics: From Stars to Galaxies, (Nice, France Jun. 21-25, 2010).

Ujihara, H., Kimura, K., **Ogawa, H.**, Matsumoto, K., Kuroiwa, K., Tsuboi, M., Kamegai, K., Kawahara, K., Murata, Y., Kasuga, T., **Homma, M.**: 2010, Development of Multimode Horns for Radio Telescopes, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Ujihara, H., Kouzuma, S., Nakagawa, A., Nakanishi, H., **Kawaguchi, N.**, Ohta, I.: 2010, Numerical Simulations of Tapterd Slot Anttenas for SKA, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Usuda, T.: 2010, Future Instrument Plan of JAPAN, SPIE Astronomical Instrumentation, (San Diego, CA, USA, Jun. 27-Jul. 2, 2010).

Usuda, T.: 2011, Near-Infrared High Resolution Spectrograph, TMT Science and Instrument WS, (Victoria, Canada, Mar. 28-30).

Usuda, T., **Terada, H.**: 2010, Subaru Telescope: The view 2010-2020, W.M. Keck Observatory in the post Astro2010 Era, (Oxnard, USA, Sep. 2010).

Uzawa, Y., **Fujii, Y.**, **Kaneko, K.**, **Kroug, M.**, **Gonzalez, A.**, Kojima, T., **Kuroiwa, K.**, **Miyachi, A.**, Makise, K., Wang, Z., Shan, W.: 2010, Development of the 787-950 GHz ALMA Band 10 Cartridge, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Uzawa, Y., **Fujii, Y.**, **Kaneko, K.**, **Kroug, M.**, Kojima, T., **Kuroiwa, K.**, **Miyachi, A.**, Makise, K., Wang, Z., Shan, W.: 2010, Performance of the ALMA Band 10 SIS Receiver Prototype Model, Applied Superconductivity Conf., (Washington DC, USA, Aug. 1-6, 2010).

Vaubaillon, J., **Watanabe, J.**, **Sato, M.**: 2010, 2011 Draconids: Meteor Storm Or Just An Outburst?, DPS 42nd Annual Meeting Pasadena, (Pasadena, CA, USA, Oct. 3-8, 2010).

Wada, T., Takata, J., Shibata, S.: 2010, A three dimensional particle simulation for axisymmetric pulsar magnetosphere with GRAPE-DR, The 4th East Asian Numerical Astrophysics Meeting, (Taipei, Taiwan, Nov. 2-5, 2010).

Watanabe, T., **Hara, H.**, Sterling, A. C., Harra, L. K.: 2010, Production of high-temperature plasmas during the early phases of C9.7 flare II, Hinode-IV: unsolved problems and recent insights, (Mondello, Palermo, Italy, Oct. 11-15, 2010).

Watanabe, T., Yamamoto, N., Kato, D., Sakaue, H. A., Murakami, I.: 2010, Fe XVII Emission Lines Seen in A Solar Active Region and the Large Helical Device, 38th COSPAR Scientific Assembly, (Bremen, Germany, Jul. 18-25, 2010).

Watnabe, T.: 2010, Iron Line Diagnostics of Non-Equilibrium Plasma in Solar and Laboratory Plasmas, Solar Plasma Spectroscopy: Achievements And Future Challenges, Celebrating the Career of Dr Helen Mason, Cambridge, UK, Sep. 13-15, 2010).

Yamada, Y., **Gouda, N.**, Lammers, U.: 2010, Nano-JASMINE: use of AGIS for the next astrometric satellite, ELSA conference 2010 GAIA: At the Frontiers of Astrometry, (Sèvres, France, Jun. 7-11, 2010).

Yamada, Y., **Gouda, N.**, Lammers, U.: 2010, Application of Gaia analysis software AGIS to Nano-JASMINE, Astronomical Data Analysis Software and Systems XX, (Boston, MA, USA, Nov. 7-11, 2010).

Yamaguchi, M., Ootsubo, T., **Watanabe, J.**, Honda, M., Sakon, I., Ishiguro, M., Sarugaku, Y., Shinnaka, Y., Kobayashi, H., Kawakita, H.: 2010, Crystalline Silicate Grains Of Comet 17P/Holmes Ejected At Its Outburst Observed With Subaru/COMICS, DPS 42nd Annual Meeting Pasadena, (Pasadena, CA, USA, Oct. 3-8, 2010).

Yamashita, K.: 2010, The young star cluster on the accretion flow in G10.6-0.4, East Asia VLBI Workshop 2010, (Kagoshima, Japan, Apr. 22-24, 2010).

Yano, T., **Gouda, N.**, **Kobayashi, Y.**, **Tsujimoto, T.**, **Hatsutori, Y.**, **Murooka, J.**, Niwa, Y., Yamada, Y.: 2010, Current Status of Astrometry Satellite missions in Japan: JASMINE project series, ELSA conference 2010 GAIA: At the Frontiers of Astrometry, (Sèvres, France, Jun. 7-11, 2010).

Yasutake. N., Maruyama, T., Tatsumi, T.: 2010, Finite size effects of quark-hadron phase transition in supernovae, From quark to supernovae, (Shizuoka, Japan, Nov. 28, 2010).

Yasutake. N., Maruyama, T., Tatsumi, T.: 2010, Quark-hadron mixed phase with hyperons in proto-neutron stars, Nuclei in the Cosmos XI, (Heidlberg, Germany, Jul. 19-23, 2010).

Yasutake. N., Maruyama, T., Tatsumi, T.: 2011, Pasta Structures of Quark-Hadron Phase Transition in Proto-Neutron Stars, 24th Int. Nuclear Physics Conf., (Vancouver, Canada, Jul. 7-9, 2010).

Yonekura, Y., **Momose, M.**, Yokosawa, M., **Ogawa, H.**, **Fujisawa, K.**, Takaba, H., Sorai, K., Nakai, N., Kameno, S., **Kobayashi, H.**, **Kawaguchi, N.**: 2010, Present Status and the Future Prospect of the Takahagi and Hitachi 32-M Radio Telescopes, Asia-Pacific Radio Science Conf., (Toyama, Japan, Sep. 22-26, 2010).

Yonezu, T.: 2010, THz High-Resolution TuFIR Spectroscopy of Pure Rotational Transitions of Molecular Ions H_2D^+, Workshop on Interstellar Matter 2010, (Sapporo, Japan, Sept. 13-15, 2010).

Yonezu, T.: 2010, THz high-resolution high-precision spectroscopy of pure rotational transitions of gas phase OH– and OD – molecular anions and analysis, Int.l Symp. on Frontier of Terahertz Spectroscopy IV: Innovation in THz Spectroscopy and THz – Wave Wireless Communications, (Matsumoto, Japan, Oct. 20-22, 2010).

Yoshida, F., **Ito, T.**, **Takahashi, S.**, **Okita, K.**, Karoji, H., **Ozaki, S.**, Yanagisawa, T., Kurosaki, H., Yoshikawa, M., Yamaguchi, T., Takahashi, N., Urakawa, S., Ohtani, H., Nozawa, Y.: 2010, Japanese activities concerning Maidanak, Maidanak Users Meeting 2010, (Tashkent, Uzbekistan, June 21-25, 2010).

Yoshida, F., **Yagi, M.**, **Komiyama, Y.**, **Nakata, F.**, **Furusawa, H.**, Ohno, T., Okamura, S., Nakamura, T.: 2010, Slitless Spectroscopy of Small Solar System Bodies on a Dark Cloud Curtain, AOGS 2010, (Hyderabad, India, Jul. 5-9, 2010).

Yoshida, F.: 2010, Stars of Asia, 8th EAMA (East Asian Meeting on Astronomy) Symp., (Shanghai, China, Oct. 10-15, 2010).

Yoshida, F.: 2010, Stars of Asia, 11thPCST, (New Delhi, India, Dec. 6-10, 2010).

Yoshida, F.: 2011, History of the solar system derived from the record on the Moon surface What happened on the Moon 3.8 billion years ago?, You are Galileo! Workshop in Indonesia, (Jakarta, Indonesia, Feb. 22, 2011)

Yoshida, F.: 2011, History of the solar system derived from the record on the Moon surface What happened on the Moon 3.8 billion years ago?, You are Galileo! Workshop in Indonesia, (Yogyakarta, Indonesia, Feb. 24, 2011).

Yoshida, H.: 2010, Super-integrable 2D homogeneous potentials of degree -2, The 13th Slovenia-Japan seminar on nonlinear science, (Tokyo, Japan, Nov. 4-6, 2010).

Yoshida, H.: 2010, Necessary conditions for integrability and super-integrability of Hamiltonian systems with homogeneous potential, 7th Int. Conf. on Differential Equations and Dynamical Systems, (Tampa, FL, USA, Dec. 15-18, 2010).

Yoshida, H.: 2010, A family of super-integrable homogeneous potentials of degree -2, UPC Int. Integrability Seminar 2010, (Barcelona, Spain, Jun. 7-8, 2010).

Annual Report of the National Astronomical Observatory of Japan

Volume 13 Fiscal 2010