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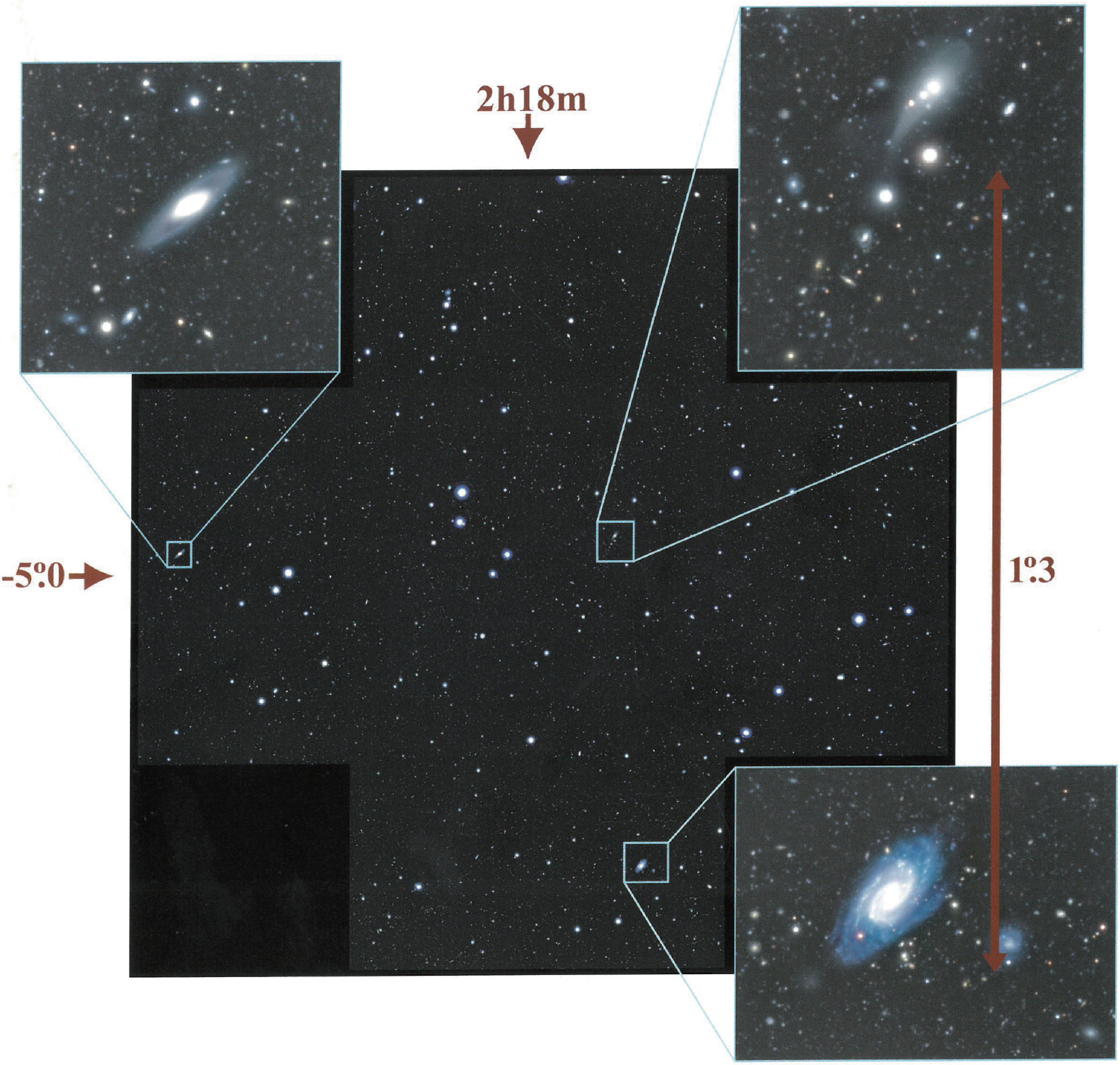
ANNUAL REPORT OF THE NATIONAL ASTRONOMICAL OBSERVATORY OF JAPAN



Volume 5 Fiscal 2002

Explanation of the cover photograph: 3-colour (B, i', & z') composite image of the Subaru/XMM-Newton Deep Field. Five pointing of the Suprime-Cam images were combined to cover a $(1\overset{\circ}{.}3)^2$ field centered at R.A. = 02h18m, decl. = $-5\overset{\circ}{.}0$ (2000.0).

Postscript

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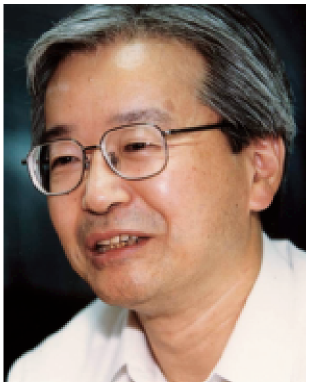
(April 2002 - March 2003)

PREFACE



We report here the achievements by NAOJ during the financial year 2002. Please find the details in each field presented in the following text sections.

The NAOJ started its history as an inter-university national research institute in 1988. During the followed 15 years the NAOJ had pushed forward the frontier in various fields of astronomy by developing and operating top level observational facilities; the Radio Heliograph at Nobeyama for solar activity monitoring, the 8.2-m Subaru Telescope at Mauna Kea, Hawaii for optical and IR observations, four 20-m aperture high performance antennas of the VERA project at Mizusawa, Kagoshima, Chichi-Jima and Ishigaki-Jima for VLBI astrometry. Also new bases to respond to the varying requests from scientific and public communities had been founded at headquarters in Mitaka, Tokyo, by establishing the super computer system for the theoretical simulation astrophysics, the world-first gravitational telescope TAMA-300, the Advanced Technology Center for astronomical engineering, and the Public Relations Center for a variety of outreach activities. Such improvements of research platforms and scientific activities of the NAOJ throughout these 15 years are quite high and successful. Sincere thanks to the community, staff members and leaders for their tremendous efforts.

As mentioned above, the NAOJ is promoting manifold fields of astronomy and astrophysics including various ground-based astronomy and theoretical astrophysics. Another role of NAOJ as an inter-university national research institute is to provide top-level facilities for university scientists as well as to represent the Japanese astronomy and astrophysics on behalf of astronomical community in Japan. Based on these characteristics the NAOJ has been promoting the research and education of astronomy, and tried to respond to the strong public interest about the universe.

The observations of the universe are now growing rapidly. One of the most epoch-making progresses is a sequential discovery of extra-solar planets since 1995. The astronomy is entering into the era to observe and study the numerous number of planets and even the evidence of life on them. Another exciting new observational data from WMAP are revealing the early history of the expanding universe and suggested the existence of "dark energy". The observational cosmology is getting more excitement through the activities of 8-m class telescopes including the Subaru Telescope which is rewriting the distance record of the remote galaxies. The construction of the ALMA, an extremely large mm and sub-mm wave telescope array atop the Atacama Plateau in northern Chile will start soon. Japan (NAOJ) will also join the construction, and the ALMA will be the first telescope which is jointly constructed by the world-wide cooperation. The full operation of ALMA will start in 2011.

The reorganization of all Japanese national universities and inter-university research institutes to be independent agencies from April FY2004 is another major subject for NAOJ. Intensive discussions are ongoing in NAOJ and among the brother institutes to create a flexible and active organization for powerful research in wide area of natural sciences.

Norio Kaifu
Director General
National Astronomical Observatory of Japan

The First Stellar Fringes Observed with Mitaka Optical / IR Array (MIRA -I.2) 30m Baseline

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The first detection of stellar fringes with MIRA -I.2 (Mitaka oprical /IR Array second phase) was achieved on a night of June 2002 during the observations of Vega (α Lyr)[1]. After the first detection, many fringe observations were carried out successfully using Vega and Deneb (α Cyg) until December 2002 (Figure 1).

MIRA -I.2 is an optical interferometer for high spatial resolution stellar observations consisting of two 30cm siderostats that are placed separated by 30m to each other (Figure 2). The suitable range of apparent stellar diameter to be observed with MIRA -I.2 is between 2 and 4 milli-arc-second at 800nm wavelength. The first action for developing the components of MIRA -I.2 began in 1995. Then baseline construction and laboratory setup were started in 1999, followed by the stellar fringe detection with a 6m test baseline in June 2001 prior to the present first fringes by using the 30m baseline.

In each telescope hut, a 30cm siderostat, a 13cm Newtonian telescope with a collimator lens, and a tip-tilt mirror are placed (Figure 3). The star light is lead from each hut to the main laboratory through the vacuum pipe-line of about 50 m long. In the laboratory, an 8 m vacuum delay line (Figure 4), 4m coarse delay line, light dividing optics, detectors for scintillation and star dancing measurements, beam combining optics and fringe detectors (Figure 5), and computers for control and data acquisition, are placed [1][2][3].

After the test observations, MIRA -I.2 has been upgraded for regular observations of stars brighter than 4 mag.

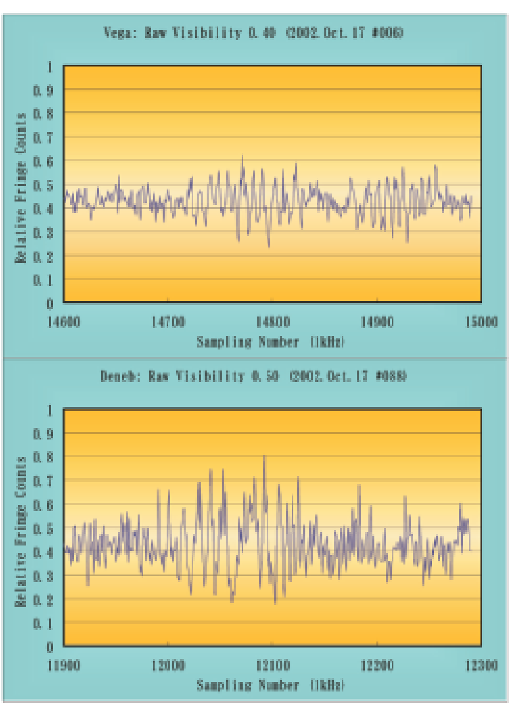

Figure 1: Fringes of Vega and Deneb

References

[1] Nishikawa, J.: 2003, Proc. SPIE, 4838, 101.
[2] Ohishi, N., Matsuda, K., Torii, Y., Nishikawa, J., Yoshizawa, M., Sato, K., Kubo, K., Iwashita, H., Kotani, T., Fukushima, T.: 2003, Proc. SPIE, 4838, 736.
[3] Sato, K., Nishikawa, J., Yoshizawa, M., Ohishi, N., Fukushima, T., Torii, Y., Matsuda, K., Kubo, K., Iwashita, H., Suzuki, S., Kotani, T., Yokoi. T.: 2003, Proc. SPIE, 4838, 1072.

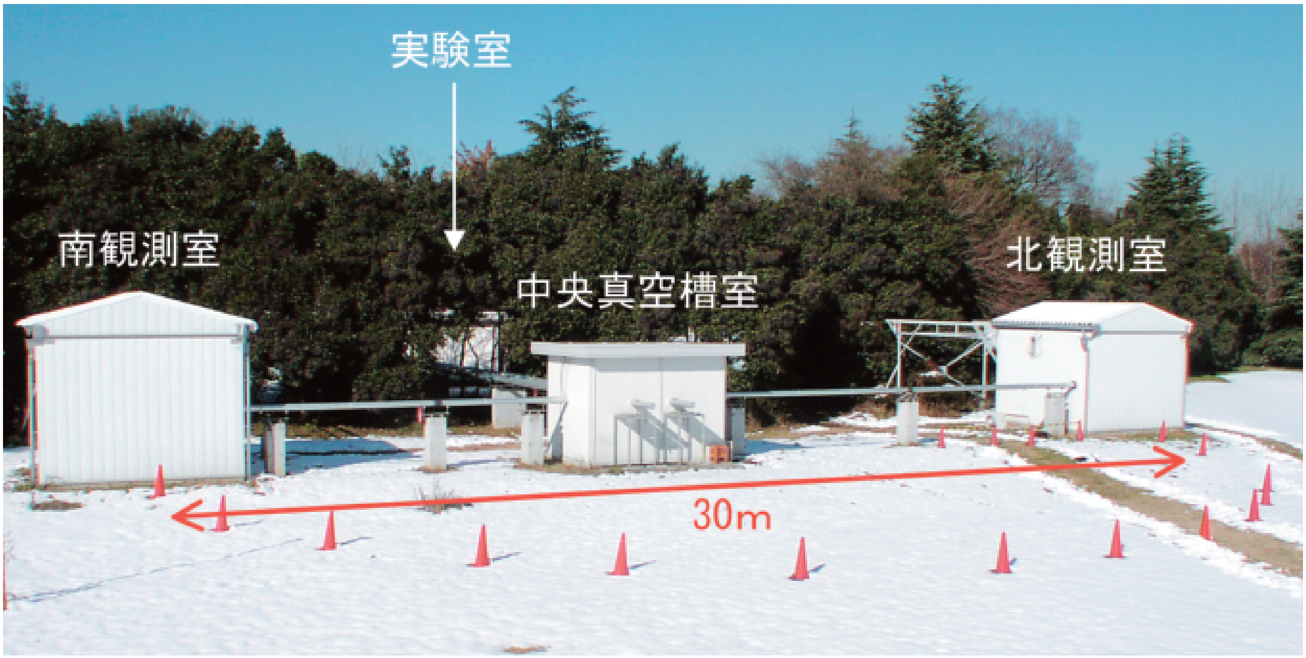

Figure 2 : Mitaka optical and InfraRed Array 30m baseline (MIRA-I.2).

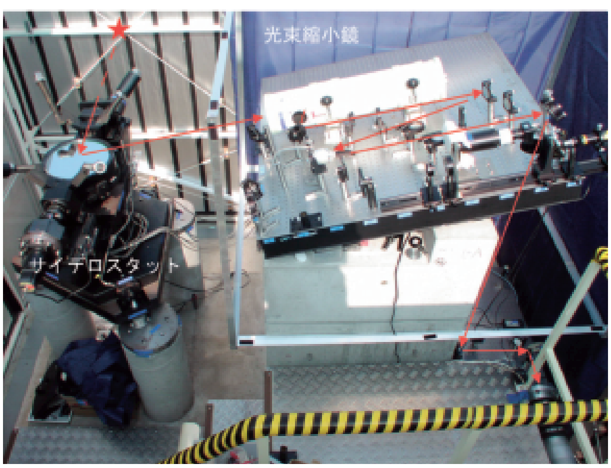

Figure 3 : Optics in the North observing hut.

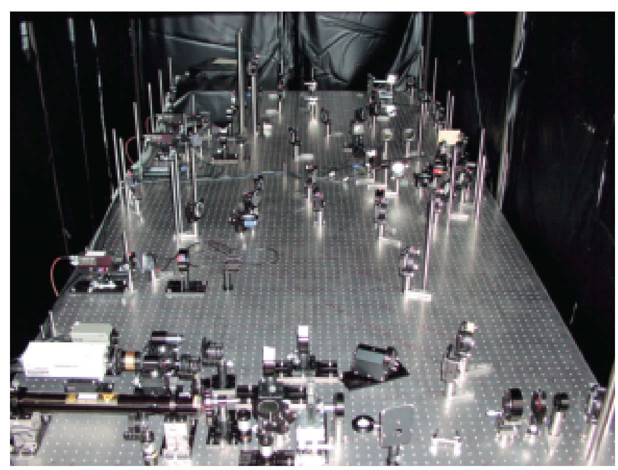

Figure 5 : Optical table in the main laboratory.

Figure 4 : 8 m vacuum optical delay line.

Development of the Solar-B X-Ray Telescope Focal Plane Camera

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The Solar-B satellite is scheduled for launch in summer 2006 by the Institute of Space and Astronautical Science (ISAS). Its goal is to better understand the overall magnetohydrodynamic behavior of the sun by observing the solar corona, chromosphere and photosphere. The X-Ray Telescope (XRT) is one of three instruments on Solar-B and is designed to image the solar corona in the soft X-ray. Soft X-ray images reveal temperature distributions and magnetic field structure of the solar corona, allowing us to observe the energy transport, storage and release process starting from the photosphere and extending throughout the corona.

The XRT is a grazing incidence telescope similar to the Soft X-ray Telescope (SXT) on the Yohkoh satellite, but with several major improvements: (1) By combining a larger aperture (34 cm) and higher precision mirror system with a larger focal plane detector (2k×2k pixel CCD), spatial resolution has been increased to 1 arcsecond while retaining a sufficient field of view to image the whole sun. (2) The use of a backside illuminated CCD allows the XRT to observe longer wavelength radiation, up to the ~60Å and longer XUV range. This allows observation of 1 million K plasma in addition to the 2 million K and higher temperatures observed by the Yohkoh SXT. (3) Using an optimized set of diagnostic filters, the XRT can observe and distinguish different temperature plasma from 1million K to the super-hot 30 million K flares. (4) The control system is based on the observation table system proven on the Yohkoh SXT, but with the addition of onboard image analysis by the satellite's Mission Data Processor (MDP) which allows automatic adjustment of exposure and imaging region.

The CCD is mounted on an adjustable focus stage with a ±1mm range along the optical axis. This eliminates the risk of focal adjustment error which would otherwise be difficult in a telescope of this size. In addition, because of the curved focal plane of the telescope, focal adjustment allows us to choose between maximum resolution at image center or optimal focus over a larger field of view to match those of the other instruments on the satellite, the Solar Optical Telescope and the EUV Imaging Spectrometer.

The XRT is a collaboration with the Smithsonian Astrophysical Observatory (SAO) and NASA in the USA. The Japanese participants, NAOJ and ISAS, are in charge of the design and construction of the X-ray CCD camera and the MDP. The camera contains a cooling system based entirely on radiative cooling, since thermoelectric coolers can cause outgas that leads to contamination of the detector. The camera is designed to achieve an on-orbit CCD temperature of -45°C. The CCD charge is read out at 500kHz and readout noise of ~$20e^-$ has been achieved.

The flight CCD camera was assembled in the Project Room 1 in the NAOJ Advanced Technology Center (ATC), recently converted into a class 100 cleanroom to eliminate molecular and dust contamination. The performance and functionality of the camera is being verified thanks to the cooperation of the ATC machine shop and optical shop. Tests included (a) X-ray quantum efficiency measurements in the medium vacuum chamber using an interchangeable target X-ray generator and X-ray monochromator, and CCD gain measurement using an ^{55}Fe source, (b) Testing and verification of the focus mechanism through thermal tests, and (c) Vibration and shock tests conducted at ISAS.

After testing in Japan, the camera will be shipped to SAO in summer of 2003 and mated to the telescope optical tube. The complete telescope will be tested in the USA and be shipped to ISAS for satellite integration test in May 2004.

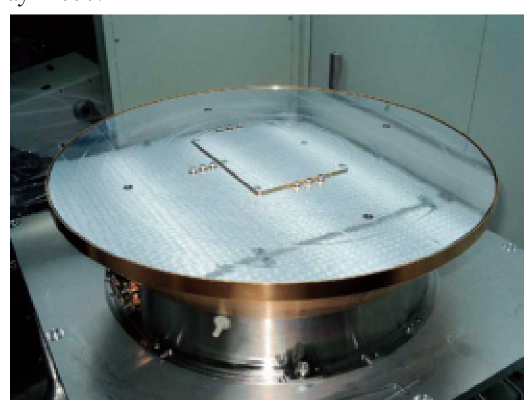

Figure 1: Flight CCD camera, shown with the radiator side up to cool the CCD.

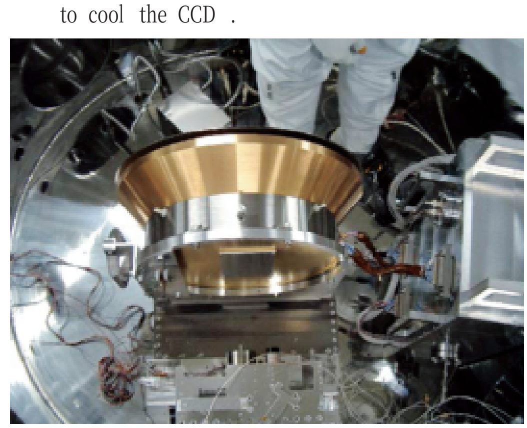

Figure 2: CCD camera mounted in the ATC medium vacuum chamber for X-ray quantum efficiency measurement.

Thermo-Optical Testing of the Solar Optical Telescope of the Solar-B

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1. Introduction

The Optical Telescope Assembly (OTA) of the Solar-B consists of a Gregorian telescope with 500mm aperture and 1500mm distance between the primary and secondary mirrors and Collimating Lens Unit (CLU) sending a parallel beam to the focal plane package. The OTA is aimed to perform a precise polarimetric measurement of the solar atmosphere from space with a diffraction limited spatial resolution. The OTA assemble test using proto-model mirrors and structures was performed in 2001-2002 and we established the procedure to realize the diffraction limited telescope. However, the optical performance was evaluated only under the room temperature. Extremely different temperature distribution is expected in orbit; i.e. the difference of temperature between the top part of OTA which is exposed to space and the bottom parts of OTA which is surrounded by spacecraft structure will be larger than 50°C. To achieve the positional stability of the primary and secondary mirrors with a micron-order precision under such severe temperature condition has been a challenging goal of the structural design of OTA, and we absolutely need to verify it before launching the telescope. In order to confirm the optical performance of OTA under the space environment, we constructed a dedicated vacuum chamber and performed the thermo-optical test of the OTA.

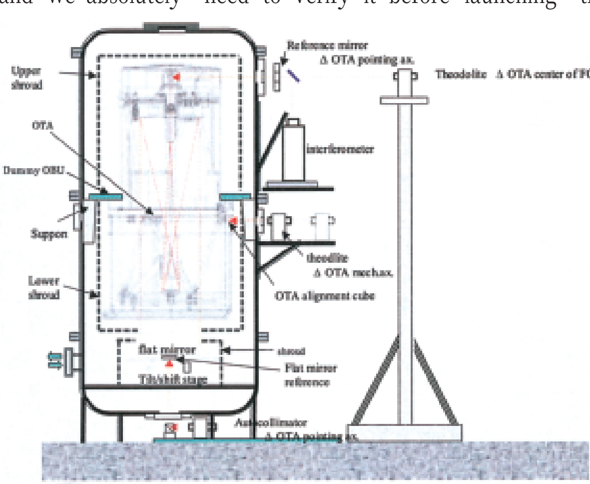

Figure 1: Configuration of the OTA thermo-optical testing.

2. Overview of the thermo-optical testing

The vacuum chamber for thermo-optical testing has a diameter of 1800mm and height of 4000mm, and has upper and lower shrouds in it. The OTA is mounted inside the shrouds with upside down via three legs of the structural interface to the space craft. The temperatures of the top and bottom parts of OTA are controlled independently by the shrouds in a range of -30°C to +50°C. On the base of the chamber, a 60cm diameter flat mirror is mounted in face to the OTA aperture to provide a optical reference, and in combination with the interferometer mounted on the outside wall of the chamber, we can measure the wave front error of the OTA in vacuum. By measuring the tilt of the flat mirror and the alignment cube attached on OTA structure, we can also evaluate the excursion of the OTA pointing axis with respect to the mechanical reference.

3. Results

The OTA thermo-optical test was performed from 28th January to 4th March in 2003 at the Structure and mechanics test building of ISAS. By simulating the predicted hot and cold case temperatures and operating the operational heaters for mirrors successively, we performed the measurements of wavefront error, focus shift and pointing axis of the OTA. The major results are summarized below:

1) The sensitivity of the OTA focus position on temperatures of various parts of OTA was measured reliably. They are mostly as predicted but a few unexpected behaviors were found and the hardware causing the

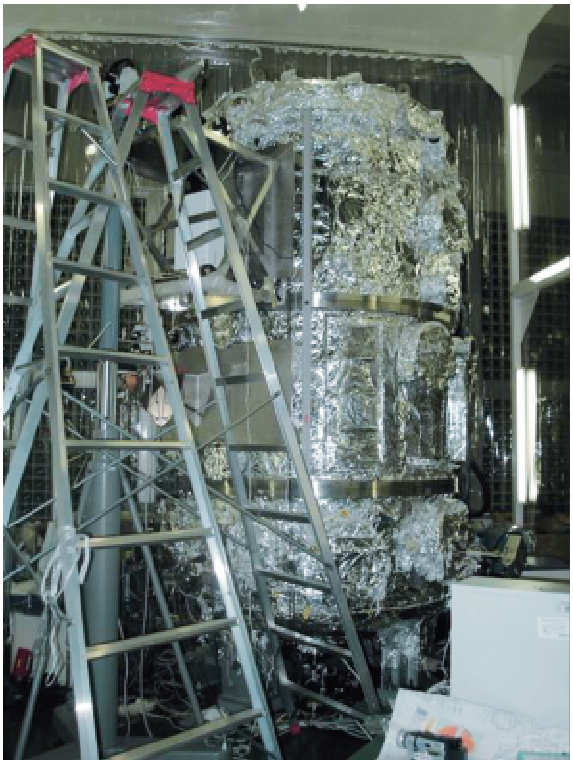

Figure 2: View of the OTA thermo-opitical testing

effect will be modified in flight model.

2) The CFRP truss structure of OTA changes its dimension gradually due to dehydration in vacuum. The effect was previously known, but the amount and the time constant were evaluated accurately for the first time. This result together with the finding 1) gives us valuable information for initial setup of the on-orbit focus adjustment mechanism and its operation.

3) Change of the OTA wavefront error was observed with the change of temperature of the primary mirror. The major component of the change was caused by a predicted stress from the metal pads of the primary mirror. However we also observed unexpected component of the wavefront error. The supporting mechanism of the primary mirror will be partially modified in flight model to mitigate the unexpected stress to the mirror. We confirmed that the temperature excursion of other parts of OTA does not cause any significant wavefront degradation (i.e. positional change of primary and secondary mirrors).

4) There was no detectable change of the pointing axis. With the OTA thermo-optical testing, we could verify the overall healthiness of the OTA structure, while some problems to be solved were identified at the same time. It can be said that we are approaching the final goal to realize the diffraction limited telescope. The vacuum chamber was moved to the new clean room in Mitaka after the OTA thermo-optical test and is going to be used continuously for the baking of the OTA flight components. The second (final) thermo-optical test with the OTA flight model is planned in spring of 2004.

ALMA Cartridge -type Receiver System on ASTE

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(Institute of Astronomy , University of Tokyo) (Osaka Prefecture University)
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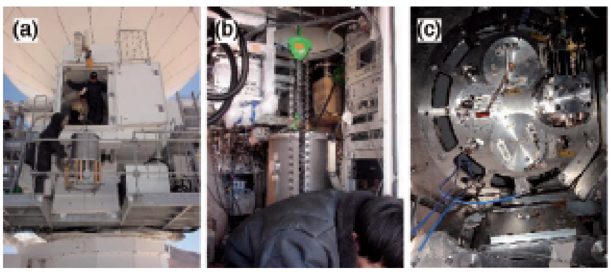

Figure 1: (a) A photograph of carrying the receiver system into the receiver cabin . (b) A photograph before instal - lation of the receiver system. (c) A photograph after installation . Bottoms of three cartridges and the cryocooler are seen. The warm IF amplifiers and bias electronics are not mounted .

We have developed an ALMA cartridge -type receiver system composed of three cartridge -type receivers and a cryostat , which is designed to test on the Atacama Submil - limeter Telescope Experiment (ASTE). It was prelimi - nary evaluated at Pampa la Bola (alt. 4800m) in the northern Chile since November 2002 [1].

A cartridge -type cryostat , which can house 3 cartrid - getype receivers , has been developed for the ASTE . The ASTE 10m telescope has been developed as a prototype antenna of the Large Millimeter Submillimeter Array . It was installed on Pampa la Bola following evaluation at Nobeyama .

The detail of this cryostat was described by [2]. The cylindrical cryostat can accommodate 2 cartridges of 170mm diameter and 1 cartridge of 140mm diameter . The cryostat has been developed with following technol - ogies ; a central pipe and bellows structure to reduce mechanical vibration ; simple and e.cient thermal links for plug -in cartridges ; 3-stage Gifford McMahon cryocooler and an outdoor compressor .

The concept of the thermal link for the ALMA receiver was proposed by the Rutherford Appleton Labo - ratory (RAL) [3]. We have designed and developed a simple and efficient thermal link with high heat conduc - tivity [4]. Measured thermal conductance of ɸ170mm links is 1.7, 5.6, 3.3 W K^{-1} for 4, 12, and 80K stages. This simple and compact links have good performance and can be easily fabricated .

Engineering models of band 3 (100 GHz) [5] [6] [7], band 8 (500 GHz), and band 10 (800 GHz) cartridge -type receivers were independently developed with cartridgetest cryostats (See [8] for more details of cartridge -test cryos - tats). They were integrated into the cryostat at NAOJ , then the system was shipped to the site.

In November 2002, 3 cartridge -type receivers were installed to the ASTE and its photograph is shown in Figure 1. At the ASTE site, we checked vacuum condi - tion of the cryostat and electronic condition of three cartridgetype receivers . Then , the cryostat was attached under the Cassegrain focus . On 17 November 2002, we detected continuum signals from the moon with all three receivers . The moon and Jupiter efficiency of the band 3 receiver were 90% and 73% at 100 GHz , respectively . The pointing accuracy at 498 GHz was about 1″, which derived from measurements of the Jupiter and the Saturn . In spite of not adjusting tilt parameters of the subre reflector , the moon and Jupiter efficiency were 82% and 42 %, respectively . After waiting good atmospheric condi - tion ($\tau < 1.3$) in several days, on 9 December 2002, we observed a spectrum of CI (rest frequency =492.16 GHz) from Orion (Figure 2). At that night , the optical depth at zenith was ~1.0 and the system noise temperature was around 1000K .

We confirmed that the system including three receivers operates as designed and the concept of cartridge -type receiver system is very promising for the ALMA .

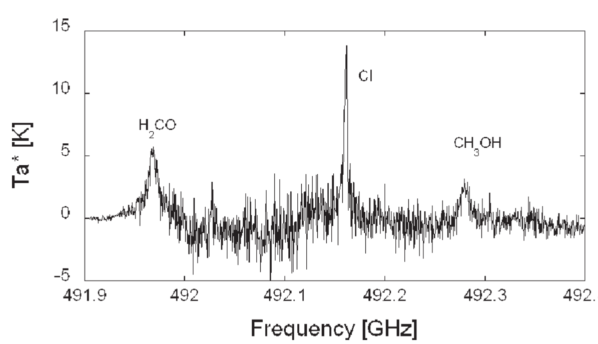

Figure 2: A spectrum of CI ($^3P_1$-$^3P_0$) from Orion KL . The beam is averaged over 2 arcminutes . H_2CO (491.97 GHz) and CH_3OH (492.28 GHz) lines also were detected . Integration time was 1 minute .

References

[1] Sugimoto et al.: 2003, ALMA memo , 458.
[2] Yokogawa et al.: 2003, PASJ , 55, L519 .
[3] Orlowska et al.: 2002, ALMA project book , Chapter 6.
[4] Sugimoto et al.: 2003, Cryogenics , in press .
[5] Ogawa et al.: 2002, Proc . IAU 8th APRM , 2, L23 .
[6] Asayama et al.: 2003a, Int . J. Infrared and Millimeter Waves , in press .
[7] Asayama et al.: 2003b, ALMA memo , 453.
[8] Sekimoto et al.: 2003, ALMA memo , 455.

Gravitational Wave Detector TAMA300 Power Recycling and International Joint Observation

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SATO, Shuichi, NAGANO, Shigeo, TSUNESADA, Yoshiki, and the TAMA collaboration
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We report on the implementation of power recycling of the TAMA300 gravitational wave detector and on the joint observation period, which exceeded 1,000 hours, by an international network of GW detectors.

The goal of power recycling is to improve the shot-noise limited sensitivity by increasing the "effective laser power" to the interferometer. This is realized by an additional recycling mirror between the laser source and the interferometer, composing an optical cavity with the interferometer. The total optical configuration becomes a complicated coupled-cavity system because the Michelson interferometer also contains Fabry-Perot cavities in its arms. TAMA300 was first successfully operated with power recycling in the end of 2001, a few months after installation. In summer 2002, considerable improvement in sensitivity was achieved after a period of optimization and noise reduction. Signal enhancement by power recycling, a modified laser frequency stabilization system, an improved laser intensity stabilization system, and a reduction of scattered light contributed to improving this sensitivity. The resulting noise curve has a best sensitivity of 1×10^{-18}mHz $^{-1/2}$ in displacement around 1kHz. The "binary inspiral range", which is the distance the antenna can detect the chirping signals generated by the coalescence of 1.4M$_\odot$, compact star binaries with an SNR of 10, exceeds 30 kpc, so the TAMA300 is sensitive enough to detect an intergalactic gravitational wave event.

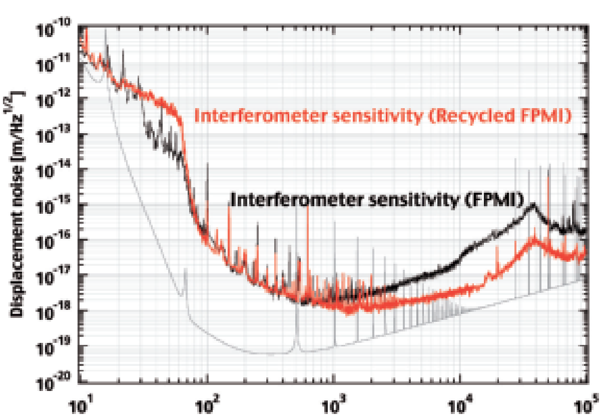

Figure 1: The interferometer displacement sensitivity. The best sensitivity for the non-recycled FPMI is shown by the black curve and for the recycled FPMI by the red curve. The sensitivity was considerably improved in the higher frequency region above around 1kHz, where the shot-noise is expected to be dominant.

As large-scale gravitational wave antennae elsewhere around the world were also becoming operational, an observation network for GWs began this year. TAMA300 participated in an international joint observation with the LIGO interferometers (U.S.) for two months from February to April 2003 (DT8). This was the first, real, joint observation in a sense that the participating interferometers were sensitive enough to detect GW events within our galaxy. The interferometer was operated for 1158 hours out of 1424 hours during DT8, even though the interferometer had became a complicated coupled cavity system. The duty cycle reached 81.3%, which was comparable with that of the non-recycled FPMI system (86.5%), so the power recycled interferometer showed sufficient stability for long-term operation. Of the interferometers in the observation network, TAMA300 had the highest duty cycle (The LIGO interferometers duty cycle was typically 40-70%).

Recorded observational data was distributed to data analysis groups in real-time via superSINET network system, and was analyzed promptly. A preliminary result of a GW search from the TAMA300 data (single detector) is that the upper limit of the event rate of coalescence of 1.4M$_\odot$. compact star binaries within our galaxy was determined to be 0.0033 event/hour (90% C.L.). This value was improved by a factor of 3 compared with the value from DT6 (0.0095), reflecting the improved sensitivity. Further analysis is ongoing.

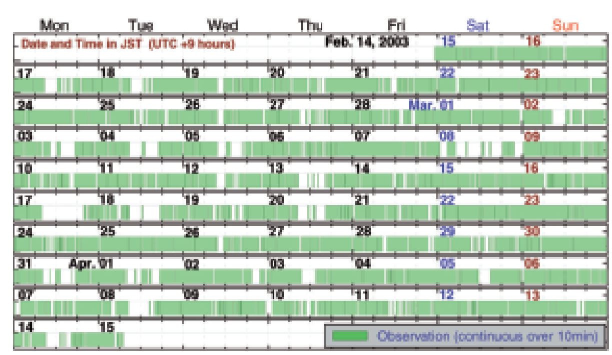

Figure 2: Observation status during DT8. Each green box shows the period when TAMA300 was fully operational and valid data was recorded.

New Limits on the Mass of the Milky Way

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We set new limits on the mass of the Milky Way, making use of the latest kinematic information for Galactic satellites and halo objects. Our sample consists of 11 satellite galaxies, 137 globular clusters, and 413 field horizontal-branch (FHB) stars up to distances of 10 kpc from the Sun. Roughly half of the objects in this sample have measured proper motions, permitting the use of their full space motions in our analysis. In order to bind these sample objects to the Galaxy, their rest-frame velocities must be lower than their escape velocities at their estimated distances. This constraint enables us to show that the mass estimate of the Galaxy is largely affected by several high-velocity objects (Leo I, Pal 3, Draco, and a few FHB stars), not by a single object alone (such as Leo I), as has often been the case in past analyses. We also find that a gravitational potential that gives rise to a declining rotation curve is insufficient to bind many of our sample objects to the Galaxy; a possible lower limit on the mass of the Galaxy is about $2.2\times10^{12}M_\odot$. To be more quantitative, we adopt a Bayesian likelihood approach to reproduce the observed distribution of the current positions and motions of the sample, in a prescribed Galactic potential that yields a flat rotation curve. This method enables a search for the most likely total mass of the Galaxy, without undue influence in the final result arising from the presence or absence of Leo I, provided that both radial velocities and proper motions are used. Although the best mass estimate depends somewhat on the model assumptions, such as the unknown prior probabilities for the model parameters, the resultant systematic change in the mass estimate is confined to a relatively narrow range of a few times $10^{11}M_\odot$, owing to our consideration of many FHB stars. The most likely total mass derived from this method is $2.5^{+0.5}_{-1.0}\times10^{12}M_\odot$ (including Leo I), and $1.8^{+0.4}_{-0.7}\times10^{12}M_\odot$ (excluding Leo I). The derived mass estimate of the Galaxy within the distance to the Large Magellanic Cloud (~50 kpc) is essentially independent of the model parameters, yielding $5.5^{+0.0}_{-0.2}\times10^{11}M_\odot$ (including Leo I) and $5.4^{+0.1}_{-0.4}\times10^{11}M_\odot$ (excluding Leo I). Implications for the origin of halo microlensing events (e.g., the possibility of brown dwarfs as the origin of the microlensing events toward the LMC, may be excluded by our lower mass limit) and prospects for more accurate estimates of the total mass are also discussed.

Reference

[1] Sakamoto, T., Chiba, M., & Beers, T. C.: 2003, Astron. Astrophys., 397, 899-911.

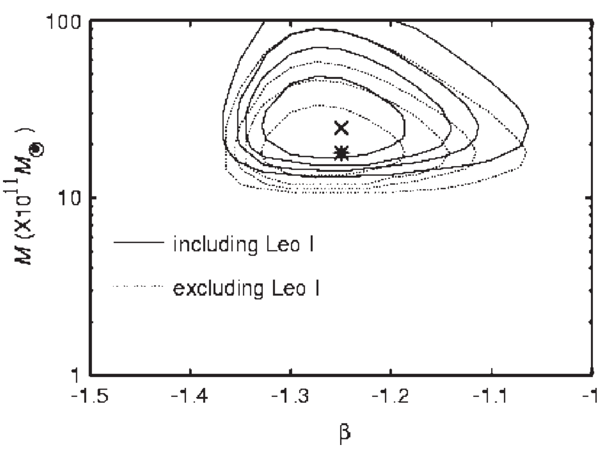

Figure 1: Likelihood contours in the plane of the mass, M, and velocity anisotropy, β, obtained from an analysis that uses both radial velocities and proper motions. Solid and dashed curves show the results including Leo I and excluding Leo I, respectively; the cross and the asterisk show the maxima of the probabilities for each case.

Kinematics of Tidal Debris from ω Centauri's Progenitor Galaxy

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Omega Centauri, the most massive globular cluster in the Milky Way, is unique in terms of its stellar population: unlike other Galactic globular clusters, ω Cen shows a wide spread in metallicity distribution and internal kinematics. Also, the metal-rich sub-population in ω Cen is largely enhanced in s-process elements relative to the stars in other clusters with similar metallicities, thereby suggesting that the ejecta from low-mass, AGB stars had to be retained and incorporated into the next-generation stars. However, in spite of its large mass ($5\times 10^6 M_\odot$), ω Cen is not unique in its ability to retain the AGB ejecta as found for other clusters. An isolated formation of ω Cen is thus unlikely, because the enriched gas would easily be lost by encountering the Galactic disk. The most viable explanation for the uniqueness of ω Cen is that it was once the dense nucleus of a nucleated dwarf galaxy. A gravitational potential provided by progenitor's stellar system and dark matter would help retaining the enriched gas and let the cluster being self-enriched at least over a few Gigayears.

If this hypothesis is the case for the origin of ω Cen, the question arises: where and in what form does the stellar system of its progenitor galaxy remain?

We have conducted an N-body simulation for the tidal disruption of a dwarf galaxy, based on the hypothesis that its central part once contained ω Cen. Dynamical evolution of a self-gravitating progenitor galaxy that follows the present-day and likely past orbits of ω Cen is calculated numerically and the kinematic nature of their tidal debris is analyzed, in comparison with various observations showing signatures of recent merging events in the Milky Way. In particular, we have found that the retrograde rotation of the debris stars at $\sim$100 km s^{-1} accords with a recently discovered, large radial velocity stream at $\sim$300 km s^{-1} towards the Galactic longitude of $\sim 270°$. Further searches for this merging siganture in the Milky Way, e.g., by the SDSS and RAVE projects, are worth exploring.

Reference

[1] Mizutani, A., Chiba, M., Sakamoto, T.: 2003, Astrophys. J., 589, L89-92.

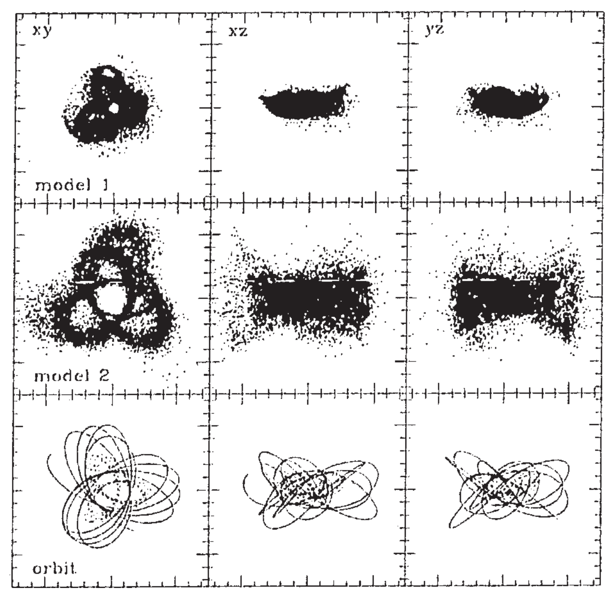

Figure 1: Upper (middle) panel shows the spatial distribution of the tidally disrupted debris for model 1 (model 2) after the 1.37 (1.86) Gyr orbital excursion of ω Cen's progenitor galaxy. Lower panel shows the orbit of the galaxy center for model 1 (dotted line) and 2 (solid line). A frame measures 15 kpc on a side of each panel, where the Sun is located at $x=-8$ kpc and xy corresponds to the disk plane.

Gravity-Driven Turbulence in Galactic Disks

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High-resolution, 2-D hydrodynamical simulations with a large dynamic range are performed to study the turbulent nature of the interstellar medium (ISM) in galactic disks. The simulations are global, where the self-gravity of the ISM, realistic radiative cooling, and galactic rotation are taken into account.

In the analysis undertaken here, feedback processes from stellar energy source are omitted. We find that the velocity field of the disk in a non-linear phase shows a steady power-law energy spectrum over three-orders of magnitude in wave number. This implies that the random velocity field can be modeled as fully-developed, stationary turbulence. Gravitational and thermal instabilities under the influence of galactic rotation contribute to form the turbulent velocity field. The Toomre effective Q value, in the non-linear phase, ranges over a wide range, and gravitationally stable and unstable regions are distributed patchily in the disk. These results suggest that large-scale galactic rotation coupled with the self-gravity of the gas can be the ultimate energy sources that maintain the turbulence in the local ISM.

We find that our models of turbulent rotating disks are consistent with the velocity dispersion of an extended HI disk in the dwarf galaxy, NGC 2915, where there is no prominent active star formation. Numerical simulations show that the stellar bar in NGC 2915 enhances the velocity dispersion, and it also drives spiral arms as observed in the HI disk.

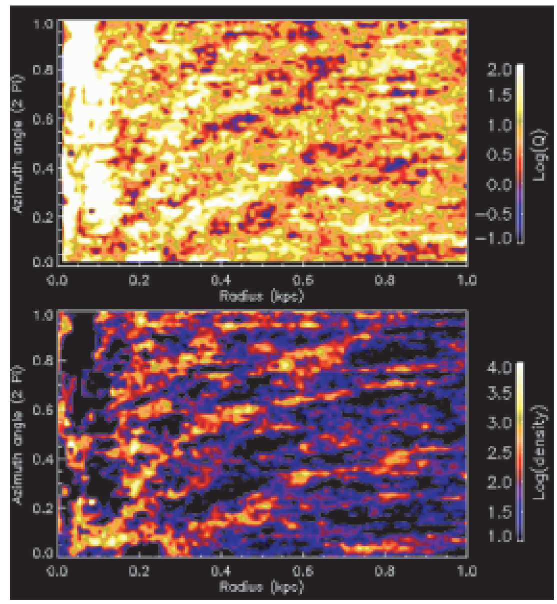

Figure 1: Two-dimensional distribution of the effective Q (r, φ) (upper panel) and the density $\Sigma_g(r, \phi)$ (lower panel) at t = 48 Myr of the high resolution model (4096^2 zones). All quantities to calculate the effective Q, i.e. the epicyclic frequency, surface density and velocity dispersion are averaged in 100×60 sub-regions.

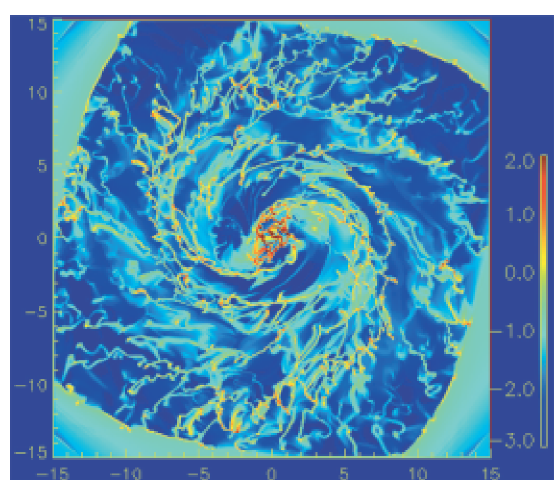

Figure 2: Numerical model of the extended HI disk of dwarf galaxy NGC2915. The two major spirals are formed due to the outer Lindblad resonance, which is caused by the central stellar bar of the pattern speed 8 km s^{-1} kpc^{-1}.

Reference

[1] Wada K., Meurer, G., & Norman C. A.: 2002, ApJ, 577, 197.

Detection of crystalline silicates in the protoplanetary disk around the T Tauri star Hen 3-600A

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Silicate dust shows spectral features in the mid-infrared wavelengths. Observation and analysis of silicate features provide information about composition, amorphousness/crystallinity and size of silicate grains. Previous observations indicate that the silicate dust is completely amophous in the interstellar matter (ISM), which is supposed to be starting material of star and planetary system formation. On the other hand, in the end of 80's, striking evidence of crsytalline silicate dust was discoverd in the cometary dust that is believed to be a primordial matters. The presence of crystalline silicate in the cometary dust is contradictory with its formation condition (~30 K), because crystallization of silicate grains need thermal annealing at high temperature condition (more than 800 K). Recently, a key to the origin of crystalline silicate grains in the cometary dust was reported. That was the detection of crystalline silicates around intermediate-mass pre main sequence stars (PMSs), Herbig Ae/Be stars. However, due to their faintness, there was no clear detection of crystalline silicates dust around low-mass PMSs, which might be more similar to the early stage of our solar system than Herbig Ae/Be stars are.

High sensitivity of the COoled Mid-Infrared Camera and Spectrometer (COMICS) enabled us to obtain the spectra of faint T Tauri stars for the first time. As a result, we succeeded in detecting clear crystalline silicate features in the spectrum of T Tauri star Hen 3-600A (Figure 1, [1]) for the first time. Our first clear detection of crystalline silicates among T Tauri stars implies that the crsytallization of silicate grains might be an universal event in the protoplanetary disks around young stars. That would also explain the origin of crystalline silicate grains in the cometary dust. Future observational studies will make clear the relevance between the silicate dust crystallization and planet formation processes.

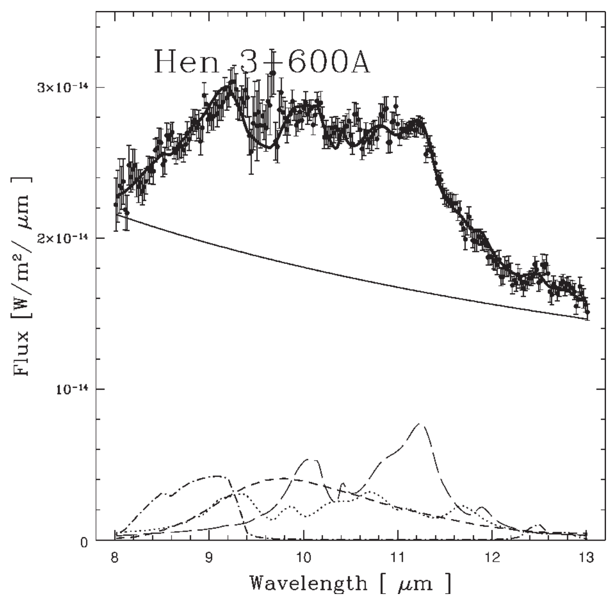

Figure 1: The 10 μm spectrum of the T Tauri star Hen 3-600A. The features are explained with a combination of amorphous olivine ($MgFeSiO_4$; dashed line), crystalline forsterite (Mg_2SiO_4; long-dashed line), crystalline enstatite ($MgSiO_3$; dotted line), silica (SiO_2; dotdashed line).

Reference

[1] Honda, M., Kataza, H., Okamoto, Y. K., Miyata, T., Yamashita, T., Sako, S., Takubo, S., and Onaka, T.: 2003, Astrophys. J., 585, L59.

Error Estimation of the Doppler Measurements for Gravity Field Recovery of the Far-side of the Moon

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Doppler measurement of a spacecraft around the Moon or planets is one of the major methods to measure the gravity fields. 2-way and 4-way Doppler measurements for the global lunar gravity field recovery will be carried out in SELENE project with the accuracies of 0.2 mm・s^{-1} and 0.5 mm・s^{-1} in range rate in 18 seconds integration, respectively. Frequency instability of a frequency standard in a ground station is one of the error sources. It has been estimated by a round trip test in a ground station and a simple modeling of the frequency instability so far. The more realistic model of the frequency instability of a ground station is applied to the test of Usuda Deep Space Center (UDSC).

The measurement error σ_d due to the frequency instability of the ground station is given by

$$\sigma_d^2 = \langle f_u^2 y_u^2 \rangle + \langle f_d^2 y_d^2 \rangle + 2 f_d^2 \sigma_y^2(2, T, \tau_l) \quad (1)$$

where f_u, f_d are carrier frequencies of up-and downlinks, respectively, $\sigma_y(2, T, \tau)$ is the two sample standard deviation with integration time τ and the measurement interval T, and y_u, y_d are standard deviation of frequency instability which are normalized by the carrier frequencies. The first and second terms in Eq.(1) can be obtained by a round trip test in the ground station. The result at UDSC is shown in Figure 1. Because the third terms in Eq.(1) cannot be obtained directly, it is estimated from a 5MHz reference signal based on H-maser which is supplied to both up-and down-converters. The third term is obtained by using the relation $\sigma_y(2, T, \tau) = B_2(\mu, T, \tau)\sigma(\tau)$, where $\sigma(\tau)$ can be calculated from measured phase noise $L(f)$. $B_2(\mu, T, \tau)$ is a bias function which depends on spectral type μ of the phase noise. Figure 2 shows the result at UDSC.

All the results of the test indicates that the Doppler system at UDSC has capability of Doppler measurements within the expected accuracy for gravity field recovery of the far-side of the Moon.

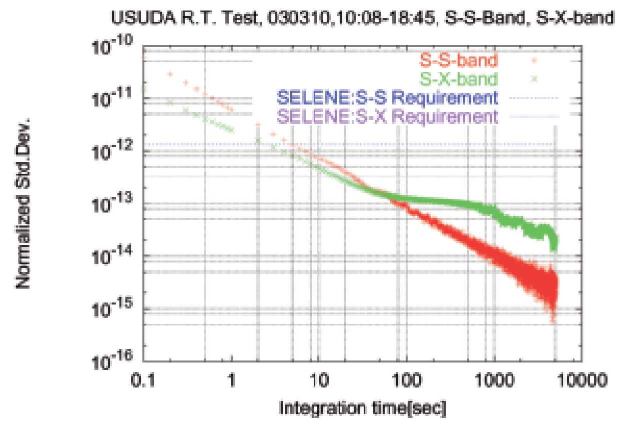

Figure 1: Round trip test at UDSC. S-S and S-X band indicate 2- and 4-way Doppler, respectively.

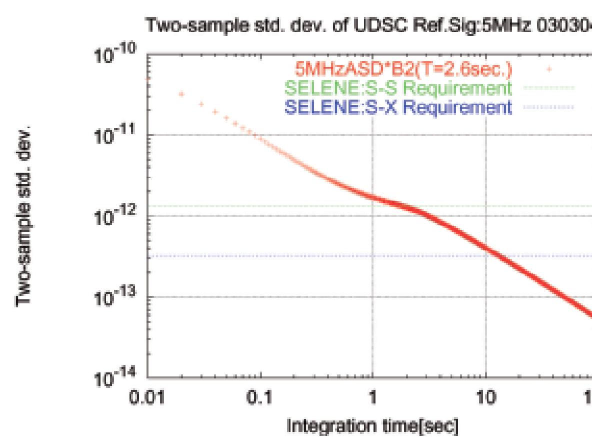

Figure 2: Two sample standard deviation of the 5MHz reference signal $\sqrt{2}\sigma_y(2, 2.6\text{sec.}, \tau)$

Microwave Imaging Observation of High-Energy Electron Propagation in a Solar Flare

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Solar flares are phenomena in which high-temperature plasma and high-energy particles are produced in a short interval of time. The mechanism of flares is not yet fully understood. Especially, particle acceleration mechanism is poorly understood. When the high-energy electrons are produced in an active region, they gyrate around active region magnetic field and propagate along the field. Gyration motion of electrons emits microwaves. So, if we can image microwave-emitting region we can identify the location of electron acceleration. With this idea, we constructed Nobeyama Radioheliograph (NoRH) 10 years ago and are continuing observation. As the speed of the high-energy electrons are close to the light speed, the radio telescope needs to have both high time and space resolution. The spatial resolution of NoRH is 10 arcsec at 17 GHz and is 5 arcsec at 34 GHz. Temporal resolution is 100 msec. As the NoRH can observe the full disk, we do not miss any events if they occur during the observing time. Even with these conditions, we could not detect events to identify electron propagation.

In the flare on August 28, 1999, we finally detected microwave-emitting electrons propagating along a loop [1]. Although the flare itself was medium class, we could observe a large and bright loop-shaped microwave source (Figure 1). We studied the formation process of the loop source by radio images every 100 msec (Figure 2). First, a compact source (C) appeared, then, a loop source started to extend from one foot point near (C) toward the other. The projected length of the loop is 45,000 km and it took 0.5 second for the bright feature to fill the complete loop. If we take into account the 3-D structure of the loop and the fact that electrons are gyrating around the magnetic field, the speed of electrons should be very close to the light speed.

Based on this observation, we can say that either 1) high-energy electrons were produced in a small loop in the source (C) and were injected into the large loop, or 2) high-energy electrons were produced by interaction between the small loop and the large loop. This information is very important to study the particle acceleration mechanism in solar flares.

Reference

[1] Yokoyama, T., Nakajima, H., Shibasaki, K., Melnikov, V. F., and Stepanov, A. V.: 2002, ApJ, 576, L87.

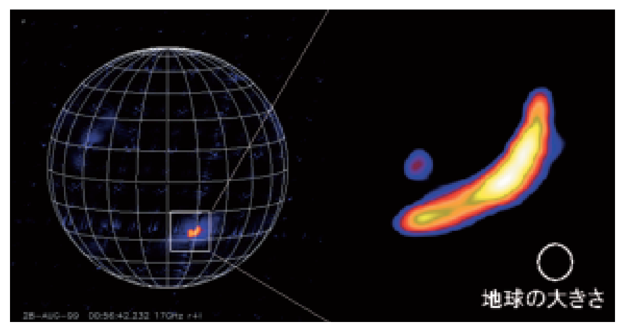

Figure 1: Full disk image (left, 17 GHz) and partial frame image (right, 34 GHz) of the 1999 August 28 flare.

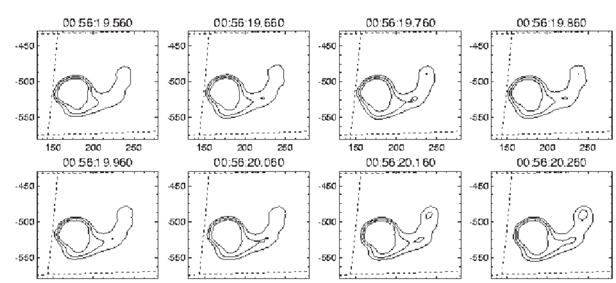

Figure 2: Radio brightness distribution every 100 msec at 17 GHz. An extending bright feature from one foot point of the loop toward the other can be seen.

Investigation of Supernova Nucleosynthesis from Elemental Abundances of Metal-Deficient Stars

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The most metal-poor stars in the Galactic halo are believed to contain the material ejected from the first generations of stars. To investigate the nucleosynthetic yields of supernovae, the chemical compositions of a number of extremely metal-poor stars have been studied recently based on high resolution spectroscopy.

We have made systematic abundance studies for very metal-poor stars with carbon excesses using the Subaru Telescope High Dispersion Spectrograph (HDS). Among these stars, we discovered a carbon-rich star which also shows remarkable excesses of magnesium (Mg) and silicon (Si) (CS29498-043, Figure 1 (left), [1] [2]). The iron abundance is very low (about 1/5000 of the solar one). Only one object which has similar abundance nature is known (CS22949-037, [3]), but the enhancements of magnesium and silicon are more significant in CS29498-043. The right panel of Figure 1 depicts the pattern of the relative elemental abundances for these two objects, with respect to other very metal-deficient stars. These two objects clearly show large excesses of light elements from carbon to silicon.

The α-elements including magnesium and silicon are ejected from the nucleosynthesis by type II supernovae, while the origins of carbon and nitrogen are rather complicated. The existence of these α-element-enhanced stars indicates a variation of the yields by type II supernovae.

Recent models of supernova nucleosynthesis suggest that the ejection of iron in the explosion is strongly dependent on the explosion energy of the supernovae. For instance, supernova models assuming low explosion energy predict low abundance ratios of iron-peak elements, which are produced in the deep interior of the core, in the ejecta. Since magnesium and silicon which are preserved in outer layer are ejected even by low energy explosion, the resulting α/Fe ratio is high. The 'α-rich' star found by our observation is interpreted as an 'iron-deficient' star in this context [4]. Recently, a supernova model which includes interior mixing before explosion was proposed [5]. This model is also trying to explain the elemental abundances of the most iron-deficient star HE0107-5240 discovered last year [6]. Further abundance studies for extremely metal-deficient stars will give a strong constraint on these supernova models.

References

[1] Aoki, W., Norris, J.E., Ryan, S. G., Beers, T. C., Ando, H.: 2002, ApJ, 576, L141.
[2] Aoki, W., Ryan, S. G., Norris, J. E., Beers, T. C., Ando, H.: 2002, PASJ, 54, 933.
[3] Norris, J. E., Ryan, S. G., Beers, T. C.: 2001, ApJ, 561, 1034.
[4] Tsujimoto, T., Shigeyama, T.: 2003, ApJ, 584, L87.
[5] Umeda, H., Nomoto, K.: 2003, Nature, 422, 871.
[6] Christlieb, N. et al.: 2002, Nature, 419, 904.

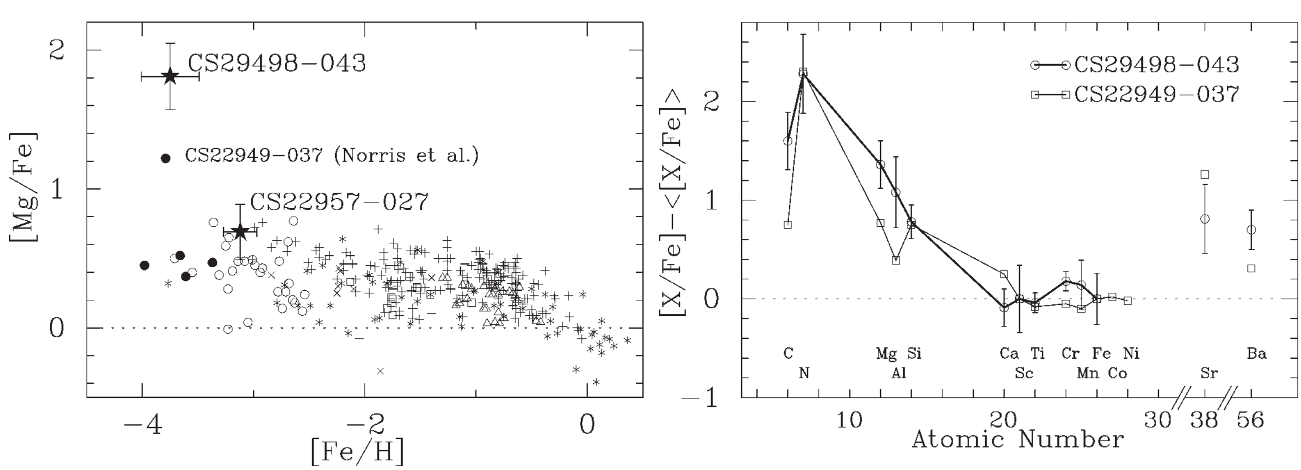

Figure 1: (left) [Mg/Fe] as a function of [Fe/H]. An extremely Mg-rich star CS29498-043 was discovered by our observation. (right) Relative abundances of elements in CS29498-043 and CS22949-037, with respect to the average values of other stars with similar iron-abundances. These two stars show significant excesses of light elements from carbon to silicon.

Centroid Experiment of Artificial Stars

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We are now investigating a selenodetic mission ILOM (In-situ Lunar Orientation Measurement) in a post SELENE project in order to study lunar rotation dynamics by direct observations of the lunar physical librations and the free librations from the lunar surfaces with order of 1 mille-arc-second (1mas) accuracy.

One of the key technologies of the ILOM project is high precision centroiding, which is common to infrared space astrometry project of NAOJ (JASMINE). So the ILOM and JASMINE groups have started centroid experiment with CCD camera. The aim of the experiment is to obtain precise positions of simulated star images on fine controlled CCD. The image data are used for validation of centroid determination algorism that has been developed in JASMINE group.

The apparatus of centroid experiments consists of optical bench which carries pseudo star unit made of 25 optical fibers and their holder, objective achromatic lens whose aperture is 5cm and F (focal ratio) is 2-5, and CCD camera (Figure 1). One side edges of the optical fiber illuminated by white light introduced from the other side are used as pseudo stars. Fine position adjustment of the CCD camera using stepping motor is possible with less than 0.1μm accuracy in the direction perpendicular to the optical axis. Image data at several positions of CCD camera to pseudo star unit are obtained systematically by the computer control system.

Figure 1: Centroid experiment apparatus.

It is desirable that pseudo star images on the CCD cover several pixels for the precise positioning. For this purpose an iris diaphragm with aperture 1 or 2 mm is inserted in front of the objective to obtain F value about 100 enough to see the diffraction image enlargement.

It is relatively easy to obtain center position (X_c) of pseudo star by photon weighting mean method. But if the true center (X_a) of pseudo star do not correspond to a pixel center, centroiding error about more than 1/10 pixel may be introduced due to some discrepancy between X_a and X_c. By using 1st order approximation for X_a-X_c ($X_a - X_c = k{*}X_c$) and the least square method applied to the data of distances between X_{a1} (for star 1) and X_{a2} (for star 2) on several positions on CCD, k1, k2, X_{a1}, and X_{a2} are obtained. It has been confirmed that the centroiding of pseudo star is possible with the accuracy of 1/300 pixel by this method (Figure 2). This is the same fine record that FAME group had achieved. Centroid experiments and analysis will continue for the ILOM goal of 1/1000 pixel accuracy incorporating 3rd order approximation for X_a-X_c and correction of image aberrations.

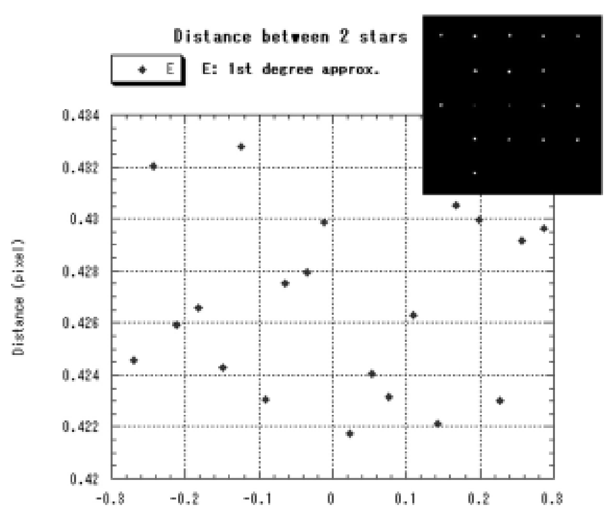

Figure 2: Results of relative position analysis between 2 pseudo stars. Upper right is a sample of imaged pseudo stars.

Prominence Eruptions and Coronal Mass Ejection : A Statistical Study Using Microwave Observations

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We studied the height-time history and CME association of all the Prominence Eruptions (PEs) automatically detected by the Nobeyama Radioheliograph. Out of the 226 events identified between 1996 January and 2001 December, 186 had simultaneous CME data coverage from the SOHO mission. From time plots we were able to classify the PEs into two groups: radial events that had motion predominantly in the radial direction and transverse events that had motion roughly parallel to the limb. Radial events attained larger heights and had greater average speeds as compared to the transverse events. We identify the radial and transverse events with the classical eruptive and active PEs, respectively. The radial events showed close relationship to the CMEs. We found that 72 % of all the PEs and 83 % of the radial events were associated with CMEs. Thus, we have confirmed the close relationship between PEs and CMEs using a large sample of microwave prominences. This result is consistent with three previous studies [1, 2, 3] that used smaller sample sizes. However, our results contradict those of [4, 5], who reported a poor association between prominence eruptions and CMEs. Our result that 73% of the PEs are associated with CMEs is twice as large as the 36% association found for BBSO H α eruptions [5]. Prominence eruptions without CMEs are very slow and are restricted to regions close to the solar surface. These events are generally the transverse events.

We also studied the spatial and temporal relationship between the PEs and the corresponding CME events. We found that the onsets of PEs and CMEs were nearly simultaneous, within 30 minutes. This result may have important implications to the theories of CME initiation. We also confirmed the spreading of the source locations of CMEs and prominences to all latitudes toward the solar maximum. However, the Central Position Angles (CPAs) of CMEs and PEs generally did not coincide. During solar minimum, the CPAs of CMEs tend to cluster around the equator, while those of the PEs were confined to the latitudes of the active region belt. During solar maximum, there is no such relationship, reflecting the varied influence of the solar dipolar field on CMEs during solar minimum and maximum.

References

[1] Munro et al.: 1979, Sol. Phys., 194, 371.
[2] Gilbert et al.: 2000, ApJ. 537, 503.
[3] Hori and Culhane.: 2000, A&A, 382, 666.
[4] Wang, H. and Goode, P.: 1998, in ASP Conf. Ser. 130, Synoptic Solar Physics, 497.
[5] Yang, G. and Wang, H.: 2002, in Proc COSPAR Collq., Ser 14, Magnetic Activity and Space Environment, 113.

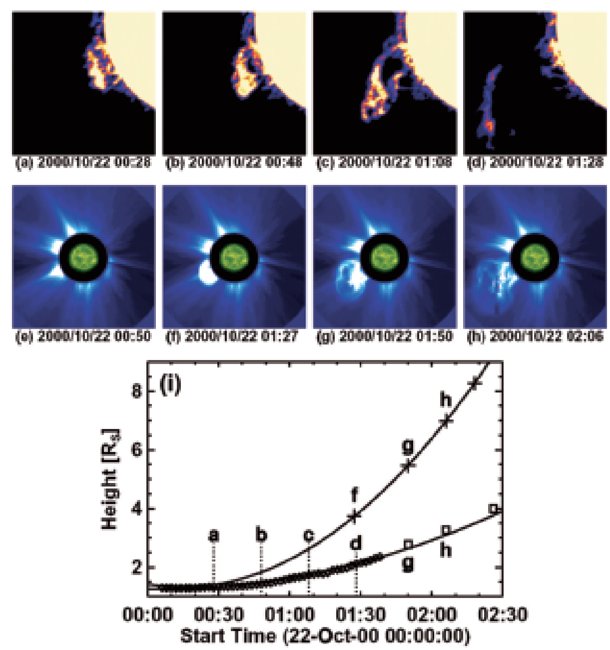

Figure 1: (a) - (d) Eruption of the 2000 October 22 microwave prominence from the east limb. (e) - (h) SOHO / LASCO images of the white-light CME at several instances. (i)Height-time plots of the CME (upper curve) and the eruptive prominence (lower curve). The diamonds represent prominence height measured from the NoRH images. The squares denote the height of the prominence core measured from the LASCO images. The curves were obtained by fitting second-order polynomials to the data points. The times corresponding to the microwave and whitelight images in (a) - (h) are indicated on the height-time plots.

Two Types of Shock-waves and Selective Acceleration of High-Energy Particles

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Interplanetary (hereafter IP) shock-waves produced by solar flares or by Coronal Mass Ejection (hereafter CME) are observed with radio-waves, particle counters onboard satellites, and in situ observations by IP spacecrafts. Thus, the most detailed study comes to be realized.

Particle observations at 1 AU immediately after solar flares have revealed that impulsive particle events have about two orders of magnitudes higher electrons/protons (hereafter e/p) ratios than those of gradual flares. This result has been interpreted as an increase of electrons due to wave-resonant acceleration by MHD waves within the flares. However, if we combine gamma-ray data with the e/p observations, it turns out that the large impulsive events accompanied by gamma-ray emissions probably indicate higher e/p ratios due to proton depletion as shown in Figure 1. Moreover, since impulsive particle events generally show a close correlation with meter-wave Type II bursts (coronal shocks), we propose that blast-wave shocks emitted directly from flare explosions may accelerate particles in this case. On the other hand, it is established that the particle acceleration in the case of gradual particle events is due to the piston-driven shock induced by CME. Therefore, the large difference in e/p ratios of the two types of events may arise from the difference between the two acceleration mechanisms [1].

Meanwhile, according to the in situ observations of the IP-shocks, it is found that seed particles injected into the shock acceleration have twice the velocity of the solar wind. Since this velocity corresponds to more than ten times the mean thermal velocity in the solar wind plasmas, it could not be a high energy tail of the Maxwell distribution. In fact, according to observations, the velocity distribution of this tenuous solar-wind plasma does not show Maxwellian, but a Kappa-function distribution that has a characteristic high-energy tail with power-law distribution [2]. After calculation, the estimated altitude where the velocity distribution changes from Maxwellian to Kappa-function seems to be several to ten times the solar radius. On the other hand, since blast-wave shocks are observed to decline within three times the solar radius, the distribution should not be converted to a Kappa-function in this case. Consequently, the lack of seed particles for proton acceleration would give a large e/p ratio.

As for the IP-shocks driven by CMEs, it is revealed in this study that proton acceleration nearby the Sun exclusively occurs near the "nose" part of the CME and only very small numbers of protons are observed at the "flank" part of the shock excited by the CME, probably because the CME no longer exists just behind the shock at the flank part. Electrons, on the other hand, are observed everywhere from the CME driven shocks including the flank part with an equal intensity as compared by other types of flare emissions [3].

As shown above, if we combine in situ observations of particles and magnetic field etc. with solar observations of radio, gamma-ray, and X-ray etc., the total physics of the shock acceleration would be revealed. Moreover, when we can completely solve the problem of injection of seed particles into the acceleration, some problems of chemical compositions in solar and galactic cosmic rays could be answered. There are many common properties between them. So, the study of particle acceleration combining several research fields is hoped in the near future.

References

[1] Ohki, K.: 2003, ApJ., 586, 617-623.
[2] Chotoo, K., et al.: 2000, JGR, 105, 23107-23122.
[3] Ohki, K.: 2003, Solar Phys., 213, 111-120.

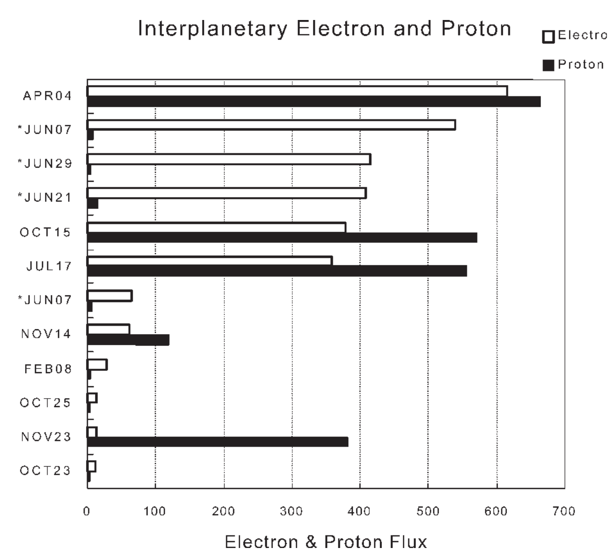

Figure 1: Electron 5-11 keV and proton 25-45 keV are shown. Open bars and thick bars indicate electron and proton flux respectively. Gamma-ray events are indicated by asterisk marks to the left of the date. The flux units are particles $m^{-2}sr^{-1}sec^{-1}MeV^{-1}$.

Molecular Outflow Search in the ρ Ophiuchus A and B2 Regions

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We have searched for CO molecular outflows associated with the cloud A and B2 of the ρ Ophiuchus star forming region. On the basis of single dish ^{12}CO (J = 3-2) and interferometric ^{12}CO (J = 1-0) observations, we have identified three molecular outflows in the ρ Oph A cloud and one in the ρ Oph B2 cloud. Out of the four outflows observed in these regions, one is the known outflow driven by the Class 0 source, VLA1623, and the other three are newly discovered ones. The inclination and opacity corrected momentum flux F_{CO} of newly detected outflows are roughly comparable to those of Class I objects observed by [3]. All the newly discovered outflows are likely to be driven by Class II sources or near infrared sources, and none of them is associated with the cold submillimetermillimeter sources [2] without infrared counter parts. These results indicate that protostars associated with outflows whose mass and momentum flux exceed our detection limit are not formed yet in the high density ridge of the ρ Oph A region and the north-eastern condensation in the ρ Oph B2 region, suggesting that they are considered to be pre-protostellar cores [1].

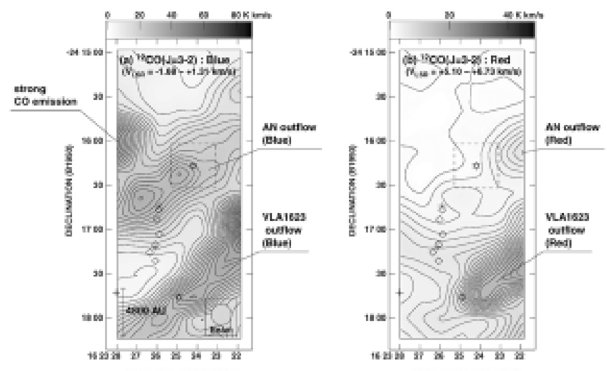

Figure 1: ^{12}CO (J = 3-2) maps of the northern field of the ρ Oph A region taken with the James Clerk Maxwell Telescope. (a) Blueshifted emission (V_{LSR} = -1.68 ∼ +1.31 km s^{-1}). (b) Redshifted emission (V_{LSR} = +5.10 ∼ +6.73 km s^{-1}). Crosses are the positions of the submillimeter continuum sources, SM1, SM1N and SM2, identified by [4]. Star marks are the positions of a NIR source, GY30 and VLA1623. Diamonds are small cores identified by [2].

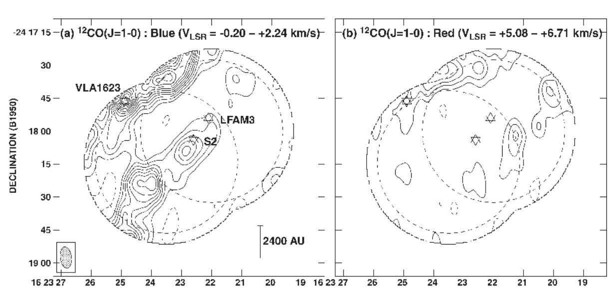

Figure 2: ^{12}CO (J = 1-0) maps of the southern fields of the ρ Oph A region observed with the Nobeyama Millimeter Array. Large solid circle indicates 40 % level of primary beam pattern of the NMA 10 m antennas and large dashed circle indicates the field of view of the NMA 10 m antennas (FWHM = 65″). (a) Blueshifted emission (V_{LSR} = -0.20 ∼ +2.24 km s^{-1}). (b) Redshifted emission (V_{LSR} = +5.08 ∼ +6.71 km s^{-1}). Stars are VLA1623 and NIR sources (LFAM3 and S2).

References

[1] Kamazaki, T., Saito, M., Hirano, N., and Kawabe, R.: 2003, ApJ, 584, 357.
[2] Kamazaki, T., Saito, M., Hirano, N., and Kawabe, R.: 2001, ApJ, 548, 278.
[3] Bontemps, S., André, P., Terebey, S., and Cabrit, S.: 1996, A&Ap, 311, 858.
[4] Motte, F., André, P., & Neri, R.: 1998, A&Ap, 336, 150.

Deep Imaging Observations of the Lupus 3 Cloud : Dark Cloud Revealed as Infrared Reflection Nebula

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Dark cloud consists of dust and gas. Dark cloud has been identified as "dark spot" in the sky, as optical light from the background stars is effectively absorbed by dust in dark cloud. Dark cloud is one of the sites of star formation. It is important to study nature of dust and gas in dark cloud for understanding of star formation.

The Lupus 3 dark cloud is one of the nearest (～150 pc) dark cloud. We carried out deep imaging observations of the most extinct part of the Lupus 3 dark cloud in near infrared wavelengths J (λ=1.25 μm), H (1.65 μm), and Ks (2.15 μm) bands. The observations were made on 2001 June with the near infrared camere SIRIUS on the IRSF 1.4m telescope in South Africa. As a result, Lupus 3 showed itself as a near infrared nebula. A JHKs color-composite image (Blue, green, and red are assigned to J, H, and Ks, respectively.) is shown in Figure 1. We obtained surface brightness distribution at each band (J = 20.6, H = 19.8, and Ks = 19.4 mag arcsec^{-2} at the maximum) and an extinction map of the background stars due to the dark cloud ($A_V > 47$ mag at the maximum). It is the first time that such a heavily extinct dark cloud is reported to shine itself in the near infrared. It is also remarkable that detailed structure of the dark cloud appeared as emission in the near infrared. The surface brightness of the dark cloud is understood in terms of scattering of starlight by dust. There are three local maxima of the extinction with $A_V > 30$ mag, dark or tanned parts in Figure 1, which we assume to be dense cores. The surface brightness distribution depends on the wavelengths and correlates with the extinction. In the J band, dark cores are surrounded by a brighter halo, while, in the Ks band, the dark cores of the J band are bright except for the central part of two of the cores. The appearance in the H band is intermediate of the J and Ks bands, having dark cores surrounded by local maxima of the surface brightness and the surface brightness decreases again outside. The surface brightness and its relationship with the extinction are understood quantitatively in terms of scattering of starlight by dust. The maximum surface brightness can be explained by scattering of starlight by dust in the cloud if we adopt a model of grain-size distribution by Weingartner and Draine [1]. Greater number density is found for a larger size regime in the Weingartner and Draine model than in the widely used model of Mathis et al. [2].

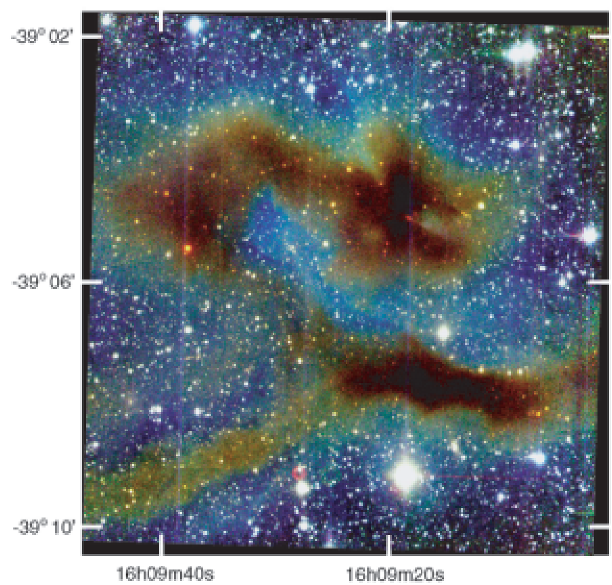

Figure 1: J, H, and Ks-band composite image. The FOV is ～9 × 9 ' (0.4 pc × 0.4 pc). The epoch is 2000.0.

References

[1] Weingartner, J. C., & Draine, B. T.: 2001, ApJ, 548, 296.
[2] Mathis, J. S., Rumpl, W., & Nordsiek, K. H.: 1997, ApJ, 217, 425.

Optical Spectropolarimetry of SN 2002ap with Subaru Telescope

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SN 2002ap was discovered in the nearby spiral galaxy M74 on 2002 January 29. It has been clasified as a Type Ic supernova and suggested to be a hypernova [1]. The kinetic energy of a hypernovae is approximately ten times as much as that of a typical supernova . Since some authors suggested that the high energy is related with the asymmetry of the explosion , polarimetry of hypernovae has been desired .

We performed optical spectropolarimetry of SN 2002ap with Subaru Telescope and Faint Object Camera and Spectrograph (FOCAS) in 2002 February (corresponding to visual maximum phase), March and June [2]. The data show the development of linear polarization (Figure 1). Distinct polarization profiles were seen only in the O I λ7773 multiplet /Ca II IR triplet absorption trough at maximum light and in the O I λ7773 multiplet and Ca II IR triplet absorption troughs a month later , with the latter showing a peak polarization . The intrinsic polarization shows three clear position angles : 80° for the February continuum , 120° for the February line feature , and 150° for the March data . We conclude that there are multiple asymmetric components in the ejecta . We suggest that the supernova has a bulk asymmetry with an axial ratio projected on the sky that is different from 1 by an order of 10%. Furthermore , we suggest very speculatively that a high -velocity ejecta component moving faster than ∼0.115c (e.g., a jet) contributes to polarization in the February epoch . High -velocity jet-like clumps have been proposed in some hydrodynamic explosion models for SNe and GRBs , this result gives a hint on the physics of core -collapse supernovae .

References

[1] Mazzali , P. A. et al.: 2002, Astrophys . J., 572, L61 -65.
[2] Kawabata , K. S. et al.: 2002, Astrophys . J., 580, L39 -42.

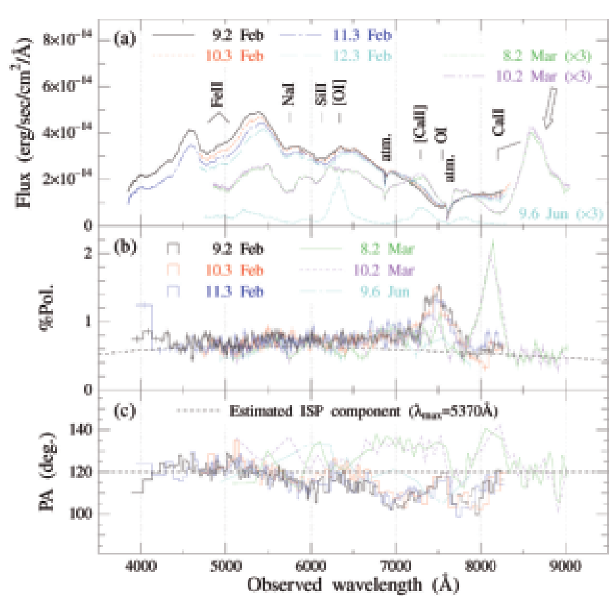

Figure 1: Flux and polarization spectra of SN 2002ap . From top to bottom , we plot (a) total flux , (b) polarization level , and (c) position angle on each observation day as indicated . The interstellar polarization component is shown by dashed lines in (b) and (c).

Compact Nuclear Starbursts in Seyfert 2 Galaxies

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According to the unification paradigm of active galactic nuclei (AGNs), Seyfert 2 galaxies (which do not show broad optical emission lines) are believed to contain AGNs obscured behind dusty tori. Since the dusty tori are rich in molecular gas, they are plausible sites for starbursts to occur. Although the presence of such nuclear starbursts has been suggested in Seyfert 2 galaxies, the true nature of these starbursts is still unclear. To understand the properties of the compact (<300 pc in size) nuclear starbursts, by disentangling from extended star-formation activity in the host galaxies, slit spectroscopy is most effective.

In particular, 3-4 μm slit spectroscopy can provide an excellent tool not only for detecting the compact nuclear starbursts, but also for making quantitative estimates of their luminosities. First, the 3.3 μm polycyclic aromatic hydrocarbon (PAH) emission feature is detected only in starbursts and not in AGNs, making its luminosity a good measure of starburst activity. Second, the 3.3 μm PAH emission from starbursts is intrinsically so strong that the signatures of even weak compact nuclear starbursts are detectable in normal (S/N ~20) spectra. Third, the effects of dust extinction are much lower than at shorter wavelengths. We have performed 3-4 μm slit spectroscopy of 12 Seyfert 2 galaxies (Figure 1) and found the following main conclusions [1].

1. For three selected Seyfert 2 galaxies, our estimates of the magnitudes of compact nuclear starbursts, based on the observed 3.3 μm PAH emission luminosities, agreed quantitatively very well with the previous estimates derived from the UV after dust extinction corrections had been applied. This agreement means that the observed 3.3 μm PAH emission luminosities are a good measure of the luminosities of compact nuclear starbursts in Seyfert 2 galaxies.
2. Except in one object, the equivalent widths of the 3.3 μm PAH emission feature were much smaller than those observed in starburst-dominated galaxies, suggesting that the 3-4 μm fluxes observed from the majority of Seyfert 2 nuclei are dominated by AGNs and not by starbursts.
3. The 3.3 μm PAH to infrared dust emission luminosity ratios were so small that the compact nuclear starbursts contribute only insignificantly to the infrared luminosities of Seyfert 2 galaxies.
4. The 3.3 μm PAH emission luminosities are statistically correlated with the IRAS 12 μm luminosities (Figure 2). If the IRAS 12 μm luminosities are a good measure of AGN power, then the magnitudes of compact nuclear starbursts and AGNs are correlated.

Reference

[1] Imanishi, M.: 2002, ApJ, 569, 44.

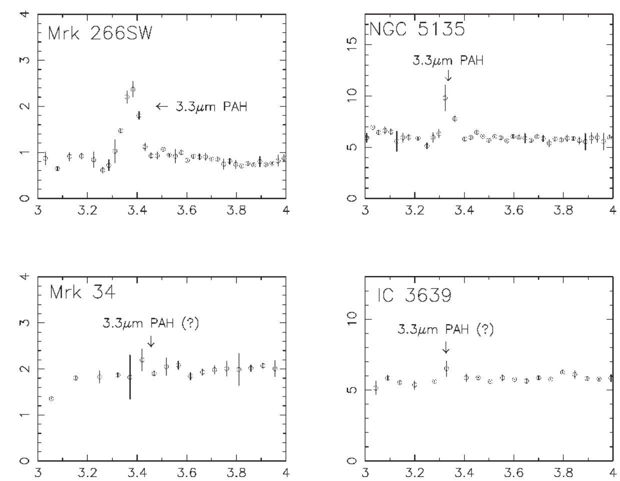

Figure 1: Examples of 3-4 μm spectra of Seyfert 2 nuclei. The abscissa is observed wavelength in μm, and the ordinate is F_λ in 10^{-15} W m^{-2} μm^{-1}. The upper two sources show clear 3.3 μm PAH emission features, while the spectra of the the lower two sources are nearly featureless, with no detectable 3.3 μm PAH emission.

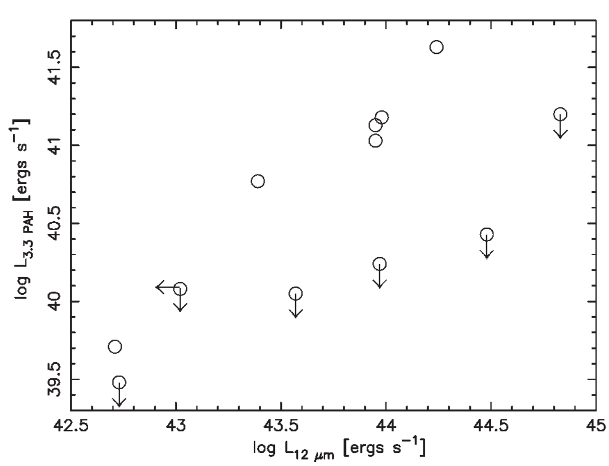

Figure 2: Comparison of the 12 μm luminosities measured with IRAS (abscissa) and the 3.3 μm PAH emission luminosities measured in our slit spectra (ordinate). Both luminosities are statistically correlated.

Size Distribution of Sub-km Main Belt Asteroids Derived from Subaru Telescope Observations

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The Suprime-Cam with Subaru telescope enabled us to make a survey observation of large number of small asteroids which have never been observed so far because of their faintness. We discovered 861 Main-Belt Asteroids (MBAs, about 80% of them were less than 1km in diameter) in only 2-nights observations. We investigated their size distribution statistically and found that the size distribution expected from theory and collision experiments is invalid in the small size range less than 1km [1][2].

Seven fields near opposition and near ecliptic were observed on February 21 and 24, 2001. The total survey area was about 3 square degrees. The limiting magnitude for MBAs was 24.4 (R) mag. This means that we could detect asteroids larger than 500m in diameter at the out-edge of the main-belt (3.5AU). The composite image produced from several images of the same observational field like figure 1 are found to be useful to detect asteroids. In the composite images, though the S/N of each object slightly reduces, we can avoid overlooking the asteroids that were near the edge of the CCD chips or asteroids overlapped with stars and galaxies. Moreover, we can remove faint asteroids which become invisible from time to time because of the light variations, which are a nuisance in our statistics.

We picked up 861 MBAs from the 1111 detected moving objects. After determining statistically the semi-major axis and inclination of each object, we assumed an albedo to calculate the size of the asteroid [3]. We found that the slope of the Cumulative Size Distribution (CSD) for the asteroids between 0.5km and 1km in diameter is ~1.0. This value is much shallow than the slope ~1.75 of the CSD of the asteroids more than several km in diameter, which was obtained in the past observations (such as the Palomer-Leiden Survey). This means that the number of small MBAs is much more depleted than the expectation so far. Moreover, we divided the mainbelt into three parts, and then estimated the CSD in each part. We found that the slope of the CSD was most shallow in the outer main-belt (see figure 2) [1]. We consider that the difference in the size distributions reflects the different impact behavior of the S-type and C-type asteroids in the main-belt.

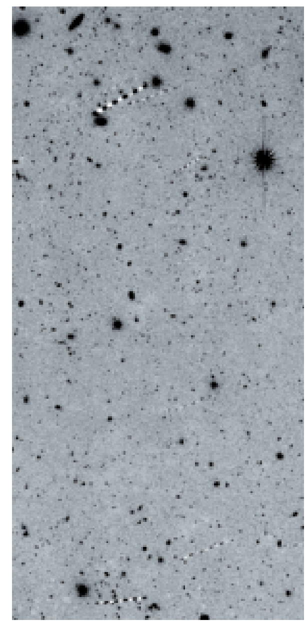

Figure 1: A composite image consists of the eleven exposures for two hours. The FOV is 6.5′×13′. The stars and galaxies are shown by black images, the black and white stick-shaped image shows an asteroid. We can see easily the motions of each asteroid on the composite image.

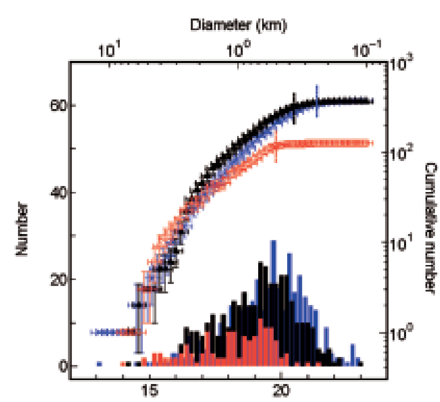

Figure 2: The size distributions of the inner (2.0-2.6AU), the middle (2.6-3.0AU), and the outer-main-belt (3.0-3.5AU) are shown by blue, black, and red, respectively. The curves with error bars show each CSD. The detection limits in each region are shown by the vertical lines.

References
[1] Yoshida, F. et al.: 2003, PASJ, in press.
[2] Yoshida, F. et al.: 2001, PASJ, 53, L13-L16.
[3] Nakamura, T. & Yoshida, F.: 2002, PASJ, 54. 1079-1089.

Plug-In Cryogenic System for Cartridge-Type SIS Receivers

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We developed a cryogenic system, which houses 3 cartridge-type superconductor-insulator-superconductor receivers for millimeter and submillimeter wavelengths. Since it was designed as a prototype receiver of the Atacama Large Millimeter/submillimeter Array (ALMA), high stability, accurate alignment, and easy handling were required. To meet these requirements, the cryogenic system included the following technologies: 1) a thermal link without screws for receiver cartridges; 2) a central support structure to reduce vacuum and gravitational deformation; 3) bellows structures to reduce mechanical vibration of the cryocooler; and 4) a 3-stage Gifford McMahon (GM) cryocooler with an He pot (temperature stabilizer) to reduce the thermal ripple.

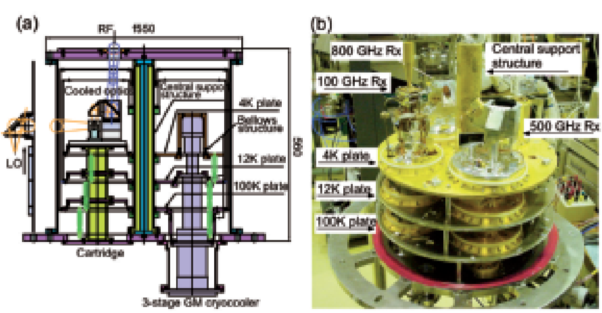

Figure 1: (a) Cross-sectional view of the cryostat. The cryostat is composed of 3 stages named "plates", 4K, 12K, and 100K from up to down. The cryostat has 3 bays for 3 cartridge-type SIS receivers. The central support structure is at the center of the vessel. Bellows structures to reduce mechanical vibrations of the cryocooler are located between the coldhead and the plates. (b) Photograph of the cryostat without radiation shields. The cooled optics of the 500 GHz receiver can be seen on the front cartridge, and the feed horn of the 100 GHz receiver can be seen on the left side cartridge. The 800 GHz receiver optics can be seen behind the central support structure.

The cryostat and receiver cartridges are composed of three stages. The temperatures on the 4K, 12K, and 100K stages of the cartridge are 3.5K, 13.4K, and 78.3K, respectively. The thermal conductances of the thermal links showed high performances of 1.7 W K^{-1} at the 4K stage, 5.6 W K^{-1} at the 12K stage, and 3.3 W K^{-1} at the 100K stage. The mechanical vibration on the 4K stage of the cartridge was reduced to one-tenth, as small as $\approx$ 2 μm peak-to-peak, compared to that on the 4K coldhead of the cryocooler, $\approx$20 μm peak-to-peak. The temperature ripple on the cartridge was reduced to as small as 2 mK peak-to-peak, which corresponds to oneseventh of the ripple on the 4K coldhead with an He pot. See [1], [2] for more details.

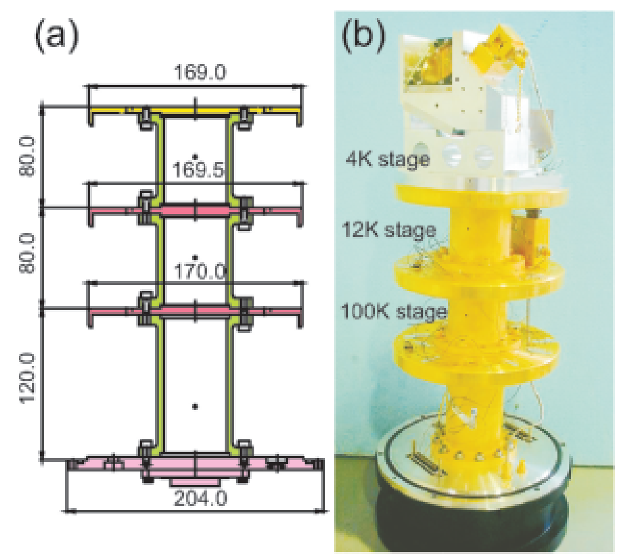

Figure 2: (a) Cross-sectional view of the φ170mm cartridge. (b) Photograph of the cartridge with the Band 8 (385-500 GHz) SIS receiver. The LNA can be seen on the 12K stage of the cartridge.

References

[1] Yokogawa, S. et al.: 2003, PASJ, 55, 519
[2] Sugimoto, M., et al.: 2003, accepted by the Cryogenics.

Seismic Noise Reduction of a Gravitational Wave Detector at the Kamioka Mine

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A laser interferometric gravitational wave (GW) detector with a base-line length of 20m was moved to the Kamioka mine from Mitaka campus in 1999. The Kamioka site is located in latitude 36.25 degree north and in longitude 137.18 degrees east. The laboratory is in a mountain, 1000m below the surface.

We decided to move the GW detector to take advantage of the quiet seismic environment provided by the site. Around a frequency of 1 Hz, the seismic motion is smaller than that at Mitaka by two orders of magnitude. This noise reduction is equivalent to applying a seismic isolator with a resonant frequency of less than 100 mHz. By taking advantage of this, we can reduce the seismic noise as shown in Figure 1. At frequencies of less than 30 Hz, the noise level was consistent with the designed goal. At 30 Hz it was $9\times10^{-17}\mathrm{m}/\sqrt{\mathrm{Hz}}$. Moreover it is smaller than that required by TAMA300 design sensitivity. ATAM300 detector is located at Mitaka campus, and has a 300m baseline length. This provides a strong appeal to advantage of the Kamioka site. Around a frequency of 100 Hz, the noise level is $2\times10^{-17}\mathrm{m}/\sqrt{\mathrm{Hz}}$ with some unknown sources. Nevertheless the noise level is still smaller than current noise level of the TAMA300.

Boyond the low frequency noise inprovement, we also succeeded in obtaining better sensitivity than TAMA300 despite of short baseline length. For the coalescence of compact star binaries, the detector can monitor over 3 kpc away in a wide mass range from one to seventy solar masses.

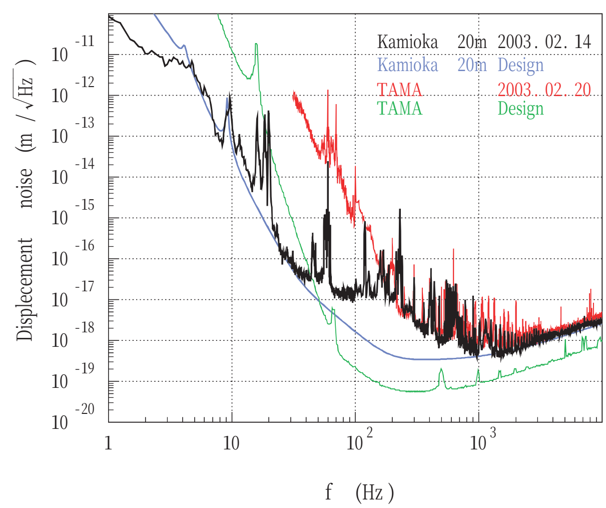

Figure 1: The detector displacement noise spectrum; measured [black], design [blue], the current TAMA300 [red] and the TAMA300 design [green].

This improvement is an important step for allowing increased sensitivity thorough further reduction of the thermal noise as planned with a 100m scale cryogenic detector, CLIO, and a fullscale detector, LCGT.

Construction and Enlargement of Dilatonic Wormholes by Impulsive Radiation

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The dynamical behavior of traversable wormholes and black holes under impulsive radiation is studied in an exactly soluble dilaton gravity model. Simple solutions are presented where a traversable wormhole is constructed from a black hole, or the throat of a wormhole is stably enlarged or reduced [1].

Wormholes are tunnels through space-time, linking otherwise separated regions of a single universe, or bridges joining two different universes. Since traversable wormholes were introduced by Morris and Thorne [2] as theoretically allowable space-times in Einstein gravity, wormholes have been pursued as an attractive research topic involving the possibility of rapid interstellar travel and even time machines.

The properties of static Morris-Thorne wormholes have been studied by many authors and it is known even in non-static situations that a negative-energy source is necessary for traversable wormholes to exist.

Not long ago, a unified framework for black holes and traversable wormholes was proposed [3], indicating that they are dynamically interconvertible when the trapping horizons locally characterizing them bifurcate or merge. In seeking analytic solutions in full Einstein gravity, we have found non-static solutions to be difficult to obtain, except in the idealization of impulsive radiation, where the radiation is concentrated so as to deliver finite energy and momentum in an instant.

In this paper, we construct some of the simplest models of dynamic wormhole processes by employing impulsive radiation in a generalized dilaton gravity model, specifically: wormhole construction from a black hole, wormhole operation by energy balance and wormhole reduction or enlargement. The last point addresses a common belief that, while wormholes are possible or even expected at the Planck scale, large-scale wormholes are unlikely or even impossible. The recipe to enlarge the wormhole is to cause the wormhole mouths to bifurcate, opening up an expanding region of past trapped surfaces, then merge again, by adding additional negative energy followed by compensating positive energy.

The general proof involves the first and second laws of wormhole dynamics and is a future important work in the unified framework for black-hole and wormhole dynamics.

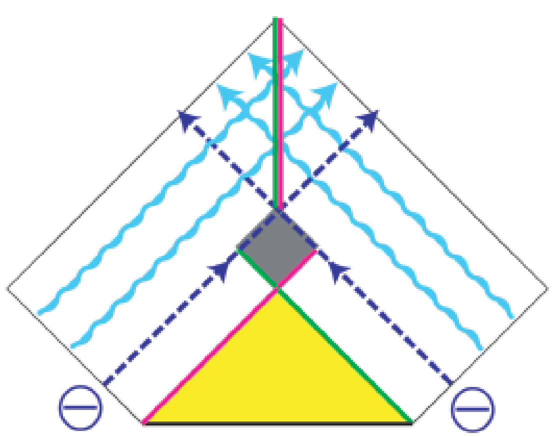

Figure 1: Penrose diagram of a wormhole-construction model. A wormhole is constructed from a black hole by irradiating with impulsive negative-energy radiation, represented by dashed lines. The bold lines represent the trapping horizons, light shading indicates past trapped regions and darker shading indicates future trapped regions. The impulses shift the black-hole trapping horizons suddenly, making them coincide, then constant non-impulsive radiation supports the resulting wormhole.

References

[1] Koyama, H. et al.: 2003, Phys. Rev., D67, 084008.
[2] Morris, M. S. and Thorne, K. S.: 1988, Am.J. Phys., 56, 395.
[3] Hayward, S. A.: 1999, J. Mod. Phys. D8, 373.

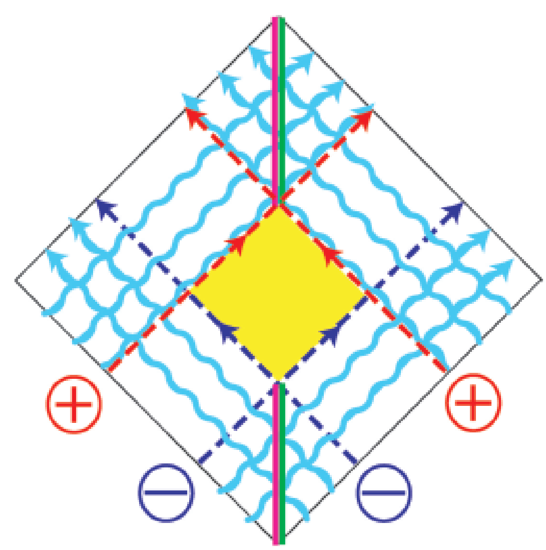

Figure 2: Penrose diagram of a wormhole-enlargement model. Wormhole enlargement process by symmetric bursts of impulsive radiation, with negative energy followed by positive energy, timed as described in the text. The non-impulsive radiation is switched off between the impulses. Then the middle shaded region is vacuum and expanding.

Near Infrared [Fe II] Spectroscopy of Young Stellar Outflows

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Young stellar outflows are closely related to the accretion process of star formation and play important roles in removing angular momentum from star-disk systems. To address the issues of accretion and outflow launching mechanisms, one must obtain not only high spatial resolution images of outflows but also their kinematical information at the regions close to the driving sources.

We observed the outflows from L1551 IRS 5 [1] and DG Tau [2], both located in the Taurus molecular cloud at a distance of 140 pc, in the [Fe II] λ 1.644 μm emission line using the Infrared Camera and Spectrograph mounted on the Subaru Telescope. These observations have shown that the near-infrared [Fe II] line provides an excellent means to study accretion and outflow launching mechanisms, because the line has small extinction compared to the optical forbidden lines, allowing us to probe deeper into the envelopes of embedded objects, and traces directly driven outflows of partially ionized gas.

In the position-velocity diagrams of the [Fe II] emission from L1551 IRS 5 and DG Tau, as shown in Figure 1 (b) and 2, respectively, we see similar characteristics between the outflows from the two objects, although their linear scales are different from each other. First, the entire emission ranges of the blueshifted outflows do not contain stellar rest velocities, suggesting that all the emission is of entirely outflow origin. Second, there are two distinct velocity components seen in the blueshifted outflows: the high velocity component (HVC) is 200-300 km s^{-1} blueshifted with respect to the stellar velocity, while the low velocity component (LVC) is ~100 km s^{-1} blueshifted. Third, the HVC and LVC are different in nature. The HVC shows a narrow line width and is more extended and located farther away from the driving source than the LVC, while the LVC shows a broad line width and is located closer to the origin. We concluded that the HVC is a well-collimated jet launched from the region close to the star and the LVC is a disk wind with a wide opening angle. The two distinct emission components well separated from each other in space and velocity have confirmed the presence of two types of directly driven outflows: jets and winds.

Although such tendency has often been observed for classical T Tauri stars (CTTSs: Class II), our observations have revealed their presence and characteristics with unprecedented clarity. More importantly, we have detected for the first time the tendency that the HVC and LVC velocities for young stars like L1551 IRS 5 and DG Tau are significantly larger than those, respectively, of more evolved classical T Tauri stars (HVC ~50-200 km s^{-1}; LVC ~5-20 km s^{-1}). We also detected for the first time the kinematical evidence of wind collimation from the LVC of L1551 IRS 5; the line width of the LVC decreases with distance from its origin as it collimates. For DG Tau, we detected a redshifted counter jet on the northeast side, with its emission within 0.7 arcseconds from the star being occulted by the circumstellar disk.

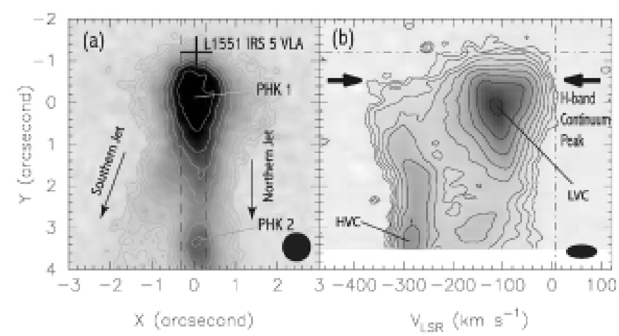

Figure 1: (a) Continuum-subtracted [Fe II] λ 1.644 μm image for the L1551 IRS 5 outflows. The parallel dashed lines indicate the slit aperture with a 0.6 arcsecond width. (b) Continuum-subtracted position-velocity diagram along the northern jet of L1551 IRS 5.

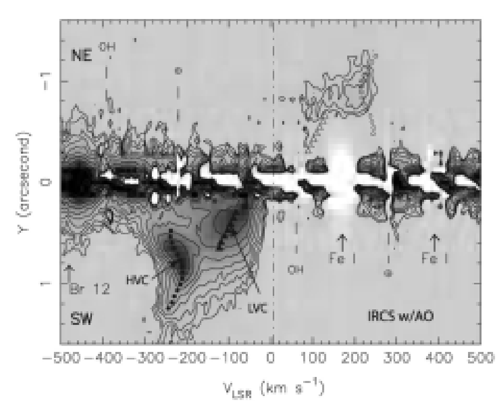

Figure 2: Continuum-subtracted position-velocity diagram of [Fe II] λ 1.644 μm emission of the DG Tau outflows.

References
[1] Pyo T.-S. et al.: 2002, ApJ, 570, 724.
[2] Pyo T.-S. et al.: 2003, ApJ, 590, 340.

Observations of Ammonia in Starburst Galaxies NGC 253 and M 82

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The results of ammonia observations in NGC 253 and M 82 with the 45 m radiotelescope at Nobeyama Radio Observatory are reported [1].

We are studying molecular abundances in nearby galaxies, and investigating the reasons for the difference in the abundances in such galaxies. This time the ammonia (J, K)=(1, 1)−(4, 4) transitions (23.7-24.1 GHz) were searched for in these famous starburst galaxies. As a result the (1, 1)−(3, 3) emission lines were clearly detected in NGC 253, but no lines were found in M 82. The beam size of this observation was 71.

It is remarkable that the shapes of the three emission lines were different from one another in NGC 253 (Figure 1). NGC 253 is a nearly edge-on galaxy, and the line width can be explained by Doppler effect due to the galaxy rotation. The difference in line shapes, therefore, reflects the difference in distributions of the emission lines. In particular, the (2, 2) emission is narrow at around 300 km/s.

This velocity corresponds to a position at about 10″ southwest from the center [2].

The rotational temperature here was about 50 K. On the other hand, the average rotational temperature within the beam was about 29 K.

Since ortho- and para-ammonia are established at the formation and subsequent transformation is thought to be neglected, the ratio should have information at the time of ammonia formation. In our observed transitions, (3, 3) belongs to ortho, and others para. Based on the analysis, the ortho/para abundance ratio was about 1 at the velocity with the strong (2, 2) emission. This value can be achieved under the condition of ortho and para distribution at more than 40 K. On the other hand, the ratio was more than 6 at the velocity with very weak (2, 2) emission (100-250km/s). This value is large and quite remarkable. It can be achieved under the condition of ortho and para distribution at less than 8 K. Some low temperature processes (e.g., cold dust) are suggested for ammonia formation in this velocity component.

The relative abundances of ammonia with respect to H_2 are obtained to be 2.7×10^{-8} and $\leq1.4\times10^{-9}$ in NGC 253 and M 82, respectively. Although both galaxies are starburst with lot of gas, the ammonia abundances are different by more than one order. This result further supports the difference in molecular abundances so far reported. We investigated molecular abundances including other nearby galaxies, and as a result we found that abundances of molecules related to formation on dust were clearly low in M 82. We concluded, therefore, that the molecular abundance in M 82 is peculiar regarding the formation mechanism. A possible reason for this is that the amount of dust in the central region of M 82 is relatively small, or that the effective temperature related to molecular formation is relatively low.

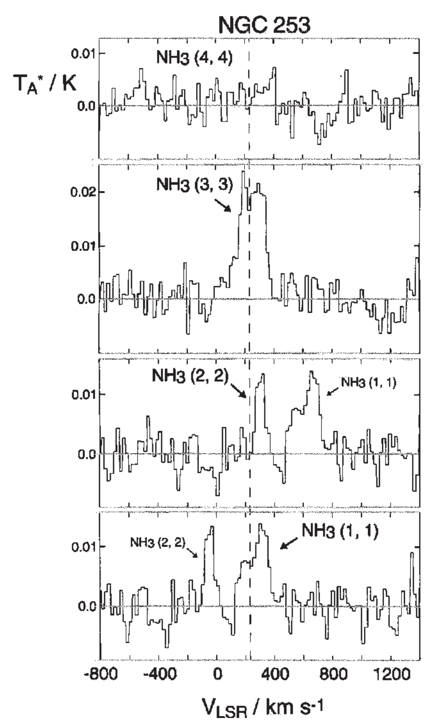

Figure 1: Spectra of ammonia (1, 1), (2, 2), (3, 3), and (4, 4) transitions from bottom to top. The LSR velocity shown is for each transition. The dashed line indicates the systemic velocity.

References
[1] Takano, S., Nakai, N., and Kawaguchi, K.: 2002, PASJ, 54, 195.
[2] Canzian, B., Mundy, L. G., and Scoville, N. Z.: 1988, ApJ, 333, 157.

Kinematic Analysis of Spiral Structures in the Local Disk

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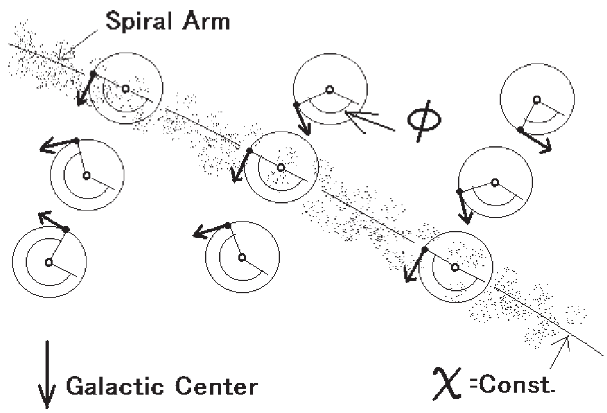

Figure 1: Schematic diagram showing the definition of phases, χ and ϕ, in the Galactic Plane. Each vector corresponds to a velocity vector of each star in epicyclic motion.

We have presented a method, based on the analysis of local kinematics of disk stars, to clarify whether the motions of the stars in the solar neighborhood follow those expected in the density wave theory. The method utilizes the expected linear relation between the "position phases" of the stars χ ($\chi = \ln(r/r_9)/\tan i - \theta + \Omega_p t$) and those of their epicyclic motions ϕ, as shown in Figure 1, where r is the distance between the star and the Galactic Center (GC), r_9 is the distance between the Sun and GC, i is the pitch angle of the spiral arm, θ is the angle between r and r_9, and Ω_p is the angular velocity of the spiral pattern in the azimuthal direction. The application of the method to the 78 Galactic Cepheids within 4 kpc from the Sun, for which accurate proper motions are available from Hipparcos, has revealed that an expected linear relation between χ and ϕ, $\phi \equiv m\chi + \phi_0$ (mod 2π), is not apparent. Based on the quantitative analysis using the least square method, we conclude that the currently available data including large observational errors are inaccurate for use in assessing the presence of density-wave motions in the solar neighborhood.

We here investigate to what extent the error in the phase ϕ should be reduced so as to extract the possible wave motions of the stars. The error for a star i, σ_i, consists of the error associated with the velocity dispersion of the Cepheids, σ_{disp}, the error associated with their apparent magnitude, σ_{mag}, and the error in Hipparcos proper motions, $\sigma_{PM,i}$. We focus on the latter effect associated with the uncertainty in the measurement of proper motions. Three representative models following density waves with 4-arm ($m=4$), where different values of $\sigma_{PM,i}$ are assigned, are examined and the results are shown in Figure 2. In the first model, $\sigma_{PM,i}$ is the same as that for the current Cepheid data using Hipparcos proper motions, referred to as $\sigma_{PM,Hipp}$. In the second and third models, we adopt the smaller errors, $\sigma_{PM,i}=0.5\sigma_{PM,Hipp}$ and $0.1\sigma_{PM,Hipp}$, respectively. As is evident in Figure 2, the third model shows a noticeable minimum of the sum of errors, Δ^2, at $m=4$, whereas in the first and second models there exists no minimum. Thus, these experiments suggest that if the error in proper motion measurement is less than a tenth of that for Hipparcos proper motion, then it is possible to obtain a minimum in Δ^2 and so to extract wave motions of stars.

Reference

[1] Yano, T., Chiba, M., & Gouda, N.: 2002, A & A, 389, 143.

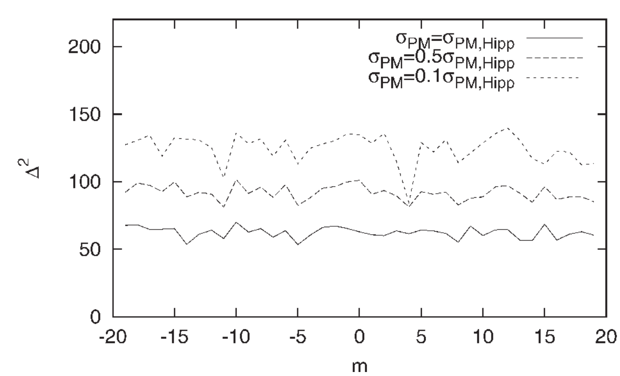

Figure 2: The relation Δ^2 vs. m for the three 4-arm models with different errors related to proper motions, σ_{PM}. The solid, dashed, and thin dashed lines denote the 4-arm models with $\sigma_{PM}=\sigma_{PM,Hipp}$, $\sigma_{PM}=0.5\sigma_{PM,Hipp}$, and $\sigma_{PM}=0.1\sigma_{PM,Hipp}$, respectively.

On Stationarity of Spiral Structure in Disk Galaxies

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We investigate whether spiral arm in disk galaxies is possible to be stationary, assuming that spiral structure is some pattern formed by density wave. We numerically calculate stellar orbits in assumed galactic potentials with spiral patterns and analyze the orbital behavior in the potentials to study the criteria for disk parameters, in which stationary spiral structure is possible.

We find the following results; spiral potential drives the dynamical evolution which results in spiral structure, bar structure or disappearance of the structure, depending on the form of an assumed spiral pattern. If stationary spiral structure appears, the only possible pitch angle of arms is around 10°. Therefore observed spiral arms in late-type spiral galaxies with large pitch angles cannot be stationary structure if the arms are induced by density wave.

Here, we present the form of the potential and parameters in calculations.

As an axisymmetric part of the potential we assume a power-law potential. The rotation velocity $v(r)$ in the potential is described as follows;

$$v(r) \propto r^{\beta}, \tag{1}$$

where r is the radius from the galactic center, and β is a constant. In our calculation, we adopt $\beta=0.25$. As a non-axisymmetric part, we give the form of two-armed spiral potential rotating stationarily,

$$U_S = -f(r)\cos\left(2\cot(i)\ln\frac{r}{r_{\rm ini}} - 2\varphi\right), \tag{2}$$

$$f(r) \propto r^{\gamma}, \tag{3}$$

where (r, φ) is the polar coordinates in the frame corotating with a spiral pattern, $r_{\rm ini}$ is some scaling radius which will be taken as the initial radius of a test star, i is the pitch angle of the spiral arm, and γ is the parameter which describes local radial slope of the spiral potential.

For convenience we introduce a new parameter p, which we call the "windedness", instead of the pitch angle i, which is defined as

$$p \equiv \begin{cases} -\dfrac{\pi}{2} - i & (i<0 \text{ : trailing arm}) \\ \dfrac{\pi}{2} - i & (i>0 \text{ : leading arm}) \end{cases}. \tag{4}$$

Negative and positive values of p represent trailing arms and leading arms, respectively.

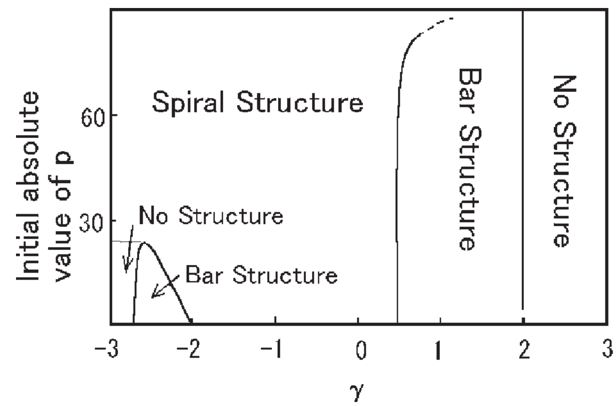

Figure 1: Schematic diagram of the final structure for a given pair of (p, γ).

We have investigated the stationarity of spiral arms in disk galaxies by analyzing the orbital behavior in spiral potential patterns. We have adopted a power-law axisymmetric potential with a two-armed weak spiral potential pattern. In the analysis, we have compared the direction of the major axis of a calculated orbit with that of the expected orbit. We have examined how the pattern in galaxies evolve for various values of γ.

Our main conclusion to be emphasized is that the spiral structure with the pitch angle $i \simeq 10°$ is the only possible stationary spiral structure. The stationary spiral structure is possible only if $-2 \lesssim \gamma \lesssim 0.5$ or $\gamma \lesssim -2$ with sufficiently large absolute value of the windedness if the arms are the manifestation of the density wave. Other spiral pattern cannot be maintained, and develops to a bar or blow out such that no structure remains. Those results are summarized in Figure 1. Therefore spiral structure in observed late-type spiral galaxies with large pitch angle cannot be due to the stationary density wave, but some transient pattern.

References

[1] Contopoulos, G. & Grosbol, P.: 1986, A & A, 155, 11.
[2] Yano, T., Kan-ya, Y., & Gouda, N.: 2003, PASJ, 55, 409.

Revised Fluorescence Efficiencies of Cometary NH_2: Ammonia Abundance in Comets

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Ammonia molecule is the first triatomic molecule discovered in the interstellar space. It is detected in many molecular clouds, and it seems to be a popular molecule in the interstellar space. In the case of comets, ammonia is important as a main reservoir of nitrogen atom. However, there was no report on secure detection of cometary ammonia until the first detection in comet Hyakutake in 1996. Ammonia molecules sublimated from the cometary nucleus would dissociate into NH_2 and H atom by solar UV radiation [3]. The lifetime of the photo-dissociation is about several thousand seconds at 1AU from the Sun. Expanding velocity of the gas is about 1 km s^{-1} and therefore the region where ammonia molecules exist is estimated to be about several thousand km in radius. When we observe inversion transitions of ammonia by radio telescope at the frequency of ≈23 GHz, the antenna beam size would be larger than the ammonia region of a comet. Thus, the dilution effect would prevent the detection of ammonia in comets. On the other hand, the amount of ammonia molecules has been estimated from NH_2 abundance. The fluorescence efficiencies (g-factor) of NH_2 are key parameters to determine the amount of NH_2 in the coma.

The g-factors of NH_2 were calculated by Tegler & Wyckoff (1989) considering electronic and vibrational energy levels of NH_2 and transitions between them by the solar fluorescence, at the first time. They estimated the ammonia abundance in comet Halley and compared it with in situ measurement of ammonia in the comet by Giotto space craft. However, estimated abundance from NH_2 was slightly smaller than the in situ measurement. Furthermore, the dependence of NH_2 flux on heliocentric distances observed in comet Hale-Bopp could not be explained by their calculation [4].

We considered that the rotational structure of energy levels which are not fully considered in [2] was the reason of these discrepancy. The g-factors of NH_2 are calculated by our fluorescence model [1]. Based on our results, the ammonia abundance in comet Halley obtained from the NH_2 observation is consistent with that obtained by the in situ measurement. The dependence of NH_2 emission flux on heliocentric distances can be also explained by our calculation. The mean abundance of ammonia relative to water in comets is estimated to be about 0.5 % based on previous NH_2 observations in comets [5] and our g-factors.

References
[1] Kawakita, H., Watanabe, J.: 2002, ApJ, 572, 177L.
[2] Tegler, S., Wyckoff, S.: 1989, ApJ, 343, 445.
[3] Kawakita, H., Watanabe, J.: 1998, ApJ, 495, 946.
[4] Rauer, H., et al.: 1997, Science, 275, 1909.
[5] Fink, U., Hicks, M. D.: 1996, ApJ, 459, 729.

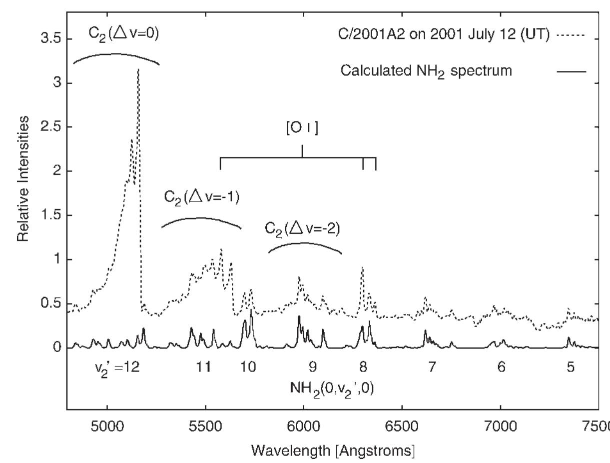

Figure 1: The comparison between a low dispersion cometary spectrum and a modeled NH_2 spectrum. The emission bands of C_2 and forbidden emission lines of atomic oxygen as well as NH_2 emission bands were shown in observed spectrum.

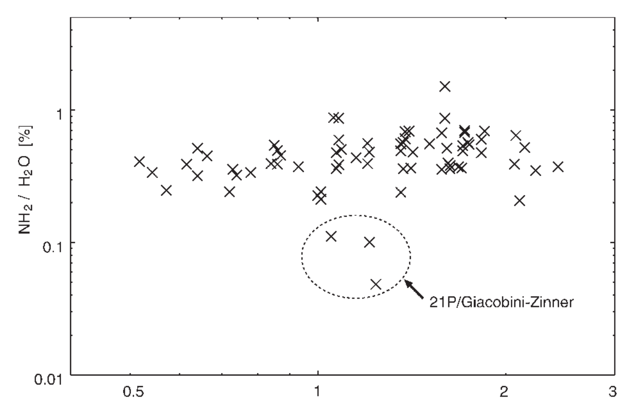

Figure 2: Ammonia abundance relative to water in comets. Mean abundance of ammonia relative to water is about 0.5 %. It is found that comet 21P/Giacobini-Zinner is a ammonia depleted comet.

Heliocentric Dependence of the Sodium Emission of Comet 153P/Ikeya-Zhang

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Sodium is one of the interesting atoms in comets, but the release mechanism of the sodium have not been clarified until now, as same as those in Moon and Mercury even that intensive researches on their sodium atmosphere have been performed so far. Although the main mechanism of sustaining the sodium atmosphere in the Moon appears to be photosputtering desorption, there is little or no consensus about the dominating mechanism, due to many kind of difficulties such as interference of the bright bodies, time variation, and finite structure of the atmosphere with definite spatial distribution. Fortunately, cometary sodium can be studied simply because we can regards the sodium produced by small grains, at under different conditions of the solar flux because of the time variation of the heliocentric distance of the comets due to the orbital motion. We tried to utilize the cometary orbital motion as a variable condition in the natural experiment for inspecting the variation of the sodium production.

A long-term monitor of the sodium on the comet will be a key to solve the unknown mechanism of the sodium release from cometary dust particles. A low-dispersion spectroscopic monitor of comet 153P/Ikeya-Zhang was carried out from 2002 February through May. The sodium emission was derived mainly during March, when the heliocentric distance of the comet was between 0.511 and 0.764 AU. The number of the produced sodium atoms relative to the total cross section of dust grains follows a power law of $r^{-5.1\pm1.0}$, where r is the heliocentric distance. This fact strongly suggests that the sodium is released by a thermal desorption mechanism, not by the photosputtering mechanism from cometary grains. The derived potential barrier for the release of the sodium is 0.49 ± 0.10 eV, which is about half of that in the case of the Moon.

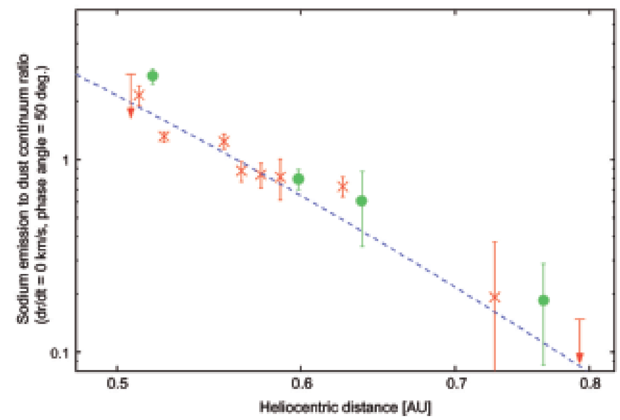

Figure 1: The heliocentric dependence of the sodium emission relative to the continuum emission of Comet 153P/Ikeya-Zhang. The red crosses are the values in the pre-perihelion, and the green circles in the postperi-helion. The fitted line indicates a power law of $r^{-5.1\pm1.0}$, where r is the heliocentric distance.

References

[1] Watanabe, J., Kawakita, H., Furusho, R., Fujii, M.: 2003, Astrophys. J., 585, L159-L162.

Dense Molecular Gas in Lenticular Galaxies

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We made simultaneous HCN and CO observations of three lenticular galaxies (NGC 404, NGC 3593, and NGC 4293) using the Nobeyama 45-m telescope. We detected CO emission from all galaxies and HCN emission from NGC 3593 and NGC 4293. The I_{HCN}/I_{CO} ratios are 0.025 ± 0.006 and 0.066 ± 0.005 in NGC 3593 and NGC 4293, respectively, which are comparable to that in late-type galaxies. The average of the I_{HCN}/I_{CO} ratios at the center of 12 nearby spiral galaxies including latetype was 0.055 ± 0.028. [2] The profiles of the HCN emission in both galaxies show different shapes from those of CO emission. Namely, the HCN emission was detected from only a part of probably the ring-like structure in NGC 3593. The HCN profile shows a double peak in NGC 4293. On the other hand, the CO spectra in both galaxies have a peak near their systemic velocity. These results indicate that the fraction of dense molecular gas is high around the center and that dense gas associates with the ring-like structure and the star-forming activities in these galaxies.

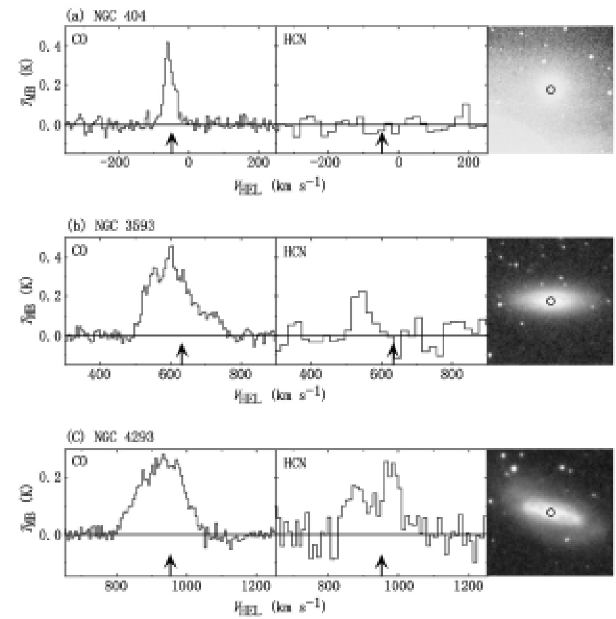

Figure 1: CO spectra, HCN spectra, and optical images of sample galaxies. (a) NGC404. (b) NGC3593. (c) NGC4293. Circles in the optical images indicate the beamsize of the 45m telescope. [1]

References

[1] Kuno, N., Nakai, N., Sorai, K., Nishiyama, K., Vila-Vilaró, B.: 2002, Publ. Astron. Soc. Japan, 54, 555.

[2] Sorai, K., Nakai, N., Kuno, N., Nishiyama, K.: 2002, Publ. Astron. Soc. Japan, 54, 179.

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A Noise Evaluation of a High Output Power W-Band Photomixer

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A large radio telescope array called Atacama large millimeter/sub-millimeter array (ALMA) is designed to achieve a large collecting area and high angular resolution. The observation frequency ranging from 30 to 950 GHz is divided into 10 frequency bands, and each band has a 20 to 30 % bandwidth. Local oscillator (LO) sources for ALMA are required to have a high frequency stability (10^{-13} at 1s), wide tuning range, ultra-low noise (10K/μW), large output power (≥1 mW at 100GHz) and common low phase noise reference for each antenna. Recently, we have developed a 100 GHz band photomixer using a unitraveling-carrier photodiode (UTC-PD)[1][2]. The UTC-PD has a higher saturation output while maintaining fast response than previous types of photodiodes. It is expected that the noise of a photonic LO is higher than that of a Gunn-diode oscillator, except under the conditions of using very low-noise optical sources and having a very high current in the photomixer. In order to study the excess noise in the photonic LO, we performed an experiment utilizing a low-noise SIS receiver with a noise temperature of 20 K at 100 GHz [3]. The experimental setup for noise measurements of an SIS receiver pumped by different LO sources is shown in Figure 1. The photomixer is driven by the heterodyne beatnote of the combined output of two DFB lasers whose emission wavelengths are around 1.55 μm. The linewidth of the lasers is a few hundred kHz in a free running operation. Measured noise temperatures of the SIS receiver driven by the Gunn and the photonic LOs are plotted in Figure 2. Both cases show the same noise temperature of around 20 K double-sideband in the frequency range of 96-110 GHz.

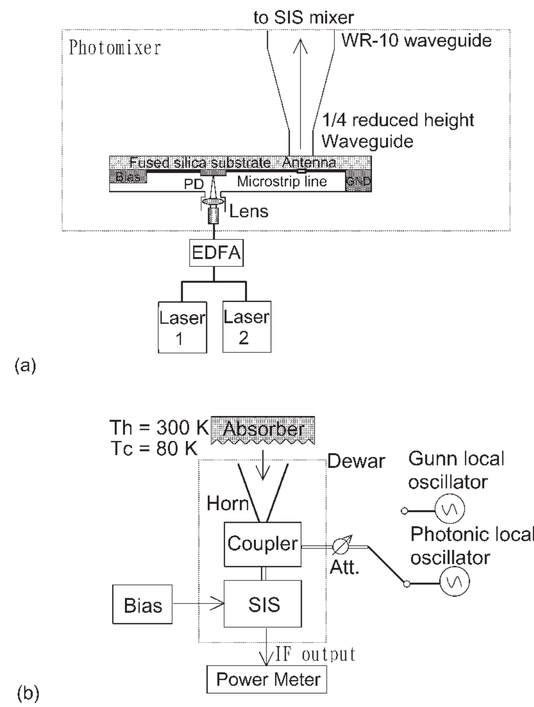

Figure 1: (a) Schematic of a photonic LO. (b) Experimental setup to measure noise temperature of an SIS receiver.

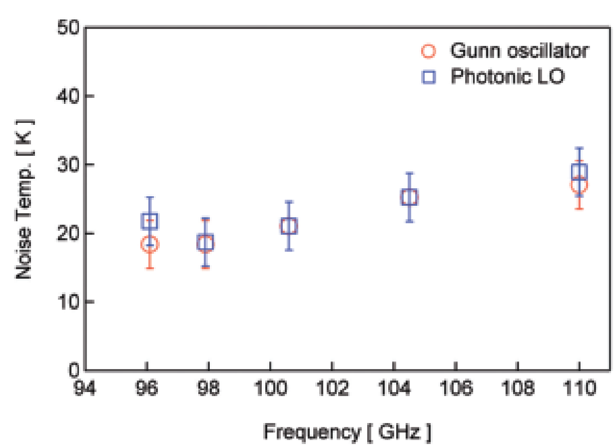

Figure 2: Receiver noise temperatures of the SIS mixer pumped by a Gunn LO and a photonic LO are shown as a function of frequency.

References

[1] H. Ito et al.: 2000, Electron. Lett., 21, 1809.
[2] A. Ueda et al.: 2003, IEEE Trans. Microwave Theory and Techniques, 51, 1455.
[3] A. Ueda et al.: 2003, Jpn. J. Appl. Phys., 42, L704.

K3-50A: An Ultracompact HII Region Ionized by Multiple Ionizing Stars

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Newly formed massive stars are embedded in natal molecular clouds and form ultracompact (UC) HII regions by ionizing the molecular gas by their emitting UV photons. Toward a massive star forming region, not only the UC HII regions but also objects indicating existence/formation of massive stars, such as hot molecular cores, maser sources, and/or out-flows are observed together. To understand formation processes of massive stars, it is essential to know how massive stars are related with each object and to know where the forming/formed massive stars are.

Toward UC HII regions, some ionic lines are observed in the mid-infrared region where extinction is much less than in the optical region. Especially, [NeII] 12.8 μm, [ArIII] 8.99 μm, and [SIV] 10.51 μm lines are radiated from ions formed by 22-35eV UV photons. The ionic abundances and distribution derived from maps of these lines can be used to estimate UV radiation ionizing the regions.

We observed an UC HII region K3-50A using the Cooled Mid-Infrared Camera and Spectrometer (COMICS) on Subaru Telescope and made extinction-corrected emission maps of the three lines (Figure 1). Especially for the [NeII] map, the [NeII] emission is resolved into more than two peaks. This indicates that K3-50A UC HII region is ionized by two or more ionizing massive stars. Though the radio continuum emission of this region suggested that the Lyman continuum photons from ionizing stars correspond to a single O5.5V star, our mid-infrared line flux ratios suggest that the UV radiation hardness of this region corresponds to ~O8V stars. The difference also suggests that there are multiple ionizing stars, which is different from the simple picture usually assumed for UC HII regions in the past radio observations ([1]).

References

[1] Okamoto, Y. K., Kataza, H., Yamashita, T., Miyata, T., Sako, S., Takubo, S., Honda, M., and Onaka, T.: 2003, Astrophys. J., 584, 368-384.

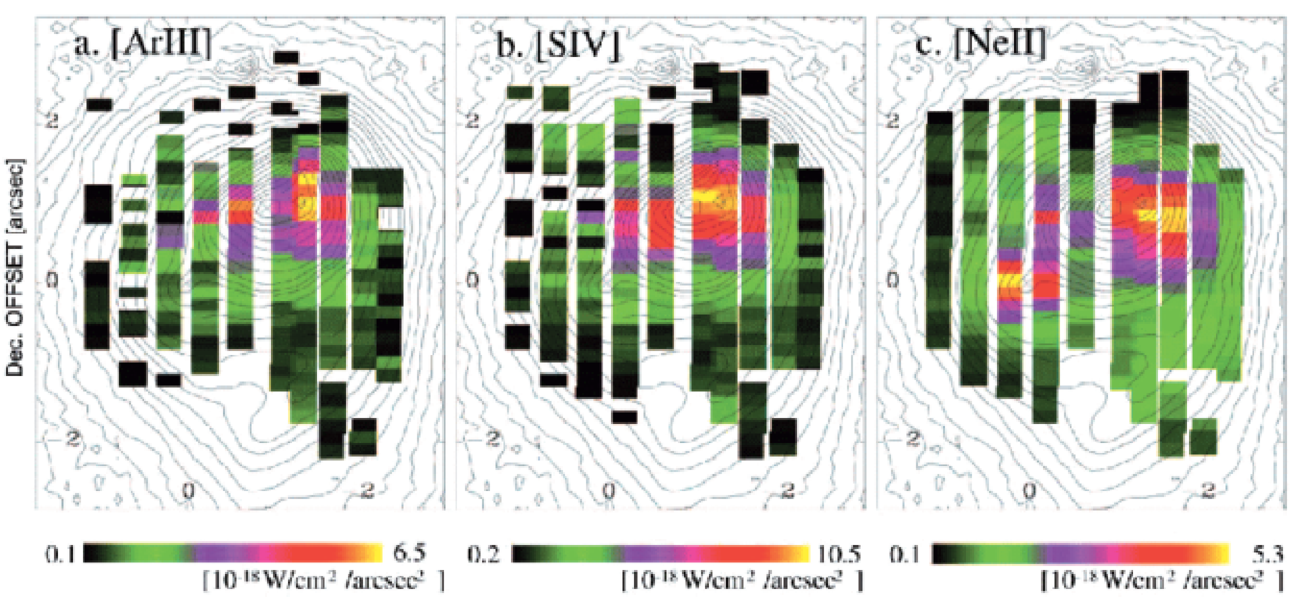

Figure 1: Extinction corrected emission maps of [NeII] 12.8 μm, [ArIII] 8.99 μm, and [SIV] 10.51 μm toward K3-50A (color map). Contours indicate the 11.7 μm image.

Relations between Galaxy Formation and Environments of Quasars

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We investigate the environments of quasars such as number distribution of galaxies using a semi-analytic model which includes both galaxy and quasar formations based on the hierarchical clustering scenario. We assume that a supermassive black hole is fueled by accretion of cold gas and that it is a source of quasar activities during a major merger of the quasar host galaxy with another galaxy. This major merger causes spheroid formation of the host galaxy. Our model can reproduce not only general form of the galaxy luminosity functions in the local Universe but also the observed relation between a supermassive black hole mass and a spheroid luminosity, the present black hole mass function and the quasar luminosity functions at different redshifts. Using this model, we predict properties of quasar environments.

First, we analyze the mean numbers of quasars and galaxies in a dark halo (Figure 1). We find that the dependence of the mean number of quasars on halo mass is different from the dependence of the mean number of galaxies. Since spatial distributions of galaxies and quasars depend on the mean numbers of quasars and galaxies in a dark halo, using the mean numbers, we calculate the bias parameters of quasars and galaxies (Figure 2). We find that the evolution of the bias parameter of quasars is different from that of galaxies. In our model, the formation effciency both of galaxies and quasars depends on the cold gas mass fraction and the galaxy merger rate in a dark halo. However, the quasar formation effciency depends on galaxy merger rate more strongly and, furthermore, depends on quasar lifetime.

Next, we show the galaxy number distribution function around quasars (Figure 3). At lower redshifts ($0.2<z<0.5$), most halos with quasars have at most several galaxies. This indicates that most quasars reside in groups of galaxies. On the other hand, at higher redshifts ($1<z<2$), the number of galaxies in a dark halo with quasars is from several to dozens; quasars reside in ranging from small groups of galaxies to clusters of galaxies. These results show that most quasars at higher redshifts reside in more various environments than at lower redshifts. In our model, we assume that galaxy major merger triggers quasar activity. Since the galaxy merger rate has a maximum in halos corresponding to groups of galaxies, $\sim 10^{13} M_{\odot}$, our model predicts that most quasars populate in groups.

Comparing these predictions with observations in the future will enable us to constrain our quasar formation model.

References

[1] Enoki, H. et al.: 2003, PASJ, 55, 133.

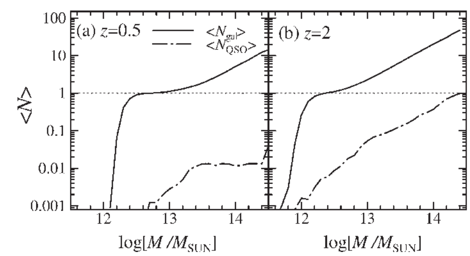

Figure 1: The mean numbers of quasars and galaxies in a dark halo.

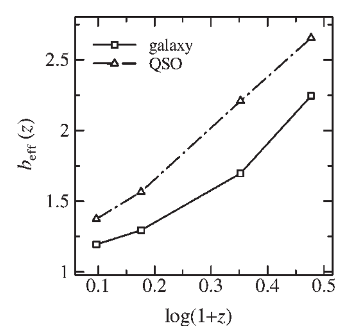

Figure 2: The evolution of the bias parameter of quasars and galaxies.

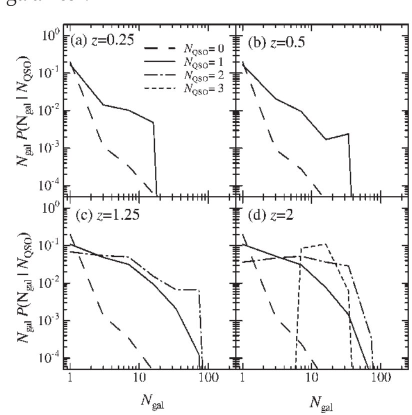

Figure 3: The galaxy number distribution function around quasars in a dark halo.

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Observation of Solar Flare Hard X-ray Spectra using CdTe Detectors

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Solar flares are observed to produce nonthermal electrons typically in the 10 to 100 keV range but sometimes reaching ~10MeV range. The acceleration mechanism of these electrons remains unknown. Hard X-ray spectra provide important diagnostic information such as energy distribution of accelerated electrons and precise temperature measurements of thermal sources. To this end we developed a balloon-borne hard X-ray spectrometer capable of 3 keV energy resolution over a 20-120 keV energy range. This is a factor of 3 better than previously launched satellites and only surpassed by the recently launched RHESSI satellite.

The system is designed for a one day flight at an altitude of 41km by an 80,000m^3 balloon developed and launched by the Institute for Space and Astronautical Science (ISAS). The main balloon gondola contains ballast, electronics and batteries, and the detector system is mounted on top surrounded by thermal shields (Figure 1). The entire gondola weighs 70kg. Detector angle is fixed at 45° elevation, and the gondola azimuth is controlled to an accuracy of ±5° using a closed-loop system. Sun position sensors and magnetic sensors were used for attitude control, and an additional 2-axis sun sensor is used to verify pointing.

The detector system contains sixteen 10×10×0.5mm CdTe detectors. CdTe detectors have good stopping power and do not require cryogenic coolers, making it possible to construct lightweight hard X-ray detector systems. At the operating temperature of 0°C, all detectors were shown to have 2.6 keV or better energy resolution at the 60 keV Am-241 line. The detector enclosure is hermetically sealed; the Rohacell/CFRP composite window was fabricated by Mitsubishi Heavy Industries and has an areal density of 0.1g cm^{-2}. The detectors are passively shielded by 2mm of lead, and a graded-Z collimator limits the field of view to 10°×60°. The detector system contains 16 preamplifiers and a 200V bias battery, and the output signal is sent to a custom made data acquisition system inside the gondola. The detector enclosure and thermal shields are designed to cool the detector by optimizing radiative cooling.

First flight of the instrument took place on August 29, 2001 from the Sanriku Balloon Center. The observation was cut short by a battery problem and no flares were observed, but a detector temperature of -15°C was successfully achieved and the instrument was recovered successfully. On the second flight (May 24, 2002), 9 hours of successful observation was performed at an altitude of 41km and a class M1.1 flare was successfully observed at 6:41 UT. A background subtracted counts spectrum of the first minute of the flare is shown in Figure 2, along with thermal-spectrum fits. The spectrum is consistent with a purely thermal plasma of 47MK temperature. This is an unexpectedly high temperature, but our analysis of a simultaneous RHESSI satellite data is in good agreement.

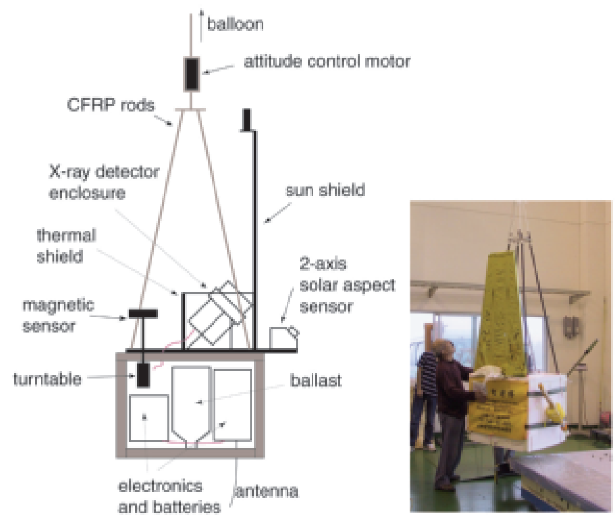
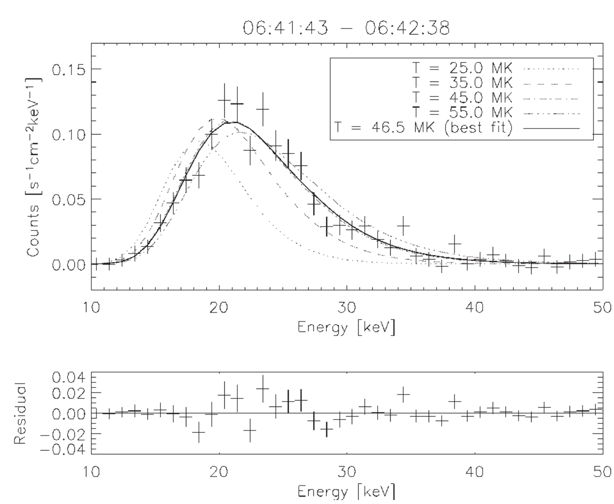


Figure 1: Overview and photograph of the entire instrument.

Figure 2: Observed flare spectrum with 1-sigma error bars and



fits to thermal spectra.

Observational Study of the Three-Dimensional Magnetic Field Structure and Mass Motion in Active Regions

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To study the three-dimensional magnetic field structure and associated plasma flow properties, spectro-polarimetric observations of active regions were carried out in the spectral lines of Si I 10827.1 Å and He I 10830 Å, using the Norikura Universal Spectro-Polarimeter at Norikura Solar Observatory, NAOJ. Comparison of Si I (photospheric) and He I (chromospheric) magnetograms with the potential field model shows that a large fraction of the magnetic field is consistent with the potential field structure, by assuming that the height difference between the origin of the two lines is about 1200 km. The slope of the scatter plot between Si I and He I magnetograms is 0.5 and 0.76 in an emerging flux and a larger active region, respectively. These values are lower than the scatter plot slopes obtained from Kitt Peak photospheric and chromospheric magnetograms, in which case the corresponding values are 0.83 and 0.9, respectively. Considering the height difference between these two sets of chromospheric magnetograms, this implies that the magnetic field spreads out faster near the transition region heights. Dopplergrams obtained by determining the centroid of the asymmetric line profiles show that, in case of emerging flux region, the chromospheric up flow regions with maximum velocity of about 5 km s^{-1} are located in the magnetic neutral line areas.

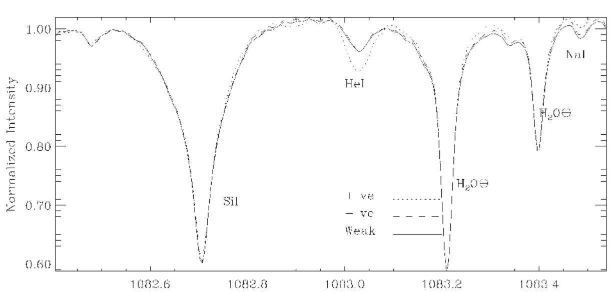

Figure 1: Sample spectra of wavelength region Si I 10827.1 Å — He I 10830 Å obtained with Norikura Universal Spectro-Polarimeter. The observed spectra have been normalized with a synthetic spectrum obtained by fitting the contiuum windows. The spectra from many pixels with different magnetic field strength and polarity are averaged to produce three sample spectra. The limits set for grouping the pixels are: ≥ 150 G for positive, ≤-150 G negative and between ± 150 G for weak. The changes are only seen in the He I 10830 Å feature.

References

[1] Choudhary, D. P. et al.: 2002, Solar Phys. 209, 349.

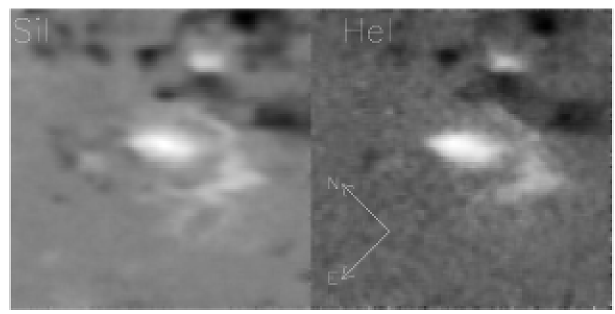

Figure 2: The photospheric and chromospheric magnetograms of the active region NOAA 8350 observed on 10 October 1998. The field of view is 152×160 arc sec^2. White and black pixels represent the positive and negative megnetic fields, respectively.

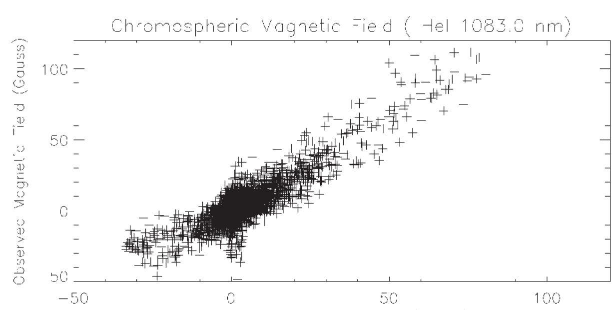

Figure 3: The scatter plot of the observed and computed chromospheric magnetograms of the active region shown in Figure 2.

Subaru/XMM-Newton Deep Survey

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Subaru/XMM-Newton Deep Survey is one of the observatory big-projects of the Subaru Telescope, and we are conducting deep imaging observation down to the limit of the Subaru Telescope with Suprime-Cam and spectroscopic survey of objects with R<24 with FOCAS, in wide field (1.3 degree^2) centered on 0218-05(J2000.0). The aims of the project are

- to reveal constituents of the young universe and their distribution,
- to examine the distribution and the evolution of the luminosity function of QSOs and galaxies,
- to reveal the natures of the faint X-ray sources.

In this observing field, X-ray survey with ESA's X-ray satellite, XMM-Newton, Sub-mm survey with SCUBA on JCMT, ultra-deep near-infrared imaging with WFCAM on UKIRT, deep radio survey with VLA are ongoing. With these data sets, we can reveal the characteristics of objects in the young universe in multi-wavelength in the scale which is free from cosmic variance.

Deep BRi′z′ bands imaging with Suprime-Cam and X-ray survey observation with XMM-Newton are almost finished this fiscal year. Radio observation in 1.4GHz waveband with VLA B-array archives flux limit of 50 μJy. Near-infrared survey observation with SIRIUS on IRSF (South-African Observatory) covers 800 arcmin^2 area down to K′=19.5. SCUBA observation aiming to reach down to S_{850}=8mJy is started. The follow-up spectroscopic observation of 1200 X-ray sources and 1000 radio sources found so far is planed in the next year.

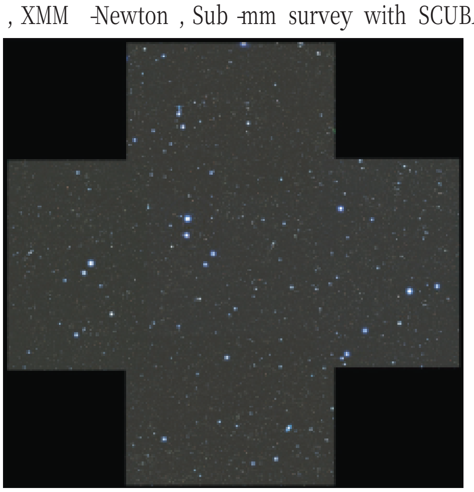

Figure 1: The optical image of the survey field taken with Subaru Prime-Focus Camera (Sprime-Cam). B, R, i′ bands three color image with 5 FoV of Suprime-Cam. The total FOV is 1.3 degree.

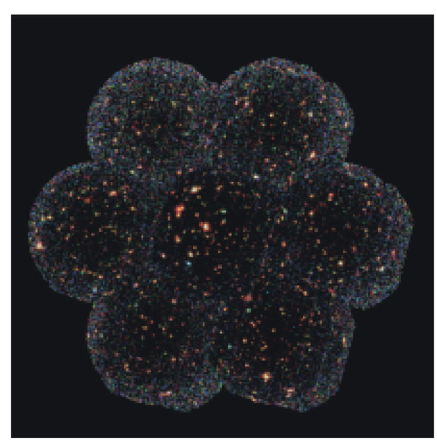

Figure 2: X-ray image of the survey field taken with XMM-Newton. Blue color means hard X-ray sources, red color represents soft X-ray sources. The 1 FoV covers 30 arcmin diameter, and the image is made from 7 FOVs.

The Evolution of Vector Magnetic Fields in an Emerging Flux Region

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It is widely believed that the magnetic fields of the sun are generated in the convection zone and then emerge to the solar surface via magnetic buoyancy. Regions with emergence are known as emerging flux regions (EFRs). Transient phenomena, such as flares, occur frequently and quasi-steady coronal heating is maintained in association with flux emergence. To understand the mechanisms of coronal heating, it is essential to investigate the evolution of magnetic fields inside EFRs. We have in detail studied the evolutions of magnetic fields in an EFR and interpreted our findings in the process of formation of sunspots.

Properties of magnetic field in EFRs have long been studied using the longitudinal component of the magnetic field with filter magnetograph. In order to understand magnetic fields in three dimension and physical parameters of plasma precisely, we observed the evolution of an EFR with Advanced Stokes Polarimeter (ASP) at National Solar Observatory (Sacramento Peak) in the United States. The ASP is a spectropolarimeter capable of precisely measuring the full state of polarization (I, Q, U, V). Vector magnetic fields in the photosphere are derived from Stokes profiles.

The previous study indicates that young emerging flux is horizontal with respect to the solar surface and it has upward motion (~0.5km s^{-1}). The intrinsic field strength is about 500±300 Gauss, which is weaker than that of vertically oriented magnetic field in sunspots. In this study, we find that an area with high filling factor (> 80%) newly appears with flux emergence (Figure 1). Filling factor represents the percentage occupied by magnetic atmosphere in each pixel. In this area, magnetic field is almost horizontal and their intrinsic field strength ($|B|$ ~500 Gauss) is weaker than the surrounding horizontally oriented magnetic field. Compact bipolar flux region is located at the either end of the horizontal magnetic field. This region gradually increases in both size and its total magnetic flux in association with the flux emergence. In this region, the magnetic field becomes vertically oriented and the intrinsic field strength becomes stronger, but filling factor becomes lower. At 12 hours after its first appearance, the magnetic field is almost vertical and the intrinsic field strength is about 1500 Gauss. This result may be explained by convective collapse (Parker 1978), in which magnetic field is compressed to kilogauss because of convergence of magnetic field by convective flows and ensuing superadiabatic effect. This is significant result for understanding the mechanism that emerging magnetic flux tubes (a few hundred Gauss) concentrates up to kilogauss. As the compact bipolar flux region grows to the sunspot over the following two days, the filling factor increases to 80%. However, the inclination and field strength are not changed. This result may be explained by concentration of magnetic flux tubes.

We also obtain the result indicating that the magnetic field in the EFR is slightly deformed by the preexisting magnetic environment surrounding the EFR through magnetic pressure, although the magnetic field at the photosphere is dominantly controlled by gas pressure. This result implies that the emerging flux loops have the energy larger than potential energy when they reach the photospheric level.

Reference

[1] Kubo, M., Shimizu, T., Lites, B. W.: 2003, ApJ, accepted.

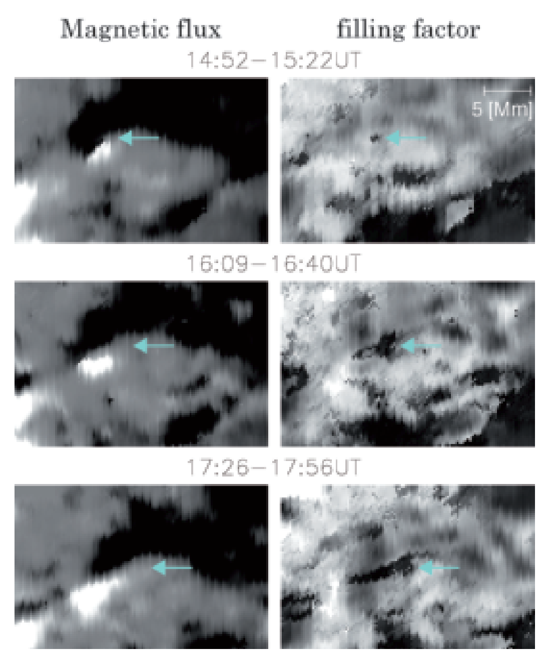

Figure 1: Magnetic flux images (left) and filling factor images (right) in the region where development of new emerging flux is in progress. These images are created from ASP observations. White (black) is positive (negative) in the magnetic flux images and white (black) is 0% (100%) in the filling factor images.

Searching for Dark Matter Halos in the Suprime-Cam 2 Square Degree Field

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NAKATA, Fumiaki, OKADA, Norio, YAGI, Masafumi, YASUDA, Naoki
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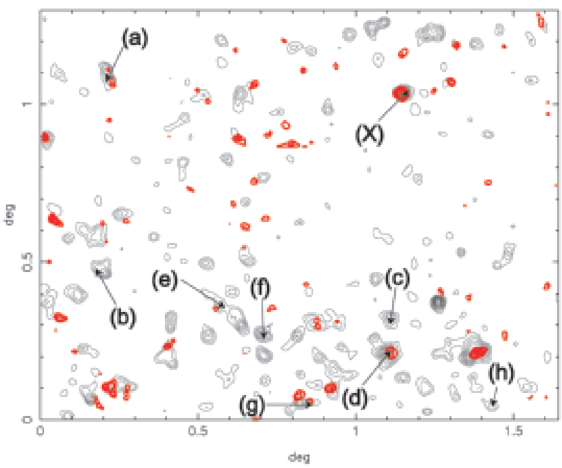

Figure 1: Demonstrating Suprime-Cam's cability for locating mass concentrations (or halos) from weak lensing data in the 2 deg^2 GTO field [2]. Red contours indicate mass over-densities where the lensing (convergence) signal/noise exceeds 3. Black contours show the surface density of visible ($20 < R < 23$) galaxies. Regions marked (a-h) represent known clusters which clearly constitute only a fraction of the massive structures detected in this field.

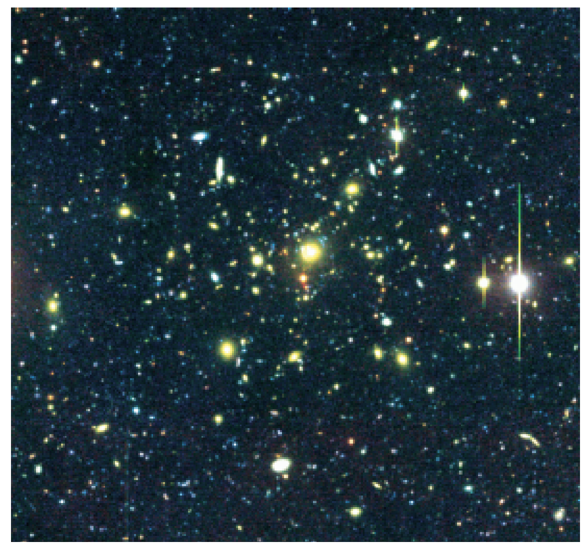

Figure 2: Optical counterpart of halo X (see left panel) identified as a new cluster at $z = 0.41$ with subsequent FOCAS spectroscopy. This cluster is not listed in the NASA/IPAC NED catalog.

Clusters of galaxies represent the largest bound systems in the universe and provide important tools for testing theories of structure formation and constraining cosmological models. Clusters have traditionally been identified using their optical or X-ray emission and thus the available catalogs are inevitably biased toward the selection of luminous objects. However, in dark matter dominated cosmologies, the usefulness of such catalog is highly questionable. This proposal is concerned with providing definitive and unambiguous versions of these tests based on clusters selected, for the first time, by their mass rather than their light.

Weak gravitational lensing offers the most reliable route to selecting clusters independently of any assumptions about their baryon content and thermodynamical state. The technique uses statistical measures of the distorted shapes of faint distant galaxies induced by the tidal gravitational field integrated along the line of sight. This, in turn, allows a reconstruction of 2-D surface mass density maps which can be used as the basis for the most reliable searches for mass concentrations completely irrespective of the nature of the baryonic material in those systems. Using GTO data secured with Suprime-Cam [1] over a contiguous 2.1 deg^2 field (3×3 Suprime-Cam pointings), we demonstrated the first reliable detection of $\simeq 5$ mass concentrations with $S/N > 5$ (Figure 1), [2]), thereby paving the way for a systematic search for such concentrations or "dark matter halos". An exposure time of 30 minutes in R-band is sufficient to detect the weak lensing signal corresponding to a $\sim 3 \times 10^{14} h^{-1} M_\odot$ structure at $z = 0.5$ with 8σ in 3.5 arcmin aperture. This corresponds roughly to a modest cluster of galaxies.

The result is consistent with the prediction assuming the Press-Schechter mass function and the NFW halo profile under the cluster normalized CDM cosmology. Although the present statistics is not enough due to the limited field of view, this work demonstrates that dark matter halo count via weak lensing is a promising way to test the paradigm of structure formation and cosmological model.

References
[1] Miyazaki, S. et al.: 2002, PASJ, 54, 833.
[2] Miyazaki, S. et al.: 2002, ApJ, 580, L97.

Fabrication of a Bandpass Filter for the Solar Optical Telescope of Solar-B Using the IBS

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ICHIMOTO, Kiyoshi (Division of Solar Physics, NAOJ)

1. Introduction

The Solar Optical Telescope of the Solar-B mission consists of a 50cm diameter Gregorian telescope (OTA: Optical Telescope Assembly) and the Focal Plane Package (FPP). OTA has a collimating lens unit (CLU) sending lights to FPP as a parallel beam. CLU consists of 6 lens elements and is required to have a very high wavefront performance to provide the diffraction limited image. One of the most critical issues of the solar telescope in space is its thermal design; i.e. unexpected heating up of the high precision optical elements due to the absorption of solar light easily causes a degradation of wavefront performance. To suppress the heat load on CLU and FPP, a band pass coating is applied on the incidence surface of the CLU to reject the unnecessary UV and IR lights. Thus the coating is a key component for the success of diffraction limited solar telescope. We developed a band pass coating using the Ion Beam Spattering facility of NAOJ, and after extensive qualification tests, we completed a flight coating for the Solar-B.

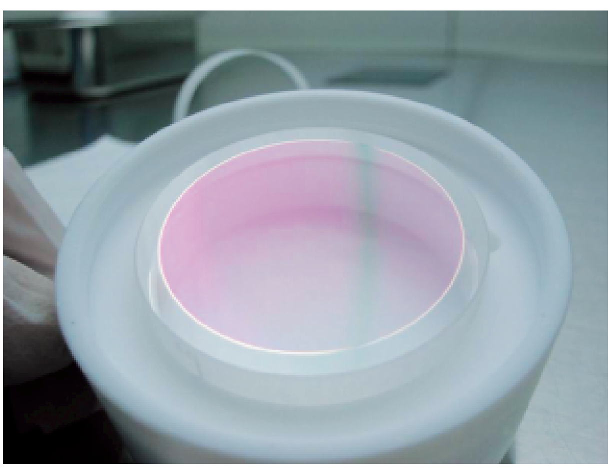

Figure 1: CLU G1 lens with a coating by IBS.

2. Design of the bandpass coating and the qualification tests

For materials of the multi-layer coating, we selected a combination of $SiO_2 + Ta_2O_5$, which is known to be durable against the general environment stress and to have fairly high transmissivity in a short wavelength. The optimized design of the multi-layer is obtained using the Macleod software with conditions that the coating has 1) high transmissivity in observing wavelength ranges (380-470nm, 500-570nm, 620-680nm), 2) high reflectivity in UV (300-370nm) and IR (700-1100nm), 3) highest transmissivity at 630nm in which interferometric measurement is made, and 4) total thickness of 4 μm. As a result we obtained a quite satisfactory coating design consisting of 55 layers. Using 8 coating samples ($20\phi \times 2.3$t) we performed various qualification testing to verify the durability in space environment as follows; 1) transmissivity / reflectivity measurements, 2) tape test, 3) polarization property measurement, 4) thermal cycling test, 5) humidity test, 6) UV illumination test, 7) γ-ray exposure test, 8) proton-beam exposure test, 9) electron-beam exposure test. The coating reveals an excellent transmission curve and showed no change of its property after any environmental tests; thus we have successfully verified the feasibility of its space usage.

3. Fabrication of the flight coating

After the series of qualification tests, we finally decided to adopt this coating for flight model and performed the IBS operation on the flight CLU element on 9-11th November 2002. The first element of the CLU has 53mm diameter and a concaved incidence surface with the radius of curvature of about 250mm. Figure 1 is the view of the coated lens and Figure 2 shows a measured transmission curve together with the theoretical one. The coincidence of measured and theoretical transmission curves is remarkable. The coated lens was assembled into the flight CLU and a series of optical performance and mechanical environment test have been done successfully. The CLU is to be installed in the flight telescope in this autumn.

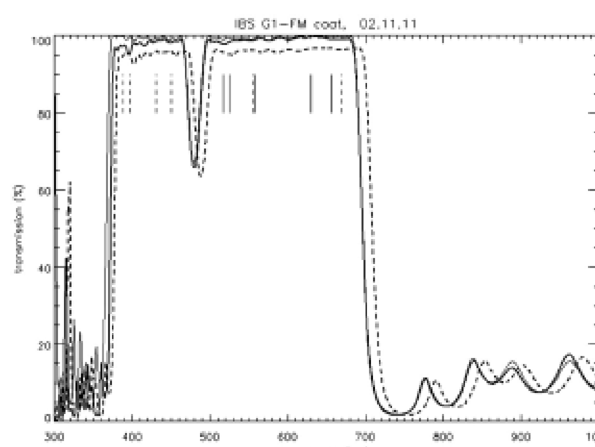

Figure 2: Transmission curves of the flight bandpass filter. Measured and theoretical curves are closely overlapped. Vertical bars on the top show wavelengths of SOT observation.

Formation of Protoplanet Systems and Diversity of Planetary Systems

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We investigate the dependence of the habitat segregation of planets on the mass and the mass distribution of a protoplanetary disk [1]. In the solar system, there are terrestrial (rocky) planets, Jovian (gaseous) planets, and Uranian (icy) planets from inside to outside. We explain this habitat segregation of the planets using the oligarchic growth model of protoplanets and the condition of Jovian planet formation. The surface density of the dust component of a protoplanetary disk is given by the power-law distribution, $\Sigma_{solid} = \Sigma_1 a^{-\alpha}$, where Σ_1 is the surface density at 1AU, a is the heliocentric distance, and $\alpha = 3/2$ is the powerlaw index. Inside the snow border a_{snow} where the disk temperature equals the ice condensation temperature, the dust is rocky. For the standard disk model, $a_{snow} \simeq 2.7$AU. Outside the snow border, the dust is icy and the surface density increases about 4 times due to ice condensation.

For this model, the oligarchic growth model gives the mass and the growth time scale of protoplanets, $M \propto \Sigma_1^{3/2} a^{(3/2)(2-\alpha)}$ and $T_{grow} \propto \Sigma_1^{-9/10} a^{(9\alpha+16)/20}$, respectively [1, 2]. In order for a protoplanet to be a Jovian planet, the protoplanet must satisfy the two conditions: (1) the contraction time scale (T_{cont}) of the gas onto the protoplanet from the gas disk is shorter than the lifetime of the gas disk (T_{disk}), and (2) the growth time of the protoplanet is shorter than the lifetime of the gas disk. The contraction time scale decreases with the mass of protoplanets [3], while the growth time of protoplanets increases with the mass of protoplanets. For the disk with $\alpha < 2$, conditions (1) and (2) determine the inner and the outer boundaries of the Jovian planet region where Jovian planets can form, respectively. In the inner and the outer regions outside the Jovian region, terrestrial and Uranian planets form, respectively. Figure 1 shows the habitat segregation for the disk with $\alpha = 3/2$, where the contraction time scale is give by $T_{cont} = 10^8 (M/M_\oplus)^{-5/2}$yr [3].

We find that for the disk life time $\sim 10^8$year, several Jovian planets would form from massive disks with $\Sigma_1 \gtrsim 30$ with Uranian planets outside the Jovian planets. Only terrestrial and Uranian planets would form from light disks with $\Sigma_1 \lesssim 3$. Solar system-like planetary systems would form from medium disks with $\Sigma_1 \simeq 10$.

The existence of the snow border, the oligarchic growth model, and the conditions for the Jovian planet formation naturally explain the habitat segregation of planets in the solar system. In other words, the mass, the mass distribution, and the temperature profile of the protoplanetary disk, and its life time determine the basic structure of planetary systems.

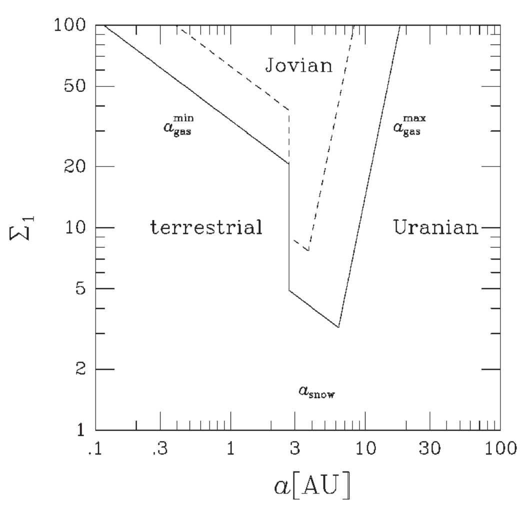

Figure 1: Habitat segregation of terrestrial, Jovian, and Uranian planets. The horizontal axis is the distance from the central star and the vertical axis is the surface density of the solid component at 1AU, which is proportional to the disk mass. a_{gas}^{min}, a_{gas}^{max}, a_{snow} stand for the inner and outer boundaries for Jovian planet region, and the snow border. The disk life time is $T_{disk} = 10^8$yr (solid) and 10^7yr (broken line).

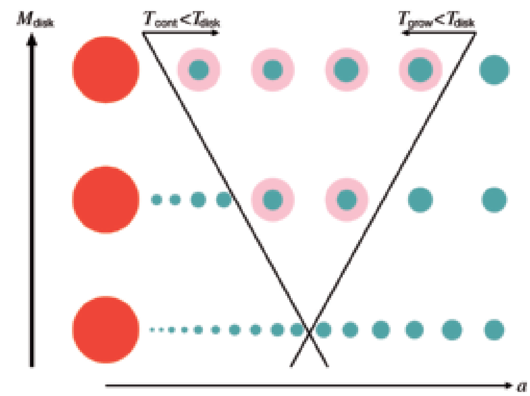

Figure 2: Schematic illustration of the diversity of planetary systems. The left large filled circles represent the central stars and the other single and double circles represent terrestria1 /Uranian and Jovian planets, respectively.

References
[1] Kokubo , E., and Ida , S.: 2002, ApJ , 581, 666.
[2] Kokubo , E., and Ida , S.: 1998, Icarus 131, 171.
[3] Ikoma , M . et al.: 2000, ApJ 537, 1013.

Spectroscopic Observation of Coronal Waves

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Observations of solar coronal waves provide valuable insights into the unresolved problem of coronal heating mechanisms. Although there have been several reports on coronal oscillations, their detailed characteristics are still unclear. Therefore we have conducted a series of spectroscopic observations of coronal oscillations and waves by using a coronagraph at the Norikura Solar Observatory [1]. As a result, a time sequence of over 80 minutes of coronal green line spectra was obtained in 1998. Doppler velocities, line intensities, and line widths were derived through fitting a single Gaussian to the observed line profiles. Coronal waves have been clearly detected in the Doppler velocity data. The Fourier analysis shows powers in a 1-3 mHz range, and in higher frequencies (5-7 mHz) at localized regions. The propagation speed of the waves was estimated by correlation analysis. The line intensity and line width did not show clear oscillations, but their phase relationship with the Doppler velocity indicates propagating waves rather than standing waves. The existence of Alfvén waves whose speed is 500 km s^{-1} or faster is possible but inconclusive, while the existence of slower waves (of the order of 100 km s^{-1}, possibly sound waves) is evident. The energy carried by the detected sound waves is far smaller than the required heat input rate to the quiet corona.

Reference

[1] Sakurai, T., Ichimoto, K., Raju, K. P., and Singh, J.: 2002, Solar Phys., 209, 265.

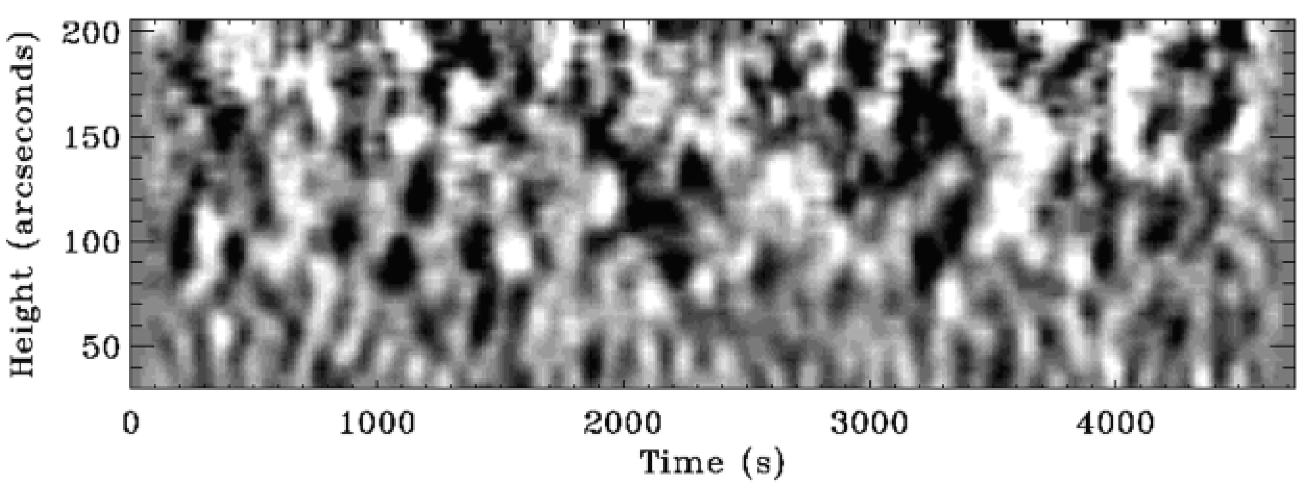

Figure 1: The observed Doppler velocity as a function of time (abscissa) and position along the spectrograph slit (ordinate). White means red shift.

Spectroscopic Studies of the Solar Corona Using Fe X, XIII, XIV Lines

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Detailed information on the physical characteristics of the solar corona can be obtained from studies of emission-line profiles of forbidden lines in the visible and infrared wavelengths. We have been conducting observations of coronal emission lines with various ionization stages by using a coronagraph at the Norikura Solar Observatory.

From the data of the green (Fe XIV 5303 Å) and red (Fe X 6374 Å) emission lines obtained in 1998, we studied any systematic differences in their properties between closed and open field structures [1]. The difference in the time-averaged values of the widths of the green line in open and closed coronal structures at a given height above the limb is small, whereas the width of the red line in open structures is substantially larger than that in the closed loop-like coronal structures.

We also obtained data of a density-sensitive line pair, 10747 Å Fe XIII and 10798 Å Fe XIII, in 1998 and 1999 [2]. The ratio of the intensities of the 10747 Å and 10798 Å emission lines in the individual coronal structures range between 1.0 and 2.5 at 10″ above the limb, which corresponds to a density range of $9.8\times10^{9}-2.4\times10^{8}$ cm^{-3}. The scale-height temperature values, derived from the variations of the intensity ratio with height above the limb for all individual coronal structures, range between 0.6×10^{6} and 8.3×10^{6} K with a most-frequent value around 1.8×10^{6} K. The large values of the scale-height temperature for 70% of the structures indicate that these structures may not be in hydrostatic equilibrium nor be isothermal in nature.

References

[1] Singh, J., Sakurai, T., Ichimoto, K., Suematsu, Y., Takeda, A.: 2002, Publ. Astron. Soc. Japan, 54, 793.

[2] Singh, J., Sakurai, T., Ichimoto, K., Takeda, A.: 2002, Publ. Astron. Soc. Japan, 54, 807.

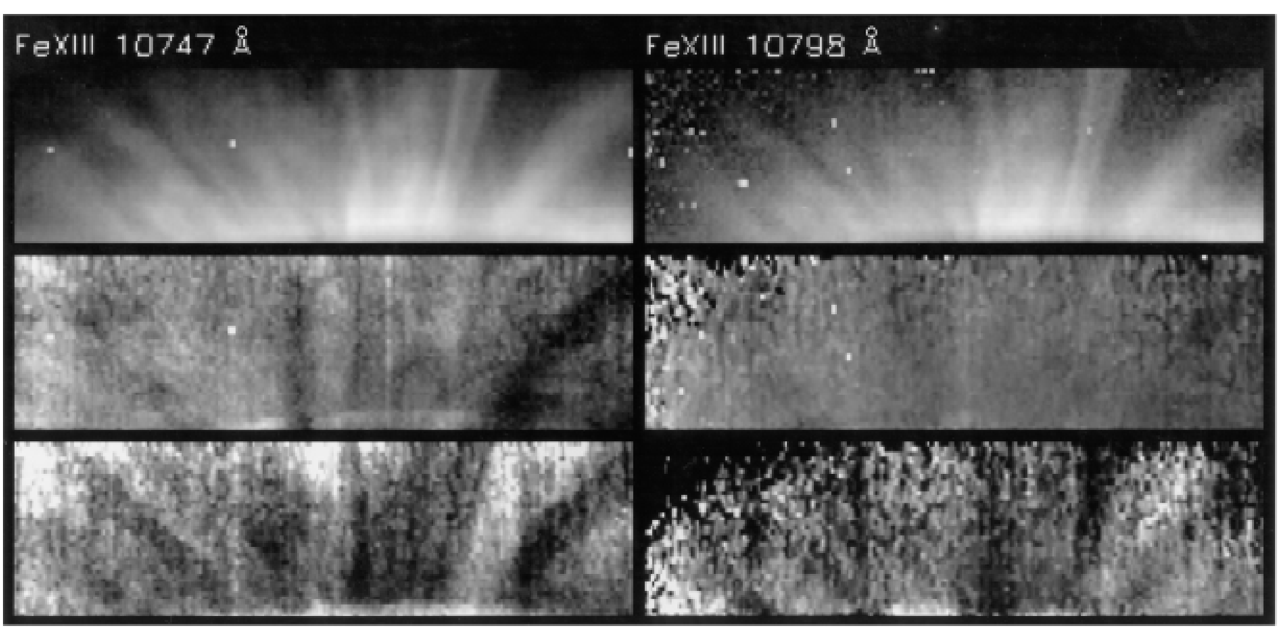

Figure 1: Images of the solar corona constructed from the line profiles observed on 1998 September 9. The top row shows the distribution of 10747 Å and 10798 Å line intensities in the observed coronal region. The middle and bottom rows indicate the velocity and line-width distributions, respectively.

Measurement of Magnetic Helicity Injection and Free Energy Loading into the Solar Corona

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Magnetic helicity has attracted great attention recently in the framework of flare models. However, precise measurement of the helicity based on real data has not been available yet. Therefore we developed a new methodology which can determine magnetic helicity flux as well as Poynting flux across the photosphere based on the magnetograph observation. By applying this method, we studied the injection mechanism of magnetic helicity and magnetic free energy into the solar corona. In order to derive the helicity and energy fluxes, first the velocity tangential to the solar surface is constructed by applying a correlation tracking technique on the magnetic observation, and secondly the velocity component across the photosphere is derived from the condition that the magnetic evolution must be consistent with the induction equation. Through this procedure, we can determine the helicity and energy fluxes separately for the shear motion effect and for the flux emerging effect. Based on this new method, the active region NOAA 8100 was analyzed from Nov. 1 to 5, 1997, using the data observed by SOHO/MDI and the vector magnetograph at NAOJ/Mitaka. The results indicate that the photospheric shear motion and the flux emerging process have equally contributed to the helicity injection, and they supplied magnetic helicity of the opposite sign into this active region.

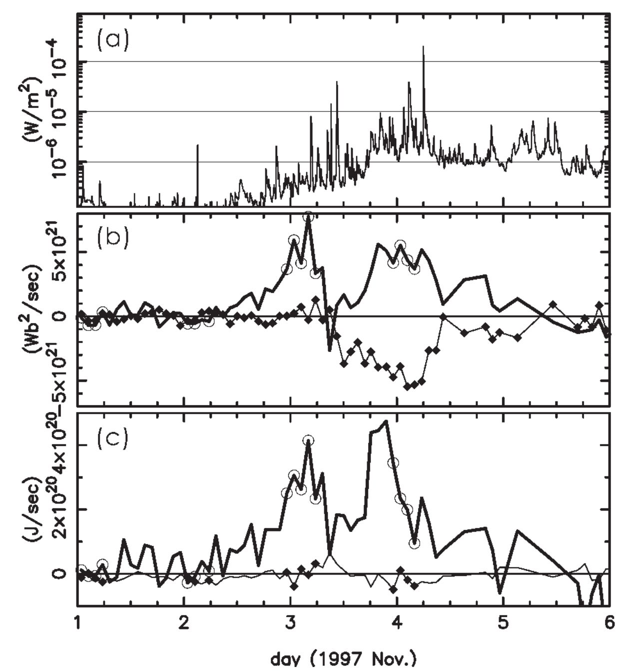

Figure 1: The top panel shows the full-sun X-ray flux in the period of 1997 November 1-6 monitored by the GOES satellite. The middle panel shows the helicity injection rate due to flux emergence (thick line) and to the shear motion (thin line). The bottom panel shows the energy injection rates. The enhanced flare activity corresponds to the injection of magnetic helicity.

Reference

[1] Kusano, K., Maeshiro, T., Yokoyama, T., Sakurai, T.: 2002, Astrophys. J., 577, 501.

The Source of Magnetic Field Twist in Solar Active Regions

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Observations have revealed that a hemispheric preference of magnetic chirality exists throughout the solar atmosphere. For example, the current helicity of active regions is predominantly negative (left-handed twist) in the northern hemisphere and positive (right-handed twist) in the southern hemisphere. The explanation for this hemispheric tendency is still open to question, and we will present our views as follows [1].

In the photosphere, the differential rotation acting on already emerged sunspot magnetic fields will lead to negative current helicity in the northern hemisphere, but the same effect caused by the Coriolis force is opposite in sign. In the turbulent convection zone, the Coriolis force acting on the rising magnetic flux tubes will result in the negative magnetic helicity in the northern hemisphere, but the corresponding action by the differential rotation will give rise to the opposite sign. Moreover, in this region the α-effect will produce the wrong sign. It should be noteworthy that the two current helicities generated by the α-effect, the one in the mean field and the other in the fluctuations, have opposite signs, and the former is positive while the latter is negative in the northern hemisphere. In the overshoot region at the base of the convection zone, the current helicity created by the α-effect has the correct sign.

Reference

[1] Bao, S.D., Sakurai, T., and Suematsu, Y.: 2002, Astrophys. J., 573, 445.

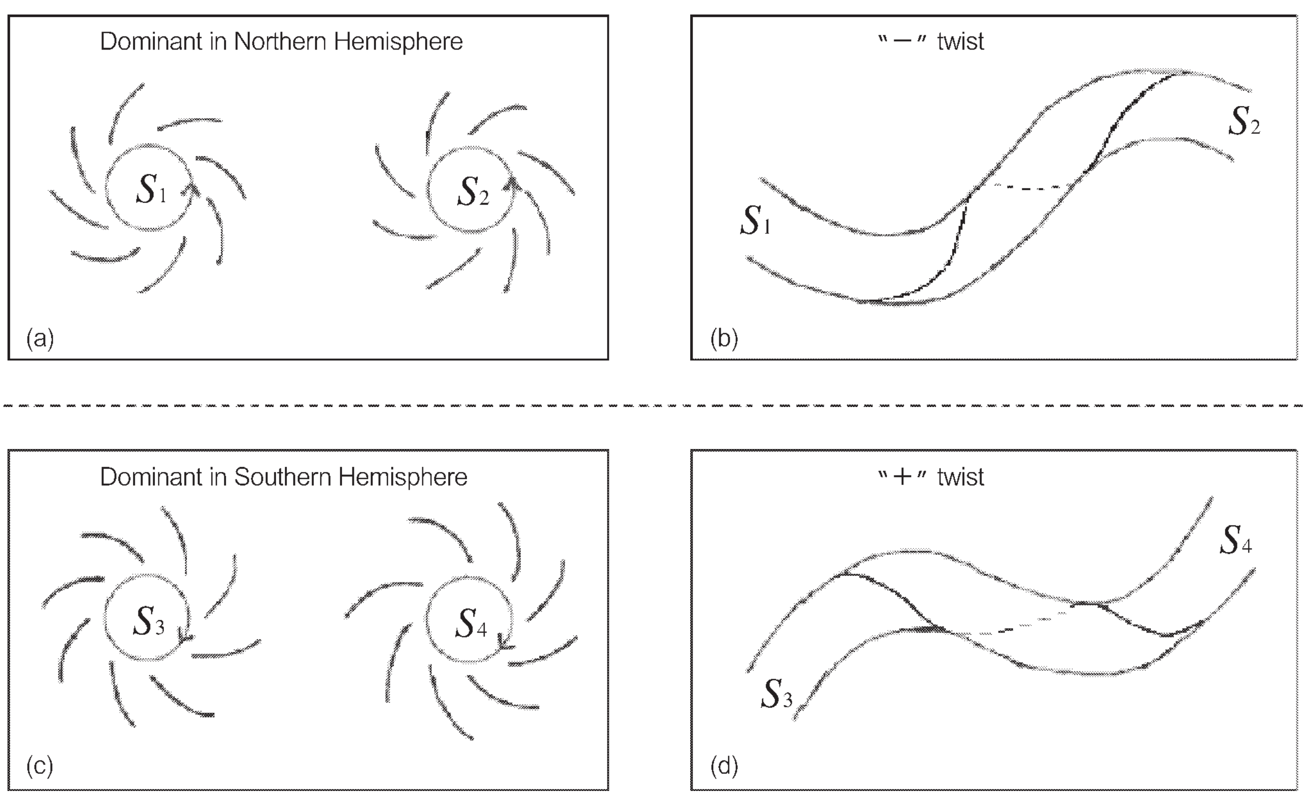

Figure 1: Influence of differential rotation on the formation of spiral patterns. Panels (a) and (c) represent two pairs of simple bipolar sunspots. The circular arrows denote the direction of the vortices. In (b) and (d) are shown two twisted flux tubes above the photosphere that connect the sunspot pairs. The axial electric currents in the tube $S_1 S_2$ ($S_3 S_4$) flow antiparallel (parallel) to the field, respectively.

Relation between Pressure Balance Structures and Polar Plumes from Ulysses High Latitude Solar Wind Observations

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Ulysses observations have shown that pressure balance structures (PBSs) are a common feature in high-latitude, fast solar wind near solar minimum. Previous studies of Ulysses/SWOOPS plasma data suggested that these PBSs may be remnants of coronal polar plumes. Here we find support for this suggestion in an analysis of PBS magnetic structure. We used Ulysses magnetometer data and applied a minimum variance analysis to magnetic discontinuities in PBSs. We found that PBSs preferentially contain tangential discontinuities, as opposed to rotational discontinuities and to non-PBS regions in the solar wind. This suggests that PBSs contain structures like current sheets or plasmoids that may be associated with network activity at the base of plumes.

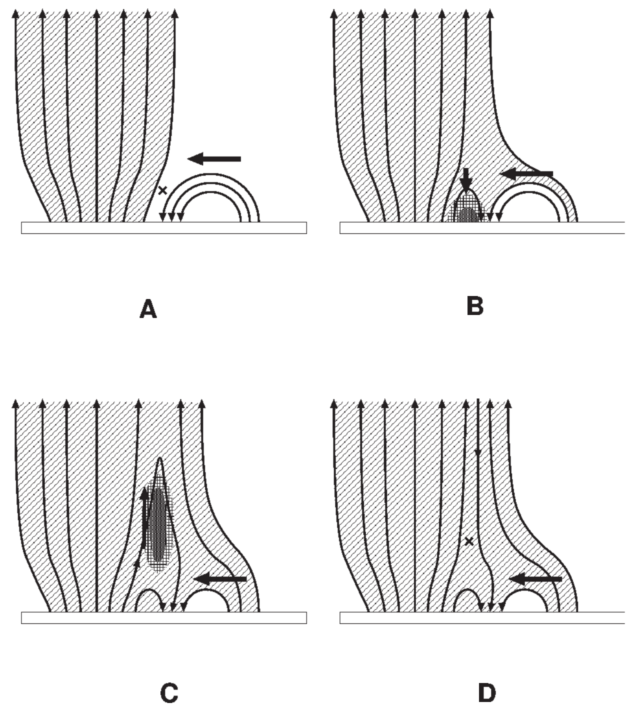

Figure 1: Illustration of a possible scenario for polar plume formation. The entire diverging field region will be a plume if heating is supplied in the chromosphere by the reconnection.

Reference

[1] Yamauchi, Y., Suess, S.T., and Sakurai, T.: 2002, Geophys. Res. Letters, 29, 21-1.

Dynamical Ordering of Accelerator Modes

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The standard mapping is the typical model of twist mappings and has a simple form. However its properties are not clearly understood.

$$y_{n+1}=y_n+a\sin x_n, \quad (1)$$
$$x_{n+1}=x_n+y_{n+1}\ (\mathrm{Mod}\ 2\pi) \quad (2)$$

where a is a positive parameter. The anomalous diffusion along the y-axis has been investigated over twenty years. Let n be an iteration number and D be a diffusion constant satisfying the relation $D\propto n^{\alpha}$. If $\alpha>1/2$ is satisfied, we call the diffusion anomalous. This is originated by the rapid motion along the y axis. Ichikawa-Kamimura-Hatori [1,2] found that the origin of anomalous diffusion is the accelerator modes (AMs). For example, $3^{m_y}_{m_x}$ (m_x,m_y: positive integers)-AM jumps $2\pi m_y$ in the y direction every three iterations and jumps $2\pi m_x$ in the x-direction at the first three iterations. The jumping rate along the x axis increases due to the increment of the value of y-coordinate of AM. If a mapping point comes in the vicinity of AMs, it jumps rapidly in the y direction.

We study the mechanism of the appearance of AMs and derive their dynamical ordering [3]. We use the following procedure.

[1] Using two involutions h and g, we express T as $T=h\circ g$. The symmetry axes are defined by the sets of fixed points of h and g.

[2] We search the symmetric accelerator modes (SAMs) that start from the symmetry axis and have an orbital point in the other symmetry axis.

[3] We obtain the dynamical ordering of SAMs.

Here we give our results. The following is the dynamical ordering of SAMs starting from the intervals I_i $(i\geq 0)$ in the x-axis (one of the symmetry axes). A notation $3\in I_1\rightarrow 5\in I_1$ means that if the initial point of a 3-SAM is located in I_1, the initial point of a 5-SAM exists in I_1. The symbol ($\downarrow$) means the same relation. We let $m_y\geq 1$.

Dynamical ordering

I_0	$1^{m_y}_{m_y}$	$\rightarrow$	$3^{m_y}_{2m_y}$	$\rightarrow$	$5^{m_y}_{3m_y}$	$\rightarrow$
$\downarrow$	$\downarrow$		$\downarrow$		$\downarrow$	
I_1	$3^{m_y}_{2m_y}$	$\rightarrow$	$5^{m_y}_{3m_y}$	$\rightarrow$	$7^{m_y}_{4m_y}$	$\rightarrow$
$\downarrow$	$\downarrow$		$\downarrow$		$\downarrow$	
I_2	$5^{m_y}_{3m_y}$	$\rightarrow$	$7^{m_y}_{4m_y}$	$\rightarrow$	$9^{m_y}_{5m_y}$	$\rightarrow$
$\downarrow$	$\downarrow$		$\downarrow$		$\downarrow$	

Let $a(i,j)$ be a critical value of SAMs included in the dynamical ordering. For example, $a(2,3)$ is the critical value of $7^{m_y}_{4m_y}\in I_1$. Let a_c be a critical value at which the last KAM (Kolmogorov-Arnold-Moser) curve is destroyed. We prove the following relation.

$$\lim_{i,j\to\infty} a(i,j)=a_c. \quad (3)$$

This means that SAMs appear just after the destruction of the last KAM curve. However the anomalous diffusion around a_c was not observed. We hope a more accurate calculation of the diffusion process.

Recently, without using the reversibility, the existence of accelerator modes in the twist mapping has been proved [4].

References

[1] Ichikawa, Y.H., Kamimura, T. and Hatori, T.: 1984, Statistical Physics & Chaos in Fusion Plasmas (Wiley, 1984), 21.
[2] Ichikawa, Y.H., Kamimura, T. and Hatori, T.: 1987, Physica D29, 247.
[3] Yamaguchi, Y. and Tanikawa, K.: 2002, Prog. Theor. Phys. 108, 669.
[4] Addas-Zanata, S.: 2002, Nonlinearity, 15, 1399.

Observational Constraints on Dark Radiation in Brane Cosmology

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We analyze the observational constraints on braneworld cosmology whereby the universe is described as a three-brane embedded in a five-dimensional anti-de Sitter space [1]. In such scenarios, our universe is a submanifold embedded in a higher-dimensional spacetime. Physical matter fields are confined to this submanifold, while gravity can reside in the higher-dimensional spacetime. In this brane-universe cosmology, the Friedmann equation is modified by the appearance of extra terms which are derived from the existence of the extra dimensions [2],

$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G_N}{3}\rho - \frac{K}{a^2} + \frac{\Lambda_4}{3} + \frac{\kappa_5^4}{36}\rho^2 + \frac{\mu}{a^4}. \quad (1)$$

In the present work we concentrate on the "dark radiation" term which diminishes with cosmic scale factor as a^{-4}. The coefficient μ is a constant of integration obtained by integrating the five-dimensional Einstein equations. Both positive and negative μ are possible mathematically. Its magnitude and sign can depend on the choice of initial conditions when solving the five dimensional Einstein equation. Hence, even the sign of μ remains an open question. We show that, although the observational constraints from primordial abundances allow only a small contribution when this term is positive, a much wider range of negative values is allowed. Furthermore, such a negative contribution can reconcile the tension between the observed primordial ^{4}He and D abundances (Figure 1). The shaded region on Figure 2 shows allowed values of the dark radiation fraction, ρ_{DR}/ρ_γ, where ρ_γ is the total energy density in background photons just before the BBN epoch at T = 1MeV. Note, that only a small ($\leq 11\%$) positive dark radiation contribution is allowed while substantial negative dark radiation (up to 123%) is allowed and even preferred by the BBN constraints. It is well known that the CMB spectrum is sensitive to many cosmological parameters which have almost no effect on BBN. For simplicity, therefore, we have fixed most cosmological parameters to their optimum values and explore the effects of varying the dark radiation content and baryon to photon ratio η. We have calculated CMB power spectra and made the standard χ^2 goodness of fit analysis to the combined BOOMERANG, DASI, and MAXIMA-1 data sets, which gives the limits to a ratio of dark radiaion to photon energy density of +92% and -135% just before nucleosynthesis. Figure 2 shows the contours of the dark radiation fraction and $\Omega_b h^2$ allowed by nucleosynthesis and the CMB. This shows that the combined nucleosynthesis and CMB constraints severely limit the possible sign and amplitude of the dark radiation. The combined 2σ 95% confidence limit from the concordance of both constraints corresponds to $-41\% \leq \rho_{DR}/\rho_\gamma \leq +10.5\%$ for $4.73 \leq \eta_{10} \leq 5.56$ (or $0.0176 \leq \Omega_b h^2 \leq 0.0207$).

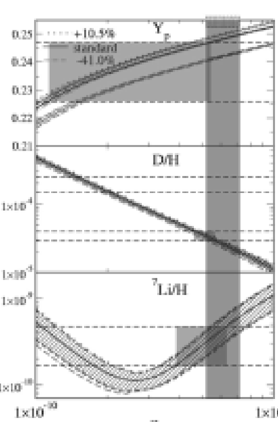

Figure 1: Light-element abundances as a function of baryon to photon ratio η. Plotted are models with 0% (blue), +10.5% (red) and -41% (green) dark radiation (relative to the background photon energy density just before the e^+e^- annihilation epoch) with $\pm 2\sigma$ uncertainties in the model predictions. Observational constraints are indicated as horizontal lines as labeled. Constraint on η from CMB is also shown as vertical shaded region.

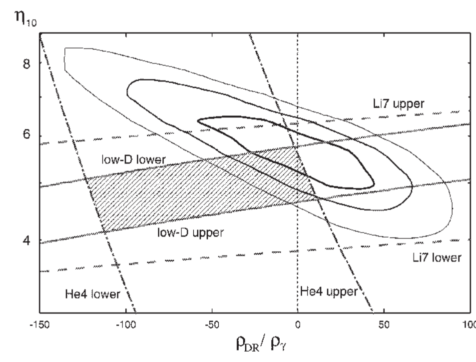

Figure 2: Constrains from the primordial abundances (lines) and the CMB (contours) on η and the fraction of the background photon energy density in dark radiation ρ_{DR}/ρ_γ just before the e^+e^- annihilation.

References

[1] Ichiki K. et al.: 2002, PRD, 66, 043521.
[2] Binetruy P. et al.: 2000, PLB, B477, 285.
[3] Mukohyama S.: 2000, PLB, 473, 241.

Astrophysical Reaction Rate for $\alpha(\alpha n,\gamma)^9$Be by Photodisintegration

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We study the astrophysical reaction rate for the formation of ^{9}Be through the three body reaction $\alpha(\alpha n,\gamma)$ [1]. This reaction is one of the key reactions which could bridge the mass gap at A=8 nuclear systems to produce intermediate-to-heavy mass elements in alpha- and neutron-rich environments such as r-process nucleosynthesis in supernova explosions [2, 3, 4, 5], s-process nucleosynthesis in asymptotic giant branch (AGB) stars [6], and primordial nucleosynthesis in baryon inhomogeneous cosmological models [7].

To calculate the thermonuclear reaction rate in a wide range of temperatures, we numerically integrate the thermal average of cross sections assuming a two-steps formation through a metastable ^{8}Be, $\alpha+\alpha \rightleftarrows {}^8\mathrm{Be}(n,\gamma)^9\mathrm{Be}$. Off-resonant and on-resonant contributions from the ground state in ^{8}Be are taken into account. As input cross section, we adopt the latest experimental data by photodisintegration of ^{9}Be with laser-electron photon beams, which covers all relevant resonances in ^{9}Be. Experimental data near the neutron threshold are added with γ-ray flux corrections and a new least-squares analysis is made to deduce resonance parameters in the Breit-Wigner formulation. Based on the photodisintegration cross section, we provide the reaction rate for $\alpha(\alpha n,\gamma)^9$Be in the temperature range from $T_9=10^{-3}$ to $T_9=10^1$ (T_9 is the temperature in units of 10^9 K) both in the tabular form and in the analytical form for potential usage in nuclear reaction network calculations.

The calculated reaction rate is compared with the reaction rates of the CF88 and the NACRE compilations. The CF88 rate, which is based on the photoneutron cross section for the $1/2^+$ state in ^{9}Be by Berman et al., is valid at $T_9>0.028$ due to lack of the off-resonant contribution. The CF88 rate differs from the present rate by a factor of two in a temperature range $T_9\geq 0.1$. The NACRE rate, which adopted different sources of experimental information on resonance states in ^{9}Be, is 4-12 times larger than the present rate at $T_9\leq 0.028$, but is consistent with the present rate to within $\pm 20\%$ at $T_9\geq 0.1$. Due to the slight increase of the reaction rate at $T_9>3.5$, the production of seed elements in the neutrino-driven wind and the alpha-rich freeze-out scenarios can be enhanced. This may lead to a slightly smaller neutron-to-seed ratio at the onset of r-process, and hence may make an appreciable influence on the entropy condition and expansion dynamics of the neutrino-driven wind [8].

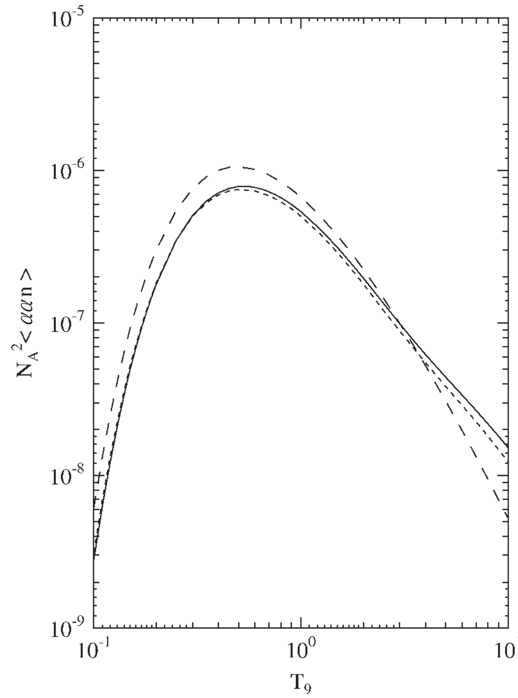


Figure 1: The reaction rate $N_A^2<\alpha\alpha n>$ in the present study is shown by the solid curve as a function of temperature. The reaction rates by CF88 and NACRE are shown by dashed and dotted curves, respectively.

References

[1] Sumiyoshi, K., Utsunomiya, H., Goko S., and Kajino, T.: 2002, Nucl. Phys., 709, 467.
[2] Otsuki, K., Tagoshi, H., Kajino T., and Wanajo, S.: 2000, Astrophys., J., 533, 424.
[3] Sumiyoshi, K., Suzuki, H., Otsuki, K., Terasawa M., and Yamada, S.: 2000, Publ. Astron. Soc. Japan, 52, 601.
[4] Terasawa, M., Sumiyoshi, K., Kajino, T., Mathews G. J., and Tanihata, I.: 2001, Astrophys., J., 562, 470.
[5] Terasawa, M., Sumiyoshi, K., Yamada, S., Suzuki H., and Kajino, T.: 2002, Astrophys., J., 578, L137.
[6] Iwamoto, N., Kajino, T., Mathews, G. J., Fujimoto M., and Aoki, W.: 2001, submitted to ApJ.
[7] Orito, M.. Kajino, T., Boyd R. N., and Mathews, G. J.: 1997, Astrophys. J., 488, 515.
[8] Kajino, T., Wanajo, S., and Mathews, G. J.: 2002, Nucl. Phys., A704, 165.

II Publications, Presentations

1. Refereed Publications

Ahrens, V., Lewen, F., Takano, S., Winnewisser, G., Urban, S., Negirev, A. A., and Koroliev, A. N.: 2002, Sub-Doppler Saturation Spectroscopy of HCN up to 1 THz and Detection of J = 3→2 (4→3) Emission from TMC 1, Zeitschrift fuer Naturforschung, 57a, 669-681.

Ajiki, M., Taniguchi, Y., Murayama, T., Nagao, T., Veilleux, S., Shioya, Y., Fujita, S. S., Kakazu, Y., Komiyama, Y., Okamura, S., Sanders, D. B., Oyabu, S., Kawara, K., Ohyama, Y., Iye, M., Kashikawa, N., Yoshida, M., Sasaki, T., Kosugi, G., Aoki, K., Takata, T., Saito, Y., Kawabata, K. S., Sekiguchi, K., Okita, K., Shimizu, Y., Inata, M., Ebizuka, N., Ozawa, T., Yadoumaru, Y., Taguchi, H., Ando, H., Nishimura, T., Hayashi, M., Ogasawara, R., Ichikawa, S.: 2002, A New High-Redshift Ly α Emitter: Possible Superwind Galaxy at z = 5.69, Astrophys. J. Lett., 576, L25-L28.

Akiyama, M., Ueda, Y., Ohta, K.: 2002, A Candidate of a Type 2 Quasi-stellar Object at z = 0.9: Large X-Ray Absorption with a Strong Broad H α Emission Line, Astrophys. J., 567, 42-49.

Ando, S., Sato, K., and Totani, T.: 2003, Detectability of the supernova relic neutrinos and neutrino oscillation, Astropart. Phys., 8, 307-318.

Aoki, W., Ando, H., Honda, S., Iye, M., Izumiura, H., Kajino, T., Kambe, E., Kawanomoto, S., Noguchi, K., Okita, K., Sadakane, K., Sato, B., Shelton, I., Takada-Hidai, M., Takeda, Y., Watanabe, E., and Yoshida, M.: 2002, Chemical Composition of Carbon-Rich, Very Metal-Poor Subgiant LP 625-44 Observed with the Subaru/HDS, Publ. Astron. Soc. Japan, 54, 427-449.

Aoki, W., Honda, S., Beers, T. C., and Sneden, C.: 2003, Measurement of the Europium Isotope Ratio for the Extremely Metal poor, r-Process-enhanced Star CS 31082-001, Astron. J., 586, 506-511.

Aoki, W., Norris, J. E., Ryan, S. G., Beers, T. C., and Ando, H.: 2002, Chemical composition of the carbon-rich, extremely metal poor star CS29498-043: A new class of extremely metal poor stars with excesses of magnesium and silicon, Astrophys. J., 576, L141-144.

Aoki, W., Ryan, S. G., Norris, J. E., Beers, T. C., and Ando, H.: 2002, Subaru/HDS Study of the Extremely Metal-Poor Star CS 29498-043: Abundance Analysis Details and Comparison with Other Carbon-Rich Objects, Publ. Astron. Soc. Japan, 54, 933-949.

Aoki, W., Ryan, S. G., Norris, J. E., Beers, T. C., Ando, H., and Tsangarides, S.: 2002, A Subaru/High Dispersion Spectrograph study of lead (Pb) abundances in eight s-process element-rich, metal-poor stars, Astrophys. J., 580, 1149-1158.

Arnaboldi, M., Freeman, K. C., Okamura, S., Yasuda, N., Gerhard, O., Napolitano, N. R., Pannella, M., Ando, H., Doi, M., Furusawa, H., Hamabe, M., Kimura, M., Kajino, T., Komiyama, Y., Miyazaki, S., Nakata, F., Ouchi, M., Sekiguchi, M., Shimasaku, K., and Yagi, M.: 2003, Narrow band imaging in [OIII] and H-α to search for ICPNe in the Virgo cluster, Astron. J., 125, 514-524.

Asada, H., Hamana, T., Kasai, M.: 2003, Images for an isothermal ellipsoidal gravitational lens from a single real algebraic equation, Astron. Astrophys., 397, 825-829.

Asada, K., Inoue, M., Uchida, Y., Kameno, S., Fujisawa, K., Iguchi, S., and Mutoh, M.: 2002, A Helical Magnetic Field in the Jet of 3C 273, Publ. Astron. Soc. Japan, 54, L39-L43.

Asai, A., Ishii, T. T., Kurokawa, H., Yokoyama, T., and Shimojo, M.: 2003, Evolution of Conjugate Footpoints inside Flare Ribbons during a Great Two-Ribbon Flare on 2001 April 10, Astrophys. J., 586, 624-629.

Asai, A., Masuda, S., Yokoyama, T., Shimojo, M., Isobe, H., Kurokawa, H., and Shibata, K.: 2002, Difference between Spatial Distributions of the H α Kernels and Hard X-Ray Sources in a Solar Flare, Astrophys. J. Lett., 578, L91-L94.

Bao, S. D., Sakurai, T., and Suematsu, Y.: 2002, The Sources of Magnetic Field Twist in Solar Active Regions, Astrophys. J., 573, 445-453.

Barraud, C., Olive, J.-F., Lestrade, J. P., Atteia, J.-L., Hurley, K., Ricker, G., Lamb, D. Q., Kawai, N., Boer, M., Dezalay, J.-P., Pizzichini, G., Vanderspek, R., Crew, G., Doty, J., Monnelly, G., Villasenor, J., Butler, N., Levine, A., Yoshida, A., Shirasaki, Y., Sakamoto, T., Tamagawa, T., Torii, K., Matsuoka, M., Fenimore, E. E., Galassi, M., Tavenner, T., Donaghy, T. Q., Graziani, C., Jernigan, J. G.: 2003, Spectral analysis of 35 GRBs/XRFs observed with HETE-2/FREGATE, Astron. Astrophys., 400, 1021-1030.

Barucci, M. A., Boehnhardt, H., Dotto, E., Doressoundiram, A., Romon, J., Lazzarin, M., Fornasier, S., de Bergh, C., Tozzi, G. P., Delsanti, A., Hainaut, O., Barrera, L., Birkle, K., Meech, K., Ortiz, J. L., Sekiguchi, T., Thomas, N., Watanabe, J., West, R. M., and Davies, J. K.: 2002, Visible and near-infrared spectroscopy of the Centaur 32532 (2001 PT13), Astron. Astrophys., 392, 335-339.

Beers, T. C., Drilling, J. S., Rossi, S., Chiba, M., Rhee, J., Fuhrmeister, B., Norris, J. E., Hippel, T.: 2002, Metal Abundances and Kinematics of Bright Metal-poor Giants Selected from the LSE Survey: Implications for the Metal-weak Thick Disk, Astron. J., 124, 931-948.

Boehnhardt, H., Delsanti, A., Barucci, A., Hainaut, O., Doressoundiram, A., Lazzarin, M., Barrera, L., de Bergh, C., Birkle, K., Dotto, E., Meech, K., Ortiz, J. E., Romon, J., Sekiguchi, T., Thomas, N., Tozzi, G. P., Watanabe, J., and West, R. M.: 2002, ESO Large Program on Physical Studies of Transneptunian Objects and Centaurs: Visible Photometry - First Results, Astron. Astrophys., 395, 297-303.

Bouquillon, S., Kinoshita, H., and Souchay, J.: 2003, Extension of Cassini's Lawa, Celest. Mech. Dyn. Astr., 86, 29-57.

Carilli, C. L., Kohno, K., Kawabe, R., Ohta, K., Henkel, C., Menten, K. M., Yun, M. S., Petric, A., and Tutui, Y.: 2002, High-Resolution Imaging of Molecular Line Emission from High-Redshift QSOs, Astron. J., 123, 838-1846.

Chin, C. C., Wang, M. J., Shah, W. L., Zhang, W., Cheng, H. W., Shi, S. C., and Noguchi, T.: 2002, A Fixed Tuned Low Noise 600-700 GHz SIS Receiver, Int. J. of IR and MM Waves, 23, 731-744.

Choudhary, D. P., Suematsu, Y., and Ichimoto, K.: 2002, Observational Study of the Three-Dimensional Magnetic Field Structure and Mass Motion in Active Regions, Solar Phys., 209, 349-360.

Chrysostomou, A., Aitken, D. K., Jenness, T., Davis, C. J., Hough, J. H., Curran, R., and Tamura, M.: 2002, The magnetic field structure in W51A, Astron. Astrophys., 385, 1014-1021.

Deguchi, S., Fujii, T., Nakashima, J.-I., and Wood, P. R.: 2002, Near-Infrared Observations of the IRAS/SiO Sources in the Galactic Bulge: a Large Scale Distribution, Publ. Astron. Soc. Japan, 54, 719-734.

Dermawan, B., Nakamura, T., Fukushima, H., Sato, H., Yoshida, F., and Sato, Y.: 2002, CCD photometry of the MUSES-C mission target: Asteroid (25143) 1998SF36, Publ. Astron. Soc. Japan, 54, 635-640.

Enoki, M., Nagashima, M., and Gouda, N.: 2003, Relations between Environments of Quasars and Galaxy Formation, Publ. Astron. Soc. Japan, 55, 133-142.

Enomoto, R., Tanimori, T., Naito, T., Yoshida, T., Yanagita, S., Mori, M., Edwards, P. G., Asahara, A., Bicknell, G. V., Gunji, S., Hara, S., Hara, T., Hayashi, S., Itoh, C., Kabuki, S., Kajino, F., Katagiri, H., Kataoka, J., Kawachi, A., Kifune, T., Kubo, H., Kushida, J., Maeda, S., Maeshiro, A., Matsubara, Y., Mizumoto, Y., Moriya, M., Muraishi, H., Muraki, Y., Nakase, T., Nishijima, K., Ohishi, M., Okumura, K., Patterson, J. R., Sakurazawa, K., Suzuki, R., Swaby, D. L., Takano, K., Takano, T., Tokanai, F., Tsuchiya, K., Tsunoo, H., Uruma, K., Watanabe, A., Yoshikoshi, T.: 2002, The acceleration of cosmic-ray protons in the supernova remnant RX J1713.7-3946, Nature, 416, 823-826.

Enya, K., Yoshii, Y., Kobayashi, Y., Minezaki, T., Suganuma, M., Tomita, H., Peterson, B. A.: 2002, JHK' Imaging Photometry of Seyfert 1 Active Galactic Nuclei and Quasars. I. Multiaperture Photometry, Astrophys. J. Suppl. Ser., 141, 23-29.

Enya, K., Yoshii, Y., Kobayashi, Y., Minezaki, T., Suganuma, M., Tomita, H., Peterson, B. A.: 2002, JHK' imaging photometry of Seyfert 1. I. (Enya +, 2002), VizieR On-line Data Catalog, 141, 23.

Enya, K., Yoshii, Y., Kobayashi, Y., Minezaki, T., Suganuma, M., Tomita, H., Peterson, B. A.: 2002, JHK' Imaging Photometry of Seyfert 1 Active Galactic Nuclei and Quasars. II. Observation of Long-Term Variability, Astrophys. J. Suppl. Ser., 141, 31-44.

Enya, K., Yoshii, Y., Kobayashi, Y., Minezaki, T., Suganuma, M., Tomita, H., Peterson, B. A.: 2002, JHK' Imaging Photometry of Seyfert 1 Active Galactic Nuclei and Quasars. III. Variability of Radio-Quiet and Radio-Loud Active Galactic Nuclei, Astrophys. J. Suppl. Ser., 141, 45-59.

Famiano, M. A., Boyd, R. N., and Kajino, T.: 2002, Light element nucleosynthesis from jet interactions in active galactic nuclei, Astrophys. J., 576, 89-100.

Ford, A., Jeffries, R. D., Smalley, B., Ryan, S. G., Aoki, W., Kawanomoto, S., James, D. J., and Barnes, J. R.: 2002, Lithium 6104A in Population II stars, Astron. Astrophys., 393, 617-628.

Fujimoto, H., Mochizuki, M., Mitsuzawa, K., Tamaki, T., Sato, T.: 2003, Ocean bottom pressure variations in the southeastern Pacific following the 1997-98 El Nino event, Geophys. Res. Lett., 30, 10.1029/2002GL016677.

Fujita, S. S., Ajiki, M., Shioya, Y., Nagao, T., Murayama, T., Taniguchi, Y., Okamura, S., Ouchi, M., Shimasaku, K., Doi, M., Furusawa, H., Hamabe, M., Kimura, M., Komiyama, Y., Miyazaki, M., Miyazaki, S., Nakata, F., Sekiguchi, M., Yagi, M., Yasuda, N., Matsuda, Y., Tamura, H., Hayashino, T., Kodaira, K., Karoji, H., Yamada, T., Ohta, K., Umemura, M.: 2003, A Search for Ly α Emitters at Redshift 3.7, Astron. J., 125, 13-31.

Fujita, S. S., Ajiki, M., Shioya, Y., Nagao, T., Murayama, T., Taniguchi, Y., Umeda, K., Yamada, S., Yagi, M., Okamura, S., and Komiyama, Y.: 2003, The H α; Luminosity Function and Star Formation Rate at z～0.24 Based on Subaru Deep Imaging Data, Astropys. J., 586, L115-L118.

Fujita, Y., Takizawa, M, and Sarazin, C. L.: 2003, Nonthermal Emissions from Particles Accelerated by Turbulence in Clusters of Galaxies, Astrophys. J., 584, 190.

Fukagawa, M., Tamura, M., Suto, H., Itoh, Y., Murakawa, K., Oasa, Y., Hayashi, S. S., Naoi, T., Kaifu, N., Doi, Y.: 2002, Subaru Near-IR Coronagraphic Image of LkH α 198, Pub. Astron. Soc. Japan, 54, 969-973.

Furuya, R. S., Kitamura, Y., Wootten, A., Claussen, M. J., and Kawabe, R.: 2003, Water Maser Survey toward Low-Mass Young Stellar Objects in the Northern Sky with the Nobeyama 45 Meter Telescope and the Very Large Array, Astrophys. J. Suppl. ser., 144, 71-134.

Gelfreikh, G. B., Makarov, V. I., Tlatov, A. G., Riehokainen, A., and Shibasaki, K.: 2002, A Study of the Development of Global Solar Activity in the 23rd Solar Cycle Based on Radio Observations with the Nobeyama Radio Heliograph. I. Latitude Distribution of the Active and Dark Regions, Astron. Astrophys., 389, 618-623.
Gelfreikh, G. B., Makarov, V. I., Tlatov, A. G., Riehokainen, A., and Shibasaki, K.: 2002, A Study of the Development of Global Solar Activity in the 23rd Solar Cycle Based on Radio Observations with the Nobeyama Radio Heliograph. II. Dynamics of the differential rotation of the Sun, Astron. Astrophys., 389, 624-628.
Gopalswamy, N., Shimojo, M., Lu, W., Yashiro, S., Shibasaki, K., and Howard, R. A.: 2003, Prominence Eruptions and Coronal Mass Ejection: A Statistical Study Using Microwave Observations, Astrophys. J., 586, 562-578.
Goto, M., Gaessler, W., Hayano, Y., Iye, M., Kamata, Y., Kanzawa, T., Kobayashi, N., Minowa, Y., Saint-Jacques, D. J., Takami, H., Takato, N., Terada, H.: 2003, Spatially Resolved 3 um Spectroscopy of IRAS 22272＋5435: Formation and Evolution of Aliphatic Hydrocarbon Dust in Proto-Planetary Nebula, Astrophys. J., 589, 419-429.
Goto, M., McCall, B. J., Geballe, T. R., Usuda, T., Kobayashi, N., Terada, H., Oka, T.: 2002, Absoroption Line Survey of H3＋ toward the Galactic Center Sources I. GCS3-2 and GC IRS3, Publ. Astron. Soc. Japan, 54, 951-961.
Gouda, N., Tsujimoto, T., Kobayashi, Y., Nakajima, T., Yasuda, N. and Matsuhara, H.: 2002, Japanese Astrometry Satellite Mission for Infrared Exploration, Astrophys. Space Sci., 280, 89-94.
Gough, D. O., and Sekii, T.: 2002, On the effect of Error Correlation on Linear Inversion, Mon. Not. Roy. Astron. Soc., 335, 170-176.
Hamana, T., Yoshida, N., Suto, Y.: 2002, Reliability of the Dark Matter Clustering in Cosmological N-Body Simulations on Scales below the Mean Separation Length of Particles, Astrophys. J., 568, 455-462.
Hattori, T., Yoshida, M., Ohtani, H., Ishigaki, T., Sugai, H., Hayashi, T., Ozaki, S., and Ishii, M.: 2002, Tridimensional Spectroscopic Observation of the Interacting System NGC 7592, Publ. Astron. Soc. Japan, 54, 393-404.
Heinzel, G., Braxmaier, C., Schilling, R., Rudiger, A., Robertson D., te Plate, M., Wand, V., Arai, K., Johann, U., and Danzmann, K.: 2003, Interferometry for the LISA technology package (LTP) aboard SMART-2, Class. Quantum Grav., 20, S153.
Heki, K.: 2003, Snow load and seasonal variation of earthquake occurrence in Japan, Earth Planet. Sci. Lett., 207, 159-164.
Honda, M., Kataza, H., Okamoto, Y. K., Miyata, T., Yamashita, T., Sako, S., Takubo, S., and Onaka, T.: 2003, Detection of Crystalline Silicates around the T Tauri Star Hen 3-600A, Astrophys. J. Lett., 585, L59-L63.
Honda, S., Aoki, W., Ando, H., and Kajino, T.: 2003, New detection of r-process elements in extremely metal-poor stars with SUBARU-HDS, Nucl. Phys. A, 718, 674-676.
Honma, M., and Kurayama, T.: 2002, Astrometric Microlensing of Distant Sources Caused by Stars in the Galaxy, Astrophys. J., 568, 717-725.
Hosokawa, M., Jauncey, D., Reynolds, J., Tzioumis, A., Ohnishi, K., and Fukushima, T.: 2002, Possible Fluctuation of the Position of Sagittarius A* Relative to Extragalactic Radio Sources, Astrophys. J., 580, 43.
Huang, G.-L., and Nakajima, H.: 2002, Diagnosis of coronal magnetic field with data of Nobeyama Radio Heliograph, New Astronomy, 7, 135-145.
Ibukiyama, A., and Arimoto, N.: 2002, HIPPARCOS age-metallicity relation of the solar neighbourhood disc stars, Astron. Astrophys., 394, 927-941.
Ichiki, K., Yahiro, M., Kajino, T., Orito, M., and Mathews, G. J.: 2002, Observational constraints on dark radiation in brane cosmology, Phys. Rev. D, 66, 043521.
Ichiki, K., Yahiro, M., Kajino, T., Orito, M., and Mathews, G. J.: 2003, Constraints on Dark Radiation in Brane Cosmology, Nucl. Phys. A, 718, 386-388.
Ichiki, K., Yahiro, M., Kajino, T., Orito, M., and Mathews, G. J.: 2003, Constraints on the nature of cosmological constant from Big-Bang Nucleosynthesis and CMB anisotropies, Nucl. Phys. A, 718, 383-385.
Iguchi, S., and Kawaguchi, N.: 2002, Higher-Order Sampling, Over Sampling and Digital Filtering Techniques for Radio Interferometry, IEICE Trans. Communications, E85-B, 1806-1816.
Ikeda, M., Kawaguchi, K., Takakuwa, S., Sakamoto, A., Sunada, K., and Fuse, T.: 2002, Multi-Transition Observations of Methanol in Comet Hale-Bopp (1995 O1), Astron. Astrophys., 390, 363-367.
Ikeda, M., Oka, T., Tatematsu, K., Sekimoto, Y., and Yamamoto, S.: 2002, The Distribution of Atomic in the Orion Giant Molecular Cloud 1, Astrophys. J. Supple. Ser., 139, 467-485.
Ikuta, C., and Arimoto, N.: 2002, Extended star formatioin in dwarf spheroidal galaxies: The cases of Draco, Sextans, and Ursa Minor, Astron. Astrophys., 391, 55-65.
Im, M., Yamada, T., Tanaka, I., and Kajisawa, M.: 2002, A Hyper Extremely Red Object in the Field near 53W002, Astrophys. J. Lett., 578, L19-L22.
Imaeda, Y., and Inutsuka, S.: 2002, Shear Flows in Smoothed Particle Hydrodynamics, Astrophys. J., 569, 501-518.
Imai, H., Deguchi, S., Fujii, T., Glass, I. S., Ita, Y., Izumiura, H., Kameya, O., Miyazaki, A., Nakada, Y., and Nakashima, J.: 2002, Detections of SiO Maser from the Large-Amplitude Variable in the Galactic Nuclear Disk, Publ. Astron. Soc. Japan, 54,

L19-L22.
Imai, H., Watanabe, T., Omodaka, T., Nishio, M., Kameya, O., Miyaji, T., and Nakajima, J.: 2002, 3-D Kinematics of Water Masers in the W 51A Region, Publ. Astron. Soc. Japan, 54, 741-755.
Imanishi, M.: 2002, 3-4 Micron Spectroscopy of Seyfert 2 Nuclei to Quantitatively Assess the Energetic Importance of Compact Nuclear Starbursts, Astrophys. J., 569, 44-53.
Inoue, K. T., and Nagashima, M.: 2002, Analytic Approach to the Cloud-in-cloud Problem for Non-Gaussian Density Fluctuations, Astrophys. J., 574, 9-18.
Inoue, K. T., and Sugiyama, N.: 2003, How Large is Our Universe?, Phys. Rev. D, 67, 043003-034010.
Inoue, S., Guetta, D., and Pacini, F.: 2003, Precursor Plerionic Activity and High Energy Gamma-Ray Emission in the Supranova Model of Gamma-Ray Bursts, Astrophys. J., 583, 379-390.
Ishiguro, M., Watanabe, J., Usui, F., Tanigawa, T., Kinoshita, D., Suzuki, J., Nakamura, R., Ueno, M., and Mukai, T.: 2002, First Detection of an Optical Dust Trail along the Orbit of 22P/Kopff, Astrophys. J. Lett., 572, L117-L120.
Ita, Y., Tanabe, T., Matsunaga, N., Nakajima, Y., Nagashima, C., Nagayama, T., Kato, D., Kurita, M., Nagata, T., Sato, S., Tamura, M., Nakaya, H., and Nakada, Y.: 2002, Pulsation at the tip of the first giant branch?, MNRAS, 337, L31-L34.
Ito, T., and Tanikawa, K.: 2002, Long-term integrations and stability of planetary orbits in our solar system, Mon. Not. Roy. Astron. Soc., 336, 483-500.
Itoh, C., Enomoto, R., Yanagita, S., Yoshida, T., Asahara, A., Bicknell, G. V., Clay, R. W., Edwards, P. G., Gunji, S., Hara, S., Hara, T., Hattori, T., Hayashi, Shin., Hayashi, Sei., Kabuki, S., Kajino, F., Katagiri, H., Kawachi, A., Kifune, T., Kubo, H., Kushida, J., Matsubara, Y., Mizumoto, Y., Mori, M., Moro, H., Muraishi, H., Muraki, Y., Naito, T., Nakase, T., Nishida, D., Nishijima, K., Okumura, K., Ohishi, M., Patterson, J. R., Protheroe, R. J., Sakurazawa, K., Swaby, D. L., Tanimori, T., Tokanai, F., Tsuchiya, K., Tsunoo, H., Uchida, T., Watanabe, A., Watanabe, S., Yoshikoshi, T.: 2002, Detection of diffuse TeV gamma-ray emission from the neaby starburst galaxy NGC 253, Astron. Astrophys., 396, L1-L4.
Itoh, C., Enomoto, R., Yanagita, S., Yoshida, T., Tanimori, T., Okumura, K., Asahara, A., Bicknell, G. V., Clay, R. W., Edwards, P. G., Gunji, S., Hara, S., Hara, T., Hattori, T., Hayashi, Shin., Hayashi, Sei., Kabuki, S., Kajino, F., Katagiri, H., Kawachi, A., Kifune, T., Kubo, H., Kushida, J., Matsubara, Y., Mizumoto, Y., Mori, M., Moro, H., Muraishi, H., Muraki, Y., Naito, T., Nakase, T., Nishida, D., Nishijima, K., Ohishi, M., Patterson, J. R., Protheroe, R. J., Sakurazawa, K., Swaby, D. L., Tokanai, F., Tsuchiya, K., Tsunoo, H., Uchida, T., Watanabe, A., Watanabe, S., Yoshikoshi, T.: 2003, Evidence of TeV gamma-ray emission from the nearby starburst galaxy NGC 253, Astron. Astrophys., 402, 443-455.
Itoh, Y., Tamura, M., and Tokunaga, A. T.: 2002, Near-Infrared Spectroscopy of Very Low-Luminosity Young Stellar Objects in the Taurus Molecular Cloud, Publ. Astron. Soc. Japan, 54, 561-574.
Itoh, Y., Tamura, M., Hayashi, S. S., Oasa, Y., Fukagawa, M., Kaifu, N., Suto, H., Murakawa, K., Doi, Y., Ebizuka, N., Naoi, T., Takami, H., Takato, N., Gaessler, W., Kanzawa, T., Hayano, Y., Kamata, Y., Saint-Jacques, D., Iye, M.: 2002, Near-Infrared Coronagraphy of the GG Tauri A Binary System, Publ. Astron. Soc. Japan, 54, 963-967.
Iwamoto, N., Kajino, T., Mathews, G. J., Fujimoto, M., and Aoki, W.: 2002, Discovery of Early Generation S-Process Star and the Nucleosynthesis, J. Ncl. Sci. and Tech. Suppl. II, 554-557.
Ji, J., Kinoshita, H., Lin, L., and Guangyu, L.: 2003, Could the 55 Cnc Planetary System Really in the 3:1 Mean Motion Resonance?, Astrophys. J. Lett., 585, L39-L42.
Jiang, Z., Yao, Y., Yang, J., Ando, M., Kato, D., Kawai, T., Kurita, M., Nagata, T., Nagayama, T., Nakajima, Y., Nagashima, C., Sato, S., Tamura, M., and Nakaya, H.: 2002, Deep Near-Infrared Survey toward the M17 Region, Astrophys. J., 577, 245-259.
Kajino, T., Otsuki, K., and Orito, M.: 2002, Recent Progress in Cosmology and Nuclear Astrophysics, Prog. Theor. Phys. Suppl., 146, 247-257.
Kajino, T., Wanajo, S., Mathews, G. J.: 2002, R-process nucleosynthesis in core-collapse supernova explosion, Nucl. Phys.A, 704, 165-178.
Kajino, T.: 2002, Cosmological Nucleosynthesis in the Big-Bang and Supernovae, J. Nucl. Sci. and Tech. Suppl. II, 530-535.
Kajino, T.: 2003, Quest for supernova r-process: New data in astronomy and nuclear physics, and theoretical modeling, Nucl. Phys.A, 718, 295-302.
Kamazaki, T., Saito, M., Hirano, N., Umemoto, T., and Kawabe, R.: 2003, Molecular Outflow Search in the ρ Ophiuchi A and B2 Regions, Astrophys. J., 584, 357-367.
Kambe, E., Sato, B., Takeda, Y., Ando, H., Noguchi, K., Aoki, W., Izumiura, H., Wada, S., Masuda, S., Okada, N., Shimizu, Y., Watanabe, E., Yoshida, M., Honda, S., and Kawanomoto, S.: 2002, Development of Iodine Cells for Subaru HDS and Okayama HIDES: I. Instrumentations and the Performance of the Spectrographs, Publ. Astron. Sco. Japan, 54, 865-871.
Kashikawa, N., Aoki, K., Asai, R., Ebizuka, N., Inata, M., Iye, M., Kawabata, K. S., Kosugi, G., Ohyama, Y., Okita, K., Ozawa, T., Saito, Y., Sasaki, T., Sekiguchi, K., Shimizu, Y., Taguchi, H., Takata, T., Yadoumaru, Y., and Yoshida, M.: 2002, FOCAS: The Faint Object Camera and Spectrograph for the Subaru Telescope, Publ. Astron. Soc.

Japan, 54, 819-832.
Kashikawa, N., Takata, T., Ohyama, Y., Yoshida, M., Maihara, T., Iwamuro, F., Motohara, K., Totani, M., Nagashima, M., Shimasaku, K., Furusawa, H., Ouchi, M., Yagi, M., Okamura, S., Iye, M., Sasaki, T., Kosugi, G., Aoki, K., and Nakata, F.: 2003, Subaru Deep Survey III. Evolution of Rest-Frame Luminosity Functions Based on the Photometric Reshifts for K'-band selected Galaxy Sample, Astron. J., 125, 53-65.
Katayama, H., Hayashida, K., Takahara, F., and Fujita, Y.: 2003, Properties of the Brightest Cluster Galaxy and Its Host Cluster, Astrophys., J., 585, 687.
Kato, T., Nogami, D., and Masuda, S.: 2002, Extended Deep Minimum and Subsequent Brightening of RX And in 1996-1997, Publ. Astron. Soc. Japan, 54, 575-580.
Kawabata, K. S., Jeffery, D. J., Iye, M., Ohyama, Y., Kosugi, G., Kashikawa, N., Ebizuka, N., Sasaki, T., Sekiguchi, K., Nomoto, K., Mazzali, P., Deng, J., Maeda, K., Umeda, H., Aoki, K., Saito, Y., Takata, T., Yoshida, M., Asai, R., Inata, M., Okita, K., Ota, K., Ozawa, T., Shimizu, Y., Taguchi, H., Yadoumaru, Y., Misawa, T., Nakata, F., Yamada, T., Tanaka, I., and Kodama, T.: 2002, Optical Spectropolarimetry of SN 2002ap: A High-Velocity Asymmetric Explosion, Astophys. J. Lett., 580, L39-L42.
Kawakita, H., and Watanabe, J.: 2002, Revised Fluorescence Efficiencies of Cometary NH2: Ammonia Abundance in Comets, Astrophys. J. Lett., 572, L177-L180.
Kawakita, H., and Watanabe, J.: 2002, Unidentified Bands in Comet Ikeya-Zhang (C/2002 C1): The Correlation between Unidentified Bands and H_2O^+, Astrophys. J. Lett., 574, L183-L185.
Kawakita, H., and Watanabe, J.: 2003, Fluorescence Efficiencies of Monodeuterio-Methane in Comets: Toward the Determination of the Deuterium/Hydrogen Ratio in Methane, Astrophys. J., 582, 534-539.
Kawakita, H., Watanabe, J., Fuse, T., Furusho, R., and Abe, S.: 2002, Spin Temperature of Ammonia Determined from NH2 in Comet C/2001 A2 (LINEAR), Earth, Moon, and Planets, 90, 371-379.
Kawanomoto, S., Suzuki, T.-K., Ando, H., and Kajino, T.: 2003, First detection of $^{7}Li/^{6}Li$-ratio in the interstellar medium beyond the Solar-system, and its impact on primordial ^{7}Li, Nucl. Phys. A, 718, 659-661.
Kawasaki, W., and Totani, T.: 2002, Positional Coincidence between the High-Latitude Steady Unidentified Gamma-Ray Sources and Possibly Merging Clusters of Galaxies, Astrophys. J., 576, 679-687.
Kepler, S. O., Nather, E. R., Winget, D. E., Nitta, A., Kleinman, S. J., Metcalfe, T., Sekiguchi, K., Xiaojun, J., Sullivan, D., Sullivan, T., Janulis, R., Meistas, E. G., Kalytis, R., Krzesinski, J., Ogoza, W., Zola, S., O'Donoghue, D., Romero-Colmenero, E., Martinez, P., Dreizler, S., Deetjen, J., Nagel, T., Schuh, S. L., Vauclair, G., Fu, J. N., Chevreton, M., Solheim, J.-E., Gonzalez Perez, J. M., Johannessen, F., Kanaan, A., Costa, J. E., Murillo Costa, A. F., Wood, M. A., Silvestri, N., Ahrens, T. J., Jones, A. Kyle, Collins, A. E., Boyer, M., Shaw, J. S., Mukadam, A. S., Klumpe, E. W., Larrison, J., Kawaler, S. D., Riddle, R. L., Ulla, A., Bradley, P.: 2003, WET Observations of GD 358 in 2000, Baltic Astronomy, 12, 45-53.
Kitamura, Y., Momose, M., Yokogawa, S., Kawabe, R., Tamura, M., and Ida, S.: 2002, Investigation of the Physical Properties of Protoplanetary Disks Around T Tauri Stars by a 1 Arcsecond Imaging Survey: Evolution and Diversity of the Disks in Their Accretion Stage, Astrophys. J., 581, 357-380.
Koda, J., and Wada, K.: 2002, Intrinsic Errors of the Central Galactic Mass Derived from Rotation Curves under the Influence of a Weak Non-axisymmetric Potential, Astron. Astrophys., 396, 867-876.
Koda, J., Sofue, Y., Kohno, K., Nakanishi, K., Onodera, S., Okumura, S. K., and Irwin, J. A.: 2002, Nobeyama Millimeter Array CO (J=1-0) Observations of the Hα/Radio Lobe Galaxy NGC 3079: Gas Dynamics in a Weak Bar Potential and Central Massive Core, Astrophys. J., 573, 105-121.
Kohno, K., Ishizuki, S., Matsushita, S., Vila-Vilaro, B., and Kawabe, R.: 2003, Enhanced HCN (1-0) Emission in the Type-1 Seyfert Galaxy NGC 1097, Publ. Astron. Soc. Japan, 55, L1-L5.
Kohno, K., Tosaki, T., Matsushita, S., Vila-Vilaro, B., Shibatsuka, T., and Kawabe, R.: 2002, Diffuse and Gravitationally Stable Molecular Gas in the Post-Starburst Galaxy NGC 5195, Publ. Astron. Soc. Japan, 54, 541-553. (NROR.561)
Kohno, K., Vila-Vilaro, B., Sakamoto, S., Kawabe, R., Ishizuki, S., and Matsushita, S.: 2003, Aperture Synthesis CO (J=1-0) Observations and Near-Infrared Photometry of the Non-Barred Seyfert Galaxy NGC 5033, Publ. Astron. Soc. Japan, 55, 103-119.
Kokubo, E., and Ida, S.: 2002, Formation of Protoplanet Systems and Diversity of Planetary Systems, Astrophys. J., 581, 666-680.
Kuno, N., Nakai, N., Sorai, K., Nishiyama, K., and Vila-Vilaro, B.: 2002, Dense Molecular Gas in Lenticular Galaxies, Publ. Astron. Soc. Japan, 54, 555-560.
Kuroda, K., Ohashi, M., Miyoki, S., Ishizuka, H., Taylor, C. T., Yamamoto, K., Miyakawa, O., Fujimoto, M.-K., Kawamura, S., Takahashi, R., Yamazaki, T., Arai, K., Tatsumi, D., Ueda, A., Fukushima, M., Sato, S., Shintomi, T., Yamamoto, A., Suzuki, T., Saito, Y., Haruyama, T., Sato, N., Higashi, Y., Uchiyama, T., Tomaru, T., Tsubono, K., Ando, M., Takamori, A., Numata, K., Ueda, K.-I., Yoneda, H., Nakagawa, K., Musha, M., Mio, N., Moriwaki, S., Somiya, K., Araya, A., Kanda, N., Telada, S., Sasaki, M., Tagoshi, H., Nakamura, T.,

Tanaka, T., and Ohara, K.: 2002, Japanese Large-Scale Interferometers, Classical and Quantum Gravity, 19, 1237-1245.
Kurtz, D. W., Kawaler, S. D., Riddle, R. L., Reed, M. D., Cunha, M. S., Wood, M., Silvestri, N., Watson, T. K., Dolez, N., Moskalik, P., Zola, S., Pallier, E., Guzik, J. A., Metcalfe, T. S., Mukadam, A., Nather, R. E., Winget, D. E., Sullivan, D. J., Sullivan, T., Sekiguchi, K., Jiang, X. J., Shobbrook, R. R., Birch, P. V., Ashoka, B. N., Seetha, S., Joshi, S., Girish, V., O'Donoghue, D., Handler, G., Mueller, M., Gonzalez Perez, J. M., Solheim, J.-E., Johannessen, F., Ulla, A., Kepler, S. O., Kanaan, A., da Costa, A., Fraga, L., Giovannini, O., Matthews, J. M., Cameron, C., Vauclair, G., Nitta, A., Kleinman, S. J.: 2003, High Precision with the Whole Earth Telescope: Lessons and Some Results from XCov20 for the roAp Star HR 1217, Baltic Astronomy, 12, 105-117.
Kusano, K., Maeshiro, T., Yokoyama, T., and Sakurai, T.: 2002, Measurement of Magnetic Helicity Injection and Free Energy Loading into the Solar Corona, Astrophys. J., 577, 501-512.
Lee, J.-E., Evans, N. J. II, Shirley, Y. L., and Tatematsu, K.: 2003, Chemistry and Dynamics in Pre-protostellar Cores, Astrophys. J., 583, 789-808. (NROR.570)
Lites, B. W., Socas-Navarro, H., Skumanich, A., and Shimizu, T.: 2002, Converging Flows in the Penumbra of a delta-Sunspot, Astrophy. J., 575, 1131-1143.
Masaki, Y., and Kinoshita, H.: 2003, Candidate Asteroids Trapped in the Mean Motion Resonance with Uranus, Astron. Astrophys., 403, 769-774.
Mazzali, P. A., Deng, J., Maeda, K., Nomoto, K., Umeda, H., Hatano, K., Iwamoto, K., Yoshii, Y., Kobayashi, Y., Minezaki, T., Doi, M., Enya, K., Tomita, H., Smartt, S. J., Kinugasa, K., Kawakita, H., Ayani, K., Kawabata, K., Yamaoka, H., Qiu, Y. L., Motohara, K., Gerardy, C. L., Fesem, R., Kawabata, K. S., Iye, M., Kashikawa, N., Kosugi, G., Ohyama, Y., Takada-Hidai, M., Zhao, G., Chornock, R., Filippenko, A. V., Benetti, S., and Turatto, M.: 2002, The Type Ic Hypernova SN2002ap, Astgrophys. J., 572, L61-L65.
Melnikov, V. F., Shibasaki, K., and Reznikova, V. E.: 2002, Loop-Top Nonthermal Microwave Source in Extended Solar Flaring Loops, Astrophys. J. Lett., 580, L185-L188.
Misawa, T., Tytler, D., Iye, M., Storrie-Lombardi, L., Suzuki, N., and Wolfe, A. M.: 2002, CIV and other Metal Absorption Line Systems in Redshift 4 QSOs, Astron. J., 123, 1847-1863.
Misawa, T., Yamada, T., Takada-Hidai, M., Wang, Y., Kashikawa, N., Iye, M., and Tanaka, I.: 2003, Subaru high resolution spectroscopy of complex metal absorption lines of QSO HS1603+3820, Astron. J., 125, 1336-1344.
Miyazaki, S., Komiyama, Y., Sekiguchi, M., Okamura, S., Doi, M., Furusawa, H., Hamabe, M., Imi, K., Kimura, M., Nakata, F., Okada, N., Ouchi, M., Shimasaku, K., Yagi, M., Yasuda, N.: 2002, Subaru Prime Focus Camera — Suprime-Cam, Publ. Astron. Soc. Japan, 54, 833-853
Miyazaki, S., Hamana, T., Shimasaku, K., Furusawa, H., Doi, M., Hamabe, M., Imai, K., Kimura, M., Komiyama, Y., Nakata, F., Okada, N., Okamura, S., Ouchi, M., Sekiguchi, M., Yagi, M., Yasuda, N.: 2002, Searching for Dark Matter Halos in the Suprime-Cam 2 Square Degree Field, Astrophys. J. Lett., 580, L97-L100.
Mizutani, A., Chiba, M., Sakamoto, T.: 2003, Kinematics of tidal debris from omega Centauri's progenitor galaxy, Astrophys. J. Lett., 589, L89-92.
Mobasher, B., Colless, M., Carter, D., Poggianti, B. M., Bridges, T. J., Kranz, K., Komiyama, Y., Kashikawa, N., Yagi, M., and Okamura, S.: 2003, A Photometric and Spectroscopic Study of Dwarf and Giant Galaxies in the Coma Cluster. IV. The Luminosity Function, Astrophys. J., 587, 605.
Motohara, K., Iwamuro, F., Maihara, T., Oya, S., Tsukamoto, H., Imanishi, M., Terada, H., Goto, M., Iwai, J., Tanabe, H., Hata, R., Taguchi, T., and Harashima, T.: 2002, CISCO: Cooled Infrared Spectrograph and Camera for OHS on the Subaru Telescope, Publ. Astron. Soc. Japan, 54, 315-325.
Mukadam, A. S., Kepler, S. O., Winget, D. E., Nather, R. E., Kilic, M., Mullally, F., von Hippel, T., Kleinman, S. J., Nitta, A., Guzik, J. A., Bradley, P. A., Matthews, J., Sekiguchi, K., Sullivan, D. J., Sullivan, T., Shobbrook, R. R., Birch, P., Jiang, X. J., Xu, D. W., Joshi, S., Ashoka, B. N., Ibbetson, P., Leibowitz, E., Ofek, E. O., Meistas, E. G., Janulis, R., Alisauskas, D., Kalytis, R., Handler, G., Kilkenny, D., O'Donoghue, D., Kurtz, D. W., Muller, M., Moskalik, P., Ogoza, W., Zoa, S., Krzesinski, J., Johannessen, F., Gonzalez-Perez, J. M., Solheim, J.-E., Silvotti, R., Bernabei, S., Vauclair, G., Dolez, N., Fu, J. N., Chevreton, M., Manteiga, M., Suarez, O., Ulla, A., Cunha, M. S., Metcalfe, T. S., Kanaan, A., Fraga, L., Costa, A. F. M., Giovannini, O., Fontaine, G., Bergeron, P., O'Brien, M. S., Sanwal, D., Wood, M. A., Ahrens, T. J., Silvestri, N., Klumpe, E. W., Kawaler, S. D., Riddle, R., Reed, M. D., Watson, T. K.: 2003, Constraining the Evolution of ZZ Ceti, Baltic Astronomy, 12, 71-103.
Murakawa, K., Tamura, M., Suto, H., Itoh, Y., Hayashi, S. S., Oasa, Y., Nakajima, Y., Kaifu, N., Yates, J. A., Gledhill, T. M., Richards, A. M., Hough, J. H., Kosugi, G., Usuda, T.: 2002, Near Infrared coronagraph images of IRC +10216. Faint structures at 1-5 arcsec from the central star, Astron. Astrophys., 395, L9-L12.
Nagano, S., Barton, M. A., Ishizuka, H., Kuroda, K., Matsumura, S., Miyakawa, O., Miyoki, S., Tatsumi, D., Tomaru, T., Uchiyama, T., Ando, M., Arai, K., Kawabe, K., Ohishi, N., Takamori, A., Taniguchi, S., Tochikubo, K., Tsubono, K., Yamamoto, K., Fujimoto, M.-K., Fukushima, M., Kawamura, S., Kozai, Y., Miyama, S., Ohashi, M., Sato, S., Taka-

hashi, R., Telada, S., Yamazaki, T., Mio, N., Moriwaki, S., Horikoshi, G., Kamikubota, N., Ogawa, Y., Saito, Y., Suzuki, T., Musha, M., Nakagawa, K., Ueda, A., Ueda, K., Araya, A., Kanda, N., Nakamura, T. Tanaka, T., Sasaki, M., Tagoshi, H., Futamase, T., Kawashima, N., Mizuno, E., Kojima, Y., Matsuda, N., Oohara, K., Tsuda, N.: 2002, Development of a Light Source with an Injection-Locked Nd:YAG Laser and a Ring-Mode Cleaner for the TAMA 300 Gravitational-Wave Detector, Rev. Sci. Instrum., 73, 2136-2142.
Nagashima, M., Totani, T., Yoshii, Y., and Gouda, N.: 2002, Galaxy Number Counts in the Subaru Deep Field: Multiband Analysis in a Hierarchical Galaxy Formation Model, Astrophys. J., 578, 675-688.
Nagashima, M., Yoshii, Y., Totani, T., and Gouda, N.: 2002, Galaxy Number Counts in the Subaru Deep Field: Multiband Analysis in a Hierarchical Galaxy Formation Model, Astrophys. J., 539, 493-496.
Nagata, R., Chiba, T., Sugiyama, N.: 2002, Observational Consequences of Evolution of Primordial Fluctuations in Scalar-Tensor Cosmology, Phys. Rev. D, 66, 103510.
Nagataki, S., and Kohri, K.: 2002, Features of Neutrino Signals from Collapsars, Prog. Theor. Phys., 108, 789-800.
Nagataki, S., Kohri, K., Ando, S., and Sato, K.: 2003, Gamma-ray burst neutrino background and star formation history in the universe, Astropart. Phys., 18, 551-564.
Nakai, N., Sato, N., and Yamauchi, A.: 2002, Detection of Water Maser Flare in the Seyfert/LINER, NGC 6240, Publ. Astron. Soc. Japan, 54, L27-L30.
Nakajima, H., and Yokoyama, T.: 2002, A Nonthermal Collimated Ejection Observed with the Nobeyama Radioheliograph, Astrophys. J. Lett., 570, L41-L45.
Nakajima, Y., Nagata, T., Sato, S., Nagayama, T., Nagashima, C., Kato, D., Kurita, M., Kawai, T., Tamura, M., Nakaya, H., Sugitani, K.: 2002, Deep Imaging Observations of the Lupus 3 Cloud: Dark Cloud Revealed as Infrared Reflection Nebula, Astron. J., 125, 1407-1417.
Nakamura, K., Nakao, K., and Mishima, T.: 2002, Hoop Conjecture and black hole on the brane, Prog. of Theor. Phys. Suppl., 148, 291-297.
Nakamura, K.: 2002, Does a Nambu-Goto wall emit gravitational waves? -Cylindricall Nambu-Goto wall as an example of gravitating non-spherical walls-, Phys. Rev. D, 66, 084005.
Nakamura, T., Yoshida, F.: 2002, Statistical method for deriving spatial and size distributions of sub-km main-belt asteroids, Publ. Astron. Soc. Japan, 54, 1079-1089.
Nakamura, T.: 2002, Acceptance and adaptation of octants and sextants in Japan in the 18th and 19th centuries, Journal. Astron. History and Heritage, 5, 8-21.
Nakano, M., Sugitani, K., and Morita, K.-I.: 2003, Dense Shell around a Young Intermediate-Mass Star: NGC 2264 IRS, Publ. Astron. Soc. Japan, 55, 1-9.
Nakashima, J., and Deguchi, S.: 2003, SiO Maser Survey toward the Inner Galactic Disk: $40° < l < 70°$ and $|b| < 10°$, Publ. Astron. Soc. Japan, 55, 203-227.
Nakashima, J., and Deguchi, S.: 2003, SiO Maser Survey of Cold IRAS Sources, Publ. Astron. Soc. Japan, 55, 229-246.
Nawa, K., Suda, N., Aoki, S., Shibuya, K., Sato, T., Fukao, Y.: 2003, Sea level variation in seismic normal mode band observed with on-ice GPS and on-land SG at Syowa Station, Antarctica, Geophys. Res. Lett., 30, 10.1029/2003GL016919.
Neta, B., and Fukushima, T.: 2003, Obrechkoff versus Super-Implicit Methods for the Solution of First and Second Order Initial Value Problems, Comp. and Math. with Appl., 45, 383.
Nishiura, S., Ohnishi, K., Dobashi, K., Watanabe, J., Miyata, T., and Nakada, Y.: 2002, Optical Imaging of the Radiant Points of Leonids during the 2001 Storm with the 105cm Kiso Schmidt Telescope, Publ. Astron. Soc. Japan, 54, L83-L88.
Nitta, S., Tanuma, S., Maezawa, K.: 2002, A self-similar solution of fast magnetic reconnection: A semianalytic study of the inflow region, Astrophys. J., 580, 538-549.
Noguchi, K., Aoki, W., Kawanomoto, S., Ando, H., Honda, S., Izumiura, H., Kambe, E., Okita, K., Sadakane, K., Sato, B., Tajitsu, A., Takada-Hidai, M., Tanaka, W., Watanabe, E., and Yoshida, M.: 2002, High Dispersion Spectrograph (HDS) for the Subaru Telescope, Publ. Astron. Soc. Japan, 54, 855-864.
Norris, J. E., Ryan, S. G., Beers, T. C., Aoki, W., and Ando, H.: 2002, Extremely Metal-poor Stars. IX. CS 22949-037 and the Role of Hypernovae, Astrophys. J. Lett., 569, L107-111.
Nusser, A., Benson, A. J., Sugiyama, N., Lacey, C.: 2002, Statistics of Neutral Regions during Hydrogen Reionization, Astrophys. J. Lett., 580, L93-L96.
Ohki, K.: 2003, Cause of Proton Depletion in Solar Impulsive Particle Events, Astrophys. J., 586, 617-623.
Ohki, K.: 2003, Origin of Large Solar Proton Events, Solar Phys., 213, 111-120.
Ohno, H., Takada, M., Dolag, K., Bartelmann, M., Sugiyama, N.: 2003, Probing Intracluster Magnetic Fields with Cosmic Microwave Background Polarization, Astrophys. J., 584, 599-607.
Ohyama, Y., Hamana, T., Kashikawa, N., Chiba, M., Futamase, T., Iye, M., Kawabata, K. S., Aoki, K., Sasaki, T., Kosugi, G., Takata, T.: 2002, Subaru Spectroscopy of the Gravitational Lens HST 14176+5226: Implications for a Large Cosmological Constant, Astron. J., 123, 2903-2912.
Ohyama, Y., Taniguchi, Y., Iye, M., Yoshida, M.,

Sekiguchi, K., Takata, T., Saito, Y., Kawabata, K. S., Kashikawa, N., Aoki, K., Sasaki, T., Kosugi, G., Okita, K., Shimizu, Y., Inata, M., Ebizuka, N., Ozawa, T., Yadomaru, Y., and Taguchi, H.: 2002, Decomposition of the Superwind in M82, Publ. Astron. Soc. Japan, 54, 891-898.

Okamoto, Y. K., Kataza, H., Yamashita, T., Miyata, T., Sako, S., Takubo, S., Honda, M., Onaka, T.: 2003, K3-50A: An Ultracompact H II Region Ionized by a Massive Stellar Cluster, Astrophys. J., 584, 368-384.

Okamura, S., Yasuda, N., Arnaboldi, M., Freeman, K. C., Ando, H., Doi, M., Furusawa, H., Gerhard, O., Hamabe, M., Kimura, M., Kajino, T., Komiyama, Y., Miyazaki, S., Nakata, F., Napolitano, N. R., Ouchi, M., Pannella, M., Sekiguchi, M., Shimasaku, K., Yagi, M.: 2002, Candidates for Intracluster Planetary Nebulae in the Virgo Cluster Based on the Suprime-Cam Narrow-Band Imaging in [O III] and H α, Publ. Astron. Soc. Japan, 54, 883-889.

Okumura, K., Asahara, A., Bicknell, G. V., Edwards, P. G., Enomoto, R., Gunji, S., Hara, S., Hara, T., Hayashi, S., Itoh, C., Kabuki, S., Kajino, F., Katagiri, H., Kataoka, J., Kawachi, A., Kifune, T., Kubo, H., Kushida, J., Maeda, S., Maeshiro, A., Matsubara, Y., Mizumoto, Y., Mori, M., Moriya, M., Muraishi, H., Muraki, Y., Naito, T., Nakase, T., Nishijima, K., Ohishi, M., Patterson, J. R., Sakurazawa, K., Suzuki, R., Swaby, D. L., Takano, K., Takano, T., Tanimori, T., Tokanai, F., Tsuchiya, K., Tsunoo, H., Uruma, K., Watanabe, A., Yanagita, S., Yoshida, T., Yoshikoshi, T.: 2002, Observation of Gamma Rays Greater than 10 TeV from Markarian 421, Astrophys. J. Lett., 579, L9-L12.

Okumura, S. K., Iguchi, S., Chikada, Y., Momose, M., and Okiura, M.: 2002, First Astronomical Fringe of a Test Correlator for the ALMA: Simultaneous Achievement of Wideband and High Resolution, Publ. Astron. Soc. Japan, 54, L59-L62.

Omukai, K., Inutsuka, S.: 2002, An upper limit on the mass of a primordial star due to the formation of an HII region: the effect of ionizing radiation force, Mon. Not. Roy. Astron. Soc., 332, 59-64.

Omukai, K.: 2003, First Star Formation -Protostellar Evolution from Prestellar Cores to Main-Sequence Stars-, Prog. Theor. Phys. Suppl., 147, 129-154.

Onishi, T., Mizuno, A., Kawamura, A., Tachihara, K., and Fukui, Y.: 2002, A Complete Search for Dense Cloud Cores in Taurus, Astrophys. J., 575, 950-973.

Orito, M., Kajino, T., Mathews, G. J., and Wang, Y.: 2002, Constraints on Neutrino Degeneracy from the Cosmic Microwave Background and Primordial Nucleosynthesis, Phys. Rev. D, 65, 123504.

Otsuki, K., Mathews, G. J., and Kajino, T.: 2003, Nuclear cosmochronometer and universality in the r-process abundance distribution, Nucl. Phys. A, 718, 677-679.

Ouchi, M., Shimasaku, K., Furusawa, H., Miyazaki, M., Doi, M., Hamabe, M., Hayashino, T., Kimura, M., Kodaira, K., Komiyama, Y., Matsuda, Y., Miyazaki, S., Nakata, F., Okamura, S., Sekiguchi, M., Shioya, Y., Tamura, H., Taniguchi, Y., Yagi, M., Yasuda, N.: 2003, Subaru Deep Survey. II. Luminosity Functions and Clustering Properties of Ly α Emitters at z=4.86 in the Subaru Deep Field, Astrophys. J., 582, 60-68.

Ping, J., Kono, Y., Matsumoto, K., Otsuka, Y., Saito, A., Shum, C., Heki, K., and Kawano, N.: 2002, Regional ionosphere map over Japanese Islands, Earth, Planets and Space, 54, e13-e16.

Pointecouteau, E., Hattori, M., Neumann, D., Komatsu, E., Matsuo, H., Kuno, N., and Bohringer, H.: 2002, SZ and X-ray Combined Analysis of a Distant Galaxy Cluster, RX J2228+2037, Astron. Astrophys., 387, 56-62.

Pyo, T., Hayashi, M., Kobayashi, N, Terada, H., Goto, M., Yamashita, T., Tokunaga, A., and Itoh, Y.: 2002, Velocity-resolved [Fe II] Line Spectroscopy of L1551 IRS 5: A Partially Ionized Wind under Collimation around an Ionized Fast Jet, Astrophys. J., 507, 724-733.

Ramsay, G., Wu, K., Cropper, M., Schmidt, G., Sekiguchi, K., Iwamuro, F., Maihara, T.: 2002, Optical/infrared spectroscopy and photometry of the short-period binary RX J 1914+24, Mon. Not. Roy. Astron. Soc., 333, 575-582.

Ryan, S. G., Gregory, S. G., Kolb, U., Beers, T. C., and Kajino, T.: 2002, Rapid rotation of ultra-Li-depleted halo stars and their association with blue stragglers, Astrophys. J., 571, 501-511.

Sadakane, K., Ohkubo, M., Takeda, Y., Sato, B., Kambe, E., and Aoki, W.: 2002, Abundance Analyses of 12 Parent Stars of Extrasolar Planets Observed with the SUBARU/HDS, Publ. Astron. Soc. Japan, 54, 911-931.

Saito, M., and Iye, M.: 2002, Chemo-dynamical Evolution of Globular Cluster Systems: 2002, Astrophys. J., 573, 122-130.

Saito, S., Aikawa, Y., Herbst, E., Ohishi, M., Hirota, T., Yamamoto, S., and Kaifu, N.: 2002, Chemical Timescale of Dark Cloud Cores Estimated from Deuterium Fractionation, Astrophys. J., 569, 836-840.

Sakamoto, T., Chiba, M., Beers, T. C.: 2003, The mass of the Milky Way: Limits from a newly assembled set of halo objects, Astron. Astrophys., 397, 899-911.

Sakurai, T., Ichimoto, K., Raju, K. P., and Singh, J.: 2002, Spectroscopic Observations of Coronal Waves, Solar Phys., 209, 265-286.

Sato, B., Kambe, E., Takeda, Y., Izumiura, H., and Ando, H.: 2002, Development of Iodine Cells for the Subaru HDS and the Okayama HIDES: II. New Software for Precise Radial Velocity Measurements, Publ. Astron. Soc. Japan, 54, 873-882.

Sato, J., Umetsu, K., Futamase, T., and Yamada, T.: 2003, The Topology of a Weak Lensing Field in the Neighborhood of MS 1054-03, Astrophys. J. Lett., 582, L67-L70.

Sato, T., Tamura, Y., Matsumoto, K., Imanishi, Y., and McQueen, H.: 2002, Parameters of the fluid core resonance estimated from superconducting gravimeter

data, BIM, 116, 10751-10760.
Sawada-Satoh, S., Kameno, S., Wajima, K., Imai, M., and Inoue, M.: 2002, Free-Free Absorber Surrounding GHz-Peaked Spectrum Sources, New Astronomy Reviews, 46, 283-285.
Schneider, R., Ferrara, A., Natarajan, P., Omukai, K.: 2002, First Stars, Very Massive Black Holes, and Metals, Astrophys. J., 571, 30-39.
Schuh, S. L., Heber, U., Dreizler, S., O'Toole, S., Jeffery, C. S., Falter, S., Woolf, V. M., Riddle, R. L., Handler, G., Hurkal, O., Pakstiene, E., Klumpe, E. W., Laurance, T., Vuckovic, M., Zoa, S., Kawaler, S. D., Kanaan, A., Monteiro, H., Giovannini, O., Kepler, S. O., Mukadam, A., Provencal, J. L., Nitta, A., Shipman, H., Mullally, F., Grauer, A., Wood, M. A., Bradley, P. A., Kilic, M., Sekiguchi, K., Crowe, R., Sullivan, D. J., Rosen, R., Clemens, C., Xiaojun, J., Janulis, R., O'Donoghue, D., Ogloza, W., Baran, A., Silvotti, R., Marinoni, S., Vauclair, G., Dolez, N., Chevreton, M., Deetjen, J. L., Nagel, T., Gonzalez Perez, J. M., Solheim, J.-E., Ostensen, R., Ulla, A., Burleigh, M., Good, S., Metcalfe, T. S., da Costa, A. F. M., Costa, J. E. S., O'Brien, M. S., Kim, S.-L., Lee, H., Sergeev, A., Akan, C., Cakirli, O., Paparo, M., Viraghalmy, G.: 2003, PG 1605+072 in WET XCov22: Support for the Multi Site Spectroscopic Telescope, Baltic Astronomy, 12, 55-70.
Sekiguchi, T., Abe, M., Boehnhard, H., Dermawan, B., Hainaut, O. R., and Hasegawa, H.: 2003, Thermal Observations of MUSES-C Mission Target (25143) 1998 SF36, Astron. Astrophys., 397, 325-328.
Shibata, K., and Yokoyama, T.: 2002, A Hertzsprung-Russell-Like Diagram for Solar/Stellar Flares and Corona: Emission Measure Versus Temperature Diagram, Astrophys. J., 577, 422-432.
Shibatsuka, T., Matsushita, S., Kohno, K., and Kawabe, R.: 2003, Multi-Line Observations of Molecular Gas in the Central Region of the Low Star-Formation Efficiency "Starburst" Galaxy NGC 4527, Publ. Astron. Soc. Japan, 55, 87-101.
Shigeyama, T., Tsujimoto, T., and Yoshii, Y.: 2003, Excavation of the First Stars, Astrophys. J. Lett., 586, L57-L60.
Shimasaku, K., Ouchi, M., Okamura, S., Kashikawa, N., Doi, M., Furusawa, H., Hamabe, M., Hayashino, T., Kawabata, K., Kimura, M., Kodaira, K., Komiyama, Y., Matsuda, Y., Miyazaki, M., Miyazaki, S., Nakata, F., Ohta, K., Ohyama, Y., Sekiguchi, M., Shioya, Y., Tamura, H., Taniguchi, Y., Yagi, M., Yamada, T., Yasuda, N.: 2003, Subaru Deep Survey. IV. Discovery of a Large-Scale Structure at Redshift ≃5, Astrophys. J. Lett., 586, L111-L114.
Shimizu, T., Shine, R. A., Title, A. M., Tarbell, T. D., and Frank, Z.: 2002, Photospheric Magnetic Activities Responsible for Soft X-Ray Pointlike Microflares (1) - Identifications of Associated Photospheric/Chromospheric Activities -, Astrophys. J., 574, 1074-1088.
Shioya, Y., Taniguchi, Y., Murayama, T., Ajiki, M., Nagao, T., Fujita, S. S., Kakazu, Y., Komiyama, Y., Okamura, S., Oyabu, S., Kawara, K., Ohyama, Y., Kawabata, K. S., Ando, H., Nishimura, T., Hayashi, M., Ogasawara, R., Ichikawa, S.: 2002, SDSSp J104433.04-012502.2 at z=5.74 is Gravitationally Magnified by an Intervening Galaxy, Publ. Astron. Soc. Japan, 54, 975-979.
Simpson, C., and Rawlings, S.: 2002, The radio galaxy 3C 356 and clues to the trigger mechanisms for powerful radio galaxies, Mon. Not. Roy. Astron. Soc., 334, 511-522.
Singh, J., Ichimoto, K., Sakurai, T., and Muneer, S.: 2003, Spectroscopic Studies of the Solar Corona IV. Physical Properties of Coronal Structure, Astrophys. J., 585, 516-523.
Singh, J., Sakurai, T., Ichimoto, K., and Muneer, S.: 2003, Spectroscopic Studies of the Solar Corona V. Physical Properties of Coronal Structures, Solar Phys., 212, 343-359.
Singh, J., Sakurai, T., Ichimoto, K., and Takeda, A.: 2002, Spectroscopic Studies of the Solar Corona III. Spatial and Temporal Variations of Intensity Ratio of Infrared Lines of Fe XIII, Publ. Astron. Soc. Japan, 54, 807-816.
Singh, J., Sakurai, T., Ichimoto, K., Suematsu, Y., and Takeda, A.: 2002, Spectroscopic Studies of the Solar Corona II. Properties of Green and Red Emission Lines in Open and Closed Coronal Structures, Publ. Astron. Soc. Japan, 54, 793-806.
Smith, J. A., Tucker, D. L., Kent, S., Richmond, M. W., Fukugita, M., Ichikawa, T., Ichikawa, S., Jorgensen, A. M., Uomoto, A., Gunn, J. E., Hamabe, M., Watanabe, M., Tolea, A., Henden, A., Annis, J., Pier, J. R., McKay, T. A., Brinkmann, J., Chen, B., Holtzman, J., Shimasaku, K., York, D. G.: 2002, The u'g'r'i'z' Standard-Star System, Astron. J., 123, 2121-2144.
Sofue, Y., Koda, J., Nakanishi, H., and Hidaka, M.: 2003, The Virgo High-Resolution CO Survey: III. NGC 4254, Publ. Astron. Soc. Japan, 55, 75-86.
Sofue, Y., Koda, J., Nakanishi, H., and Onodera, S.: 2003, The Virgo High-Resolution CO Survey: II. Rotation Curves and Dynamical Mass Distributions, Publ. Astron. Soc. Japan, 55, 59-74.
Sofue, Y., Koda, J., Nakanishi, H., Onodera, S., Kohno, K., Tomita, A., and Okumura, S. K.: 2003, The Virgo High-Resolution CO Survey: I. CO Atlas, Publ. Astron. Soc. Japan, 55, 17-58.
Sôma, M.: 2002, Unobservable mutual events of the Galilean satellites, Astron. Astrophys., 395, L39-L40.
Sorai, K., Nakai, N., Kuno, N., and Nishiyama, K.: 2002, Radial Distributions of the HCN/CO Ratio in Nearby CO Bright Glaxies, Publ. Astron. Soc. Japan, 54, 179-194.
Strauss, M. A., Weinberg, D. H., Lupton, R. H., Narayanan, V. K., Annis, J., Bernardi, M., Blanton, M., Burles, S., Connolly, A. J., Dalcanton, J., Doi, M., Eisenstein, D., Frieman, J. A., Fukugita, M., Gunn, J. E., Ivezic, Z., Kent, S., Kim, R. S. J., Knapp, G. R., Kron, R. G., Munn, J. A., Newberg, H. J., Nichol, R.

C., Okamura, S., Quinn, T. R., Richmond, M. W., Schlegel, D. J., Shimasaku, K., SubbaRao, M., Szalay, A. S., Vanden, B., D., Vogeley, M. S., Yanny, B., Yasuda, N., York, D. G., Zehavi, I.: 2002, Spectroscopic Target Selection in the Sloan Digital Sky Survey: The Main Galaxy Sample, Astron. J., 124, 1810-1824.

Sumiyoshi, K., Utsunomiya, H., Goko, S., and Kajino, T.: 2002, Astrophysical reaction rate for $\alpha(\alpha n, \gamma)^9$Be by photodisintegration, Nucl. Phys. A, 709, 467-486.

Suzuki, T. K., Inoue, S.: 2002, Cosmic Ray Production of ^{6}Li by Structure Formation Shocks in the Early Milky Way: A Fossil Record of Dissipative Processes during Galaxy Formation, Astrophys. J., 573, 168-173.

Suzuki, T. K.: 2002, On the Heating of the Solar Corona and the Acceleration of the Low-Speed Solar Wind by Acoustic Waves Generated in Corona, Astrophys. J., 578, 598-609.

Takada, M., Sugiyama, N.: 2002, On the Cross-Correlation between Dark Matter Distribution and Secondary Cosmic Microwave Background Anisotropies of the Ionized Intergalactic Medium, Astrophys. J., 569, 8-17.

Takada-Hidai, M., Aoki, W., and Zhao, G.: 2002, Na I D Lines in the SN 2002ap Spectrum, Publ. Astron. Soc. Japan, 54, 899-903.

Takada-Hidai, M., Takeda, Y., Sato, S., Honda, S., Sadakane, K., Kawanomoto, S., Sargent, W. L., Lu, L., Barlow, T. A.: 2002, Behavior of Sulfur Abundances in Metal-poor Giants and Dwarfs, Astrophys. J., 573, 614.

Takagi, T., Arimoto, N., and Hanami, H.: 2003, Evolutionary spectral energy distribution diagnostics of starburst galaxies: signature of bimodality, Mon. Not. Roy. Astron. Soc., 340, 813-831.

Takagi, T., Vansevicius, A., and Arimoto, N.: 2003, Spectral energy distributions of dusty galaxies, Publ. Astron. Soc. Japan, 55, 385-407.

Takahashi, R., Kuwahara, F., Majorana, E., Barton, M. A., Uchiyama, T., Kuroda, K., Araya, A., Takamori, A., Ando, M., Tsubono, K., Fukushima, M., Saito, Y.: 2002, Vacuum-compatible vibration isolation stack for an interferometric gravitational wave detector TAMA300, Rev. Sci. Instrum., 73, 2428-2433.

Takahashi, R., Saito, Y., Fukushima, M., Ando, M., Arai, K., Tatsumi, D., Heinzel, G., Kawamura, S., Yamazaki, T., and Moriwaki, S.: 2002, Direct measurement of residual gas effect on the sensitivity in TAMA300, J. Vac. Sci. Technol., A20, 1237-1241.

Takakuwa, S., Kamazaki, T., Saito, M., and Hirano, N.: 2003, $H^{13}CO^+$ and CH_3OH Line Observations of Prestellar Dense Cores in the TMC-1C Region. II. Internal Structure, Astrophys. J., 584, 818-831.

Takami, M., Usuda, T., Sugai, H., Suto, H., Pyo, T. S., Takeyama, N., Aoki, T., Mizutani, K., Tanaka, M.: 2002, [FeII] 1.257 μm and HeI 1.083 μm Emission in the Central Region of the Orion Nebula: HII Region, HH Flows, Jets, and Proplyds, Astrophys. J., 566, 910-924.

Takano, S., Nakai, N., and Kawaguchi, K.: 2002, Observations of Ammonia in External Galaxies. I. NGC 253 and M 82, Publ. Astron. Soc. Japan, 54, 195-207.

Takeda, M., and Noguchi, T.: 2002, A 200-285-GHz Waveguide SIS Mixer with an Inhomogeneous Distributed Junction Array, IEEE Trans. Microwave Theory and Techniques, 50, 2618-2623.

Takeda, Y., Parthasarathy, M., Aoki, W., Ita, Y., Nakada, Y., Izumiura, H., Noguchi, K., Takada-Hidai, M., Sato, B., Tajitsu, A., Honda, S., Kawanomoto, S., Ando, H., and Karoji, H.: 2002, Detection of Zinc in the Very Metal-Poor Post-AGB Star HR 4049, Publ. Astron. Soc. Japan, 54, 765-773.

Takeda, Y., Sato, B., Kambe, E., Sadakane, K., and Ohkubo, M.: 2002, Spectroscopic Determination of Stellar Atmospheric Parameters: Application to Mid-F through Early-K Dwarfs and Subgiants, Publ. Astron. Soc. Japan, 54, 1041.

Takeda, Y., Sato, B., Kambe, E., Watanabe, E., Miyazaki, H., Wada, S., Ando, H., Masuda, S., Izumiura, H., Koyano, H., Maehara, H., Norimoto, Y., Okada, T., Shimizu, Y., Uraguchi, F., Yanagisawa, K., Yoshida, M., Okada, N., Kawanomoto, S., and Miyama, S. M.: 2002, Iodine-Cell Spectroscopy at Okayama Astrophysical Observatory: First Results, Publ. Astron. Soc. Japan, 54, 113-120.

Taniguchi, Y., Ajiki, M., Murayama, T., Nagao, T., Veilleux, S., Sanders, D. B., Komiyama, Y., Shioya, Y., Fujita, S. S., Kakazu, Y., Okamura, S., Ando, H., Nishimura, T., Hayashi, M., Ogasawara, R., Ichikawa, S.: 2003, The Discovery of a Very Narrow Line Star-forming Object at a Redshift of 5.66, Astrophys. J. Lett., 585, L97-L100.

Tanikawa, K., and Yamaguchi, Y.: 2002, Non-symmetric periodic points in reversible maps: examples from the standard map, Progr. Theor. Phys., 108, 987-997.

Tanikawa, K., and Yamaguchi, Y.: 2003, Non-Birkhoff periodic orbits with 2n-turning points in the standard map, Prog. Theor. Phys., 109, 187-202.

Tanuma, S., Yokoyama, T., Kudoh, T., and Shibata, K.: 2003, Magnetic Reconnection Triggered by the Parker Instability in the Galaxy: Two-dimensional Numerical Magnetohydrodynamic Simulations and Application to the Origin of X-Ray Gas in the Galactic Halo, Astrophys. J., 582, 215-229.

Taruya, A., Hamana, T., Kayo, I.: 2003, Non-Gaussian tails of cosmological density distribution function from dark halo approach, Mon. Not. Roy. Astron. Soc., 339, 495-504.

Taruya, A., Takada, M., Hamana, T., Kayo, I., Futamase, T.: 2002, Lognormal Property of Weak-Lensing Fields, Astrophys. J., 571, 638-653.

Terasawa, M., Sumiyoshi, K., Yamada, S., Suzuki, H., and Kajino, T.: 2002, R-process nucleosynthesis in neutrino-driven winds from a typical neutron star with $M = 1.4M_\odot$, Astrophys. J. Lett., 578, 137-140.

Tingay, S. J., Reynolds, J. E., Tzioumis, A. K., Jauncey, D. L., Lovell, J. E. J., Dodson, R., Costa, M. E., McCulloch, P. M., Edwards, P. G., Hirabayashi, H.,

Murphy, D. W., Preston, R. A., Piner, B. G., Nicolson, G. D., Quick, J. F. H., Kobayashi, H., and Shibata, K. M.: 2002, VSOP Space VLBI and Geodetic VLBI Investigations of Southern Hemisphere Radio Sources, Astrophys. J. Suppl., 141, 311-335.
Tomaru, T., Miyoki, S., Ohashi, M., Kuroda, K., Uchiyama, T., Suzuki, T., Yamamoto, A., Shintomi, T., Ueda, A., Tatsumi, D., Sato, S., Arai, K., Ando, M., Watanabe, K., Nakamura, K., Watanabe, M., Ito, K., Kataoka, I., Yamamoto, H., Bochner, B., and Hefetz, Y.: 2002, Evaluation of the Performance of Polished Mirror Surfaces for the TAMA Gravitational Wave Detector by Use of a Wave-Front Tracing Simulation, Applied Optics, 41, 5913-5920.
Tomisaka, K.: 2002, Collapse of Rotating Magnetized Molecular Cloud Core and Mass Outflows, Astrophys. J., 575, 306-326.
Tosaki, T., Hasegawa, T., Shioya, Y., Kuno, N., and Matsushita, S.: 2002, Variation of Molecular Cloud Properties across the Spiral Arm in M 51, Publ. Astron. Soc. Japan, 54, 209-221.
Totani, T., and Inoue, S.: 2002, Preheating in the universe suppressing high energy gamma rays from structure formation, Astropart. Phys., 17, 79-85.
Totani, T., and Panaitescu, A.: 2002, Orphan Afterglows of Collimated Gamma-Ray Bursts: Rate Predictions and Prospects for Detection, Astrophys. J., 576, 120-134.
Totani, T., and Takeuchi, T. T.: 2002, A Bridge from Optical to Infrared Galaxies: Explaining Local Properties and Predicting Galaxy Counts and the Cosmic Background Radiation, Astrophys. J., 570, 470-491.
Totani, T., Kawasaki, W., and Kawai, N.: 2002, A Deep Optical Observation for an Enigmatic Unidentified Gamma-Ray Source 3EGJ1835+5918, Publ. Astron. Soc. Japan, 54, L45-L49.
Totani, T.: 2003, Cluster-Cluster Microlensing as a Probe of Intracluster Stars, MACHOs, and Remnants of the First-Generation Stars, Astrophys. J., 586, 735-744.
Tsuji, T., and Nakajima, T.: 2003, Transition from L to T Dwarfs on the Color-Magnitude Diagram, Astrophys. J. Lett., 585, L151-154.
Tsujimoto, T., and Shigeyama, T.: 2002, History of Milky Way Dwarf Spheroidal Galaxies Imprinted on Abundance Patterns of Neutron-Capture Elements, Astrophys. J. Lett., 571, L93-L97.
Tsujimoto, T., and Shigeyama, T.: 2003, Relics of Subluminous Supernovae in Metal-poor Stars, Astrophys. J. Lett., 584, L87-L90.
Tsujimoto, T., Shigeyama, T., and Yoshii, Y.: 2002, Chemical Evolution of Odd Elements in an Inhomogeneous Early Galaxy, Astrophys. J., 565, 1011-1016.
Wada, K., and Norman, C. A.: 2002, Obscuring Material around Seyfert Nuclei with Starbursts, Astrophys. J., 566, L21-24.
Wada, K., Meurer, G., and Norman, C. A.: 2002, Gravity-Driven Turbulence in Galactic Disks, Astrophys. J., 577, 197-205.
Watanabe, J., Kawakita, H., Furusho, R., and Fujii, M.: 2003, Heliocentric Dependence of the Sodium Emission of Comet 153P/Ikeya-Zhang, Astrophys. J. Lett., 585, L159-L162.
Watanabe, J., Sekiguchi, T., Shikura, M., Naito, S., and Abe, S.: 2002, Wide-Field TV Observation of the Leonid Meteor Storm in 2001: Main Peak over Japan, Publ. Astron. Soc. Japan, 54, L23-L26.
Watanabe, S., Akiyama, M., Ueda, Y., Ohta, K., Mushotzky, R., Takahashi, T., and Yamada, T.: 2002, Chandra Observations and Optical Identification of Hard X-Ray Sources Discovered with ASCA, Publ. Astron. Soc. Japan, 54, 683-694.
White, S. M., Kundu, M. R., Garaimov, V. I., Yokoyama, T., and Sato, J.: 2002, The Physical Properties of a Flaring Loop, Astrophys. J., 576, 505-518.
Willlot, C. J., Simpson, C., Almaini, O., Manners, J. C., Johnson, O., Lawrence, A., Dunlop, J. S., Ivison, R. J., Rawlings, S., Gonzalez-Solares, E., Perez-Fournon, I., Serjeant, S., Oliver, S. J., Roche, N. D., Mann, R. G., Rowan-Robinson, M.: 2003, Obscured AGN from the ELAIS Deep X-ray Survey, Mon. Not. Roy. Astron. Soc, 339, 397-409.
Yahiro, N., Mathews, G. J., Ichiki, K., Kajino, T., and Orito, M.: 2002, Constraints on Cosmic Quintessence and quintessential inflation, Phys. Rev. D, 65, 063502.
Yamada, T., Koyama, Y., Nakata, F., Kajisawa, M., Tanaka, I., Kodama, T., Okumura, S., De Propris, R.: 2002, Witnessing the Hierarchical Assembly of the Brightest Cluster Galaxy in a Cluster at $z=1.26$, Astrophys. J. Lett., 577, L89-L92.
Yamaguchi, Y., and Tanikawa, K.: 2002, Dynamical ordering of non-Birkhoff orbits and topological entropy in the standard mapping, Prog. Theor. Phys., 107, 1117-1145.
Yamaguchi, Y., and Tanikawa, K.: 2002, Dynamical ordering of periodic accelerator modes in the standard mapping, Prog. Theor. Phys., 108, 669-678.
Yamaguchi, Y., and Tanikawa, K.: 2002, Non-Birkhoff periodic orbits in a circle mapping, Prog. Theor. Phys., 108, 231-240.
Yamauchi, Y., Suess, S. T., and Sakurai, T.: 2002, Relation between Pressure Balance Structures and Polar Plumes from Ulysses High Latitude Observations, Geophys. Res. Lett., 29(10), 21-1—21-4.
Yano, T., Chiba, M., Gouda, N.: 2002, Kinematic analysis of spiral structures in the local disk, Astron. Astrophys., 389, 143-148.
Yano, T., Kan-ya, Y., and Gouda, N.: 2003, On the Stationarity of a Spiral Structure in Disk Galaxies, Publ. Astron. Soc. Japan, 55, 409-414.
Yokoyama, T., Nakajima, H., Shibasaki, K., Melnikov, V. F., and Stepanov, A. V.: 2002, Microwave Observations of the Rapid Propagation of Nonthermal Sources in a Solar Flare by the Nobeyama Radioheliograph, Astrophys. J. Lett., 576, L87-L90.
Yoshida, H.: 2002, Non-existence of the modified first integral by symplectic integration methods II: Kepler

problem, Celest. Mech. Dyn. Astron., 83, 355-364.
Yoshimura, K., Kurokawa, H., Shimojo, M., and Shine, R.: 2003, Close Correlation among $H\alpha$ Surges, Magnetic Flux Cancellations, and UV Brightenings Found at the Edge of an Emerging Flux Region, Publ. Astron. Soc. Japan, 55, 313-320.
Zare, K., and Tanikawa, K.: 2002, Reversible maps in two degrees of freedom Hamiltonian systems, Chaos, 12, 699-705.
Zhang, H., LaBonte, B., Li, J., and Sakurai, T.: 2003, Analysis of Vector Magnetic Fields in Solar Active Regions by Huairou, Mees, and Mitaka Vector Magnetographs, Solar Phys., 213, 87-102.
Zhong, M., Naito, I., and Kitoh, A.: 2003, Atmospheric, hydrological, and ocean current contributions to Earth's annual wobble and length-of-day signals based on output from a climate model, J. Geophys. Res., 108, B1, ETG13.
Zhu, Z. H., and Fujimoto, M.-K.: 2002, Cardassian Expansion: Constraints from Compact Radio Source Angular Size versus Redshift Data, Astrophys. J., 581, 1-4.
Zhu, Z. H., and Fujimoto, M.-K.: 2003, Constraints on Cardassian Expansion from Distant Type Ia Supernovae, Astrophys. J., 585, 52-56.

2. Publications of the National Astronomical Observatory of Japan

Sôma, M., and Kato, Y.: 2002, Limb Profiles of the Moon from Grazing Occultation Observations Collected at RGO, Publ. Natl. Astron. Obs. Japan, 6, 75-105.
Miyauchi-Isobe, N., and Maehara, H.: 2002, The Second Kiso Survey for Ultraviolent-Excess Galaxies. III, Publ. Natl. Astron. Obs. Japan, 6, 107-146.
Makita, M.: 2003, Chromospheric Structure Derived from Flash Spectra of the Total Solar Eclipse, Publ. Natl. Astron. Obs. Japan, 7, 1-24.

3. Report of the National Astronomical Observatory of Japan (in Japanese)

Watanabe, M., Aoki, K., Miura, A., Yasuda, N.: 2002, Java-based Multi-wavelength Astronomical Image Service ON-line, Rep. Nat. Astron. Obs. Japan, 6, 1-9.
Tanaka, N., Kobiki, T., Saito, M., Shinoda, K., and Irie, M.: 2002, Observations of the Mie Scattered Light Intensities around the Sun with a Portable Coronagraph, Rep. Nat. Astron. Obs. Japan, 6, 11-21.
Baba, H., Yasuda, N., Ichikawa, S.-I., Yagi, M., Iwamoto, N., Takata, T., Horaguchi, T., Taga, M., Watanabe, M., Okumura, S.-I., Ozawa, T., Yamanoto, N., and Hamabe, M.: 2002, Development of Pulic Science Archive System of Subaru Telescope, Rep. Nat. Astron. Obs. Japan, 6, 23-36.
Saito, M., and Irie, M.: 2002, Meteorological Observations at Norikura Solar Observatory, Rep. Nat. Astron. Obs. Japan, 6, 37-47.
Tamura, T., Hara, H., Tsuneta, S., Ichimoto, K., and Kumagai, K.: 2002, Contaminations Evaluation and Control for Solar-B Optical Telescope, Rep. Nat. Astron. Obs. Japan, 6, 49-58.
Iwashita, H., and Matsuda, K.: 2003, First Actions Towards Dust-proof Clean Conditions in Optical Lab of Mikata Optical and Infrared Array (MIRA-I. 2): Clean Level of Air in Laboratory Room, Rep. Nat. Astron. Obs. Japan, 6, 59-65.
Ozawa, T., Yadoumaru, Y., Okyudo, M., Taguchi, H., Ichikawa, S.-I., and Watanabe, J.-I.: 2003, Development of the Night Sky Movie System Using Timelapse Cinematography, Rep. Nat. Astron. Obs. Japan, 6, 67-78.

4. Other Publications

Abada-Simon, M., Mouchet, M., Casares, J., Evans, A., Eyres, S. P. S., Fender, R. P., Garrington, S. T., de Jager, O., Kuno, N., Martinez-Pais, I. G., de Martino, D., Matsuo, H., Pooley, G., Ramsay, G., Salama, A., and Schulz, B.: 2002, First Detections of the Cataclysmic Variable AE Aquarii from 4.8 to 7.3 Microns, and at 90 Microns with ISO, SF2A-2002: Semaine de l'Astrophysique Francaise, eds. F. Combes, and D. Barret, EdP-Sciences (Editions de Physique), Conf. Ser.
Abe, M., Ohba, Y., Ishiguro, M., Hasegawa, S., Fuse, T., Aoki, K., Ohyama, Y., Kashikawa, N., Tokunaga, A., Goto, M., Usuda, T., Terada, H., Kobayashi, N., Fujiwara, A.: 2002, Physical Model and Taxonomic Type of 1998 SF36, the Target Asteroid of Sample Return Mission, MUSES-C, 33rd Annual Lunar and Planetary Science Conf., 33, 1666-1667.
Abe, S., Yano, H., Ebizuka, N., Kasuga, T., Watanabe, J., Sugimoto, M., Fujino, N., Fuse, T., Ogasawara, R.: 2002, First results of OH emission from meteor and afterglow: search for organics in cometary meteoroids, Proc. Asteroids, Comets, Meteors - ACM 2002, ESA SP-500, 213-216.
Akabane, K., and Kuno, N.: 2002, Dust Content in Compact HII Regions (NGC 7538 - IRS 1, IRS 2, and IRS 3), Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 121-122.
Akiyama, S., and Hara, H.: 2002, Soft X-ray High-Temperature Regions above Solar Flare Loops, Multi-Wavelength Observations of Coronal Structure and Dynamics — Yohkoh 10th Anniversary Meeting, eds. P. C. H. Martens and D. P. Cauffman, COSPAR Colloq. Ser., 13, 367-370.
Aoki, W.: 2003, Subaru/HDS Studies on Elemental Abundances of very metal-poor stars, Nuclear Physics, A718, 37c-44c.
Appourchaux, T., Andersen, B., and Sekii, T.: 2002, What Have We Learnt with the Luminosity Oscillations Imager over the Past 6 Years?, 'SOHO 11 Workshop: From Solar Min to Max: Half a Solar Cycle with SOHO', ed. A. Wilson, ESA Publication Division, 47-50.
Asahara, A., Komiyama, Y., Kosugi, G., Kubo, H.,

Miyazaki, S., Mori, M., Nakagiri, M., Nishida, D., Ogasawara, R., Orito, R., Sakurazawa, K., Takata, T., Tanimori, T., Usuda, T.: 2003, Performance of 10-100 GeV gamma ray camera for SUBARU optical-infared telescope, Proc. SPIE, 4858, 347-357.
Asai, A., Masuda, S., Yokoyama, T., Shimojo, M., Ishii, T. T., Isobe, H., Shibata, K., and Kurokawa, H.: 2002, Evolution of Flare Ribbons and Energy Release, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 415-416.
Asaki, Y., Hirosawa, H., Ichikawa, M., Hirabayashi, H., Kobayashi, H., and Ishiguro, M.: 2002, Comparison of Atmospheric Phase Fluctuations with a 22 GHz Water Vapor Line Measurements Along a Single Line of Sight, Proc. of a workshop "Astronomical site evaluation in the visible and radio range: IAU Technical Workshop", eds. J. Vernin, Z. Benkhaldom, C. Munoz-Tunon, ASP Conf. Ser., 266, 230-237.
Boehnhardt, H., Barucci, A., Delsanti, A., de Bergh, C., Doressoundiram, A., Romon, J., Dotto, E., Tozzi, G., Lazzarin, M., Fournisier, S., Peixinho, N., Hainaut, O., Davies, J., Rousselot, P., Barrera, L., Birkle, K., Meech, K., Ortiz, J. Sekiguchi, T., Watanabe, J.-I., Thomas, N., and West, R.: 2003, Exploring the icy world of the Edgeworth-Kuiper Belt - an ESO Large Programme, The Messenger, 111, 22-28.
Boehnhardt, H., Delsanti, A., Hainaut, O., Barucci, A., Romon, J., Peixinho, N., de Bergh, C., Doressoundiram, A., Dotto, E., Lazzarin, M., Tozzi, G. P., Davies, J., Barrera, L., Birkle, K., Meech, K., Ortiz, J. L., Rousselot, P., Sekiguchi, T., Watanabe, J., Thomas, N., and West, R. M.: 2002, The ESO Large Program on physical studies of TNOs and Centaurs, Proc. Asteroids, Comets, Meteors - ACM 2002, ESA SP-500, 47-50.
Bundy, K., Fukugita, M., Ellis, R., Conselice, C., Kodama, T., Brinchmann, J.: 2002, The Stellar Mass Assembly of Galaxies at z=1 — New Results from Subaru, American Astronomical Society Meeting 201, 52.15.
Byun, D.-Y., Koo, B.-C., Tatematsu, K., and Sunada, K.: 2002, Interaction between the Supernova Remnant HB21 and Molecular Clouds, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 131-132.
Delsanti, A., Boehnhardt, H., Hainaut, O., Barucci, A., Doressoundiram, A., Barrera, L., de Bergh, C., Birkle, K., Dotto, E., Lazzarin, M., Meech, K., Ortiz, J., Romon, J., Sekiguchi, T., Thomas, N., Tozzi, G. P., Watanabe, J., and West, R.: 2002, Photometry of Kuiper Belt objects with the ESO Large Program, Proc. Asteroids, Comets, Meteors-ACM 2002., ESA SP-500, 25-28.
Dermawan, B., Nakamura, T., Yoshida, F., Sato, Y.: 2002, Search for fast-rotators among the main-belt asteroids, Bull. AAS, 34, 3, 14.09.
Dermawan, B., Nakamura, T., Yoshida, F., Sato, Y.: 2002, Search for fast-rotators among the main-belt asteroids, Proc. of the 35th ISAS Lunar and Planetary Conf, 146-149.
Dobashi, K., Uehara, H., Kandori, R., Umemoto, T., and Sato, F.: 2002, A Catalogue of Dark Clouds Using the Digitized Sky Survey I, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 67-68.
Ebizuka, N., Oka, K., Yamada, A., Watanabe, M., Shimizu, K., Kotate, K., Kawabata, M., Teranishi, T., Kawabata, K. S., and Iye, M.: 2003, Development of Volume Phase Holographic (VPH) Grism for Visible to Near Infrared Instruments of the 8.2m Subaru Telescope, Proc. SPIE, 4842, 319-328.
Ezawa, H.: 2002, The Atacama Submillimeter Telescope Experiment (ASTE) and Observations of Galaxy Clusters with Submillimeter Waves, Proc. of the workshop "Tracing cosmic evolution with galaxy clusters", eds. S. Borgani, M. Mezzetti, and R. Valdarnini, ASP Conf. Ser., 268, 357-360.
Fleishman, G. D., Melnikov, V. F., and Shibasaki, K.: 2002, Observational Constraints on Short-wave turbulence in Flares, Proc. of 10th European Solar Physics Meeting, Solar Variability: from Core to Outer Frontiers, ESA SP-506, 283-286.
Fujita, Y., Sarazin, C. L., Nagashima, M., and Yano, Y.: 2002, Analytical Approach to the Mass Distribution Function of Subhalos and Cold Fronts in Galaxy Clusters, The Proc. of the IAU 8th Asian-Pacific Regional Meeting, Volume II, ASP Conf. Ser., 289, 249-250.
Fujita, Y.: 2003, The Age and Number of Galaxies in Clusters: Are Galaxy Groups Unvirialized Galaxy Clusters?, Carnegie Observatories Astrophysics Series, 3. (published on the Internet)
Furuya, R. S., Kitamura, Y., Wootten, A., Claussen, M. J., and Kawabe, R.: 2002, Imaging of 2-mm Dust Continuum Emission Towards S106 FIR and Its Spectral Energy Distribution, Proc. of the IAU Symp. 206, Cosmic MASERs: From Protostars to Blackholes, eds. V. Migenes and M. J. Reid, 22-25.
Furuya, R. S., Kitamura, Y., Wootten, A., Claussen, M. J., and Kawabe, R.: 2002, Multi-Epoch Water Maser Survey Towards Low-Mass YSOs, Proc. of the IAU Symp. 206, "Cosmic MASERs: From Protostars to Blackholes", eds. V. Migenes and M. J. Reid, 35-38.
Gaessler, W., Takami, H., Takato, N., Hayano, Y., Kamata, Y., Iye, M.: 2003, Software and algorithms of Subaru AO, Proc. SPIE, 4839, 954-963.
Gaessler, W., Takami, H., Takato, N., Hayano, Y., Kamata, Y., Saint-Jacques, D., Minowa, Y., Iye, M.: 2002, First results from the Subaru AO system, Adaptive Optics Systems and Technology II, eds. R. K. Tyson, D. Bonaccini, M. C. Roggemann, Proc. SPIE, 4494, 30-40.
Gopalswamy, N., Shimojo, M., Yashiro, S., and Shibasaki, K.: 2002, Prominence Eruptions and CMEs: A Statistical Study, American Astronomical Society Meeting, 200, #37.05.
Goto, M., Hayano, Y., Kobayashi, N., Terada, H., Pyo, T.-S., Tokunaga, A. T., Takami, H., Takato, N., Minowa, Y., Gaessler, W., Iye, M.: 2003, Spectroscopy with Adaptive Optics: Spectroral Slope

Variations, Proc. SPIE, 4839, 1117-1123.
Goto, T., Okamura, S., Yagi, M., and SDSS Collaboration: 2002, Morphological Butcher-Oemler effect based on the SDSS Cut & Enhance Galaxy Cluster Catalog, American Astronomical Society Meeting, 201, #148.02.
Gouda, N., Tsujimoto, T., Kobayashi, Y., Nakajima, T., Matsuhara, H., Yano, T., Yasuda, N., Kan-ya, Y., Yamada, Y., Ueno, M.: 2003, Introduction of Japanese astrometry satellite mission for infrared exploration (JASMINE), IR Space Telescopes and Instruments, ed. J. C. Mather, Proc. SPIE, 4850, 1161-1168.
Gouda, N., Tsujimoto, T., Kobayashi, Y., Nakajima, T., Matsuhara, H., Yano, T., Yasuda, N., Kan-ya, Y., Yamada, Y., Ueno, M.: 2003, IR Space Astrometry: JASMINE-Galactic Structure Surveyor Project, Proc. of the IAU 8th Asian-Pacific Regional Meetng, 2, ASP Conf. Ser., 289, 5-6.
Gouda, N., Tsujimoto, T., Kobayashi, Y., Nakajima, T., Yasuda, N., Kan-ya, Y., Matsuhara, H., Yano, T., Yamada, Y., Ueno, M.: 2003, IR Space Astrometry - JASIME Project -, Mass-Losing Pulsating Stars and Their Circumstellar Matter, Kluwer Academic Publishers, eds. Y. Nakada, M. Honma, and M. Seki, 397-404.
Hagino, M., and Sakurai, T.: 2002, Hemispheric Helicity Asymmetry in Active Regions for Solar Cycles 21-23, "Multi-Wavelength Observations of Coronal Structure and Dynamics — Yohkoh 10th Anniversary Meeting," eds. P. C. H. Martens and D. P. Cauffman, COSPAR Colloq. Ser., 13, 147-148.
Hamana, T.: 2002, Numerical study of the lensing deflection angle due to the large-scale structures, the Astronomical Society of the Pacific Conf. Seri., 257, 207-214.
Hamana, T.: 2002, Numerical study of weak lensing, Proc. The 5th RESCEU International Symp., New Trends in Theoretical and Observational Cosmology, 213-216.
Hanada, H., Iwata, T., Kono, Y., Matsumoto, K., Tsuruta, S., Ishikawa, T., Asari, K., Ping, J., Heki, K., and Kawano, N.: 2002, VRAD mission; precise observation of sub-satellites in SELENE with international VLBI Network, Proc. 2nd. IVS General Meeting, 72-76.
Hanaoka, Y., Noguchi, M., Ichimoto, K. and Sakurai, T.: 2002, A High-Speed H-alpha Camera for Solar Flare Observations, Multi-Wavelength Observations of Coronal Structure and Dynamics, COSPAR Colloq. Ser., 13, 427-428.
Hanaoka, Y., Noguchi, M., Sakurai, T., and Ichimoto, K.: 2003, High-Speed H-alpha Camera and the Real-Time Image Processing System for Solar Observations, Proc. SPIE, 4853, 576-583.
Hanaoka, Y.: 2003, Multi-Wavelength, High-Speed Video Spectroheliograph, Proc. SPIE, 4853, 584-592.
Hasegawa, T., Malasan, H. L., Kawakita, H., Obayashi, H., Kurabayashi, T., Nakai, T., Hyakkai, A., and Arimoto, N.: 2003, A Search for Old Open Clusters: The Astronomical School for Public 2000 at Gunma Astronomical Observatory, The Proc. of the IAU 8th Asian-Pacific Regional Meeting, ASP Conf. Ser., 289, 139-140.
Hayano, Y., Geassler, W., Takami, H., Takato, N., and Minowa, Y.: 2002, Rayleigh scatter measurement of Keck LGS by Subaru telescope, Proc. SPIE. 4839, 452.
Hayano, Y., Takami, H., Gaessler, W., Takato, N., Kamata, Y., Minowa, Y., Kobayashi, N., Iye, M.: 2003, Upgrade plans for the Subaru AO system, Proc. SPIE, 4839, 32-43.
Hayano, Y., Takami, H., Geassler, W., Takato, N., Goto, M., Kamata, Y., Minowa, Y., Kobayashi, N., and Iye, M.: 2002, Upgrade plans for Subaru AO system. Proc. SPIE, 4839, 32.
Hirata, A., Nagatsuma, T., Yano, R., Ito, H., Furuta, T., Hirota, Y., Ishibashi, T., Matsuo, H., Ueda, A., Noguchi, T., Sekimoto, Y., Ishiguro, M., and Matsuura, S.: 2002, Output Power Measurement of Photonic Millimeter-Wave and Sub-Millimeter-Wave Emitter at 100-800 GHz, Electronics Letters, 38, 798-800.
Hirota, T., Ikeda, M., Ohishi, M., and Yamamoto, S.: 2002, A Search for Carbon-Chain-Rich Cores in Dark Clouds, eds. Curry, C. L. and Fich, M., Proc. of Chemistry as a Diagnostic of Star Formation, 43.
Honda, M., Yamashita, T., Kataza, H., Miyata, T., Fujiyoshi, T., Sako, S., Okamoto, Y. K., Onaka, T., Sekiguchi, T., Kinoshita, D., Watanabe, J.: 2003, Comets C/2001 RX_14 (LINEAR) and C/2002 V1 (NEAT), IAU Circ., 8053, 2.
Hough, J. H., Lucas, P. W., Bailey, J. A., Tamura, M.: 2003, A high sensitivity polarimeter for the direct detection and characterization of extra-solar planets, Proc. SPIE, 4843, 517-523.
Ichikawa, T., Matsumoto, D., Yanagisawa, K., Katsuno, Y., Suzuki, R., Tokoku, C., Asai, K., and Nishimura, T.: 2003, Tohoku University Focal Plane Array Controller (TUFPAC), Proc. SPIE, 4841, 376-381.
Ikeda, Y., Akitaya, H., Matsuda, K., Kawabata, K. S., Seki, M., Hirata, R., Okazaki, A.: 2003, Development of high resolution spectropolarimeter; LIPS, Proc. SPIE, 4843, 437-447.
Imaeda, Y., and Inutsuka, S.: 2003, New SPH Scheme for Shear Flows and its Application to the Dynamics of a Circumbinary Disk, Proc. of the IAU 8th Asian-Pacific Regional Meeting, Volume II, ASP Conf. Ser., 289, 147-148.
Imai, H., Deguchi, S., Nakashima, J.-I., Miyazaki, A., Kameya, O., Fujii, T., Ita, Y., Nakada, Y., Izumiura, H., and Glass, I. S.: 2003, SiO Maser Survey towards the Stellar Cluster at the Galactic Center, Mass-Losing Pulsating Stars and their Circumstellar Matter, eds. Y. Nakada, M. Honma, and M. Seki, 373-376.
Imai, H., Watanabe, T., Omodaka, T., Nishio, M., Kameya, O., Miyaji, T., and Nakajima, J.: 2003, 3-D Kinematics of Water Masers in the W 51A Region, Winds, Bubbles, and Explosions: a conference to honor

John Dyson, eds. S. J. Arthur and W. J. Henney, Revista Mexicana de Astronomia y Astrofisica (Serie de Conferencias), 15, 202-202.
Imanishi, M.: 2002, 3-4 Micron Spectroscopy of Seyfert 2 Nuclei, Active Galactic Nuclei: from Central Engine to Host Galaxy, ASP Conf. Ser., 290, 511-512.
Imanishi, M.: 2002, Buried AGNs in LINER-Type ULIRGs, Active Galactic Nuclei: from Central Engine to Host Galaxy, ASP Conf. Ser., 290, 509-510.
Inoue, S., and Suzuki, T. K.: 2003, Cosmic Ray Production of ^{6}Li by Structure Formation Shocks in the Early Galaxy, Nuc. Phys. A, 718, 69-72.
Inoue, S.: 2002, Probing the Formation and Evolution of Galaxies and Clusters with Gamma-Rays and Cosmic Rays, New Trends in Theoretical and Observational Cosmology, eds. K. Sato, and T. Shiromizu, 133-136.
Ishiguro, M., Sekimoto, Y., Ueda, A., Iguchi, S., Noguchi, T., Payne, J. M., D Addario, L. R., and Shillue, W.: 2002, A Hybrid Option for the First LOs using Direct Photonic LO Driver, ALMA memo, 435.
Ishihara, Y., Nakai, N., Iyomoto, N., Makishima, K., Diamond, P., and Hall. P.: 2002, H_2O Maser Emission from the Seyfert 2 Galaxy IC 2560: Evidence for a Super-Massive Black Hole and a Probe for Mass-Accretion Rate, Proc. of the IAU Symp. 206, Cosmic MASERs: From Protostars to Blackholes, eds. V. Migenes and M. J. Reid, 400-403.
Ishii, M., Tamura, M., Nagata, T., Sato, S., Yao, Y., Jiang, Z., and Yanagisawa, K.: 2002, K band spectroscopy of Herbig Ae/Be stars, American Astronomical Society Meeting, 202, #28.03
Isobe, H., Shibata, K., Yokoyama, T., and Imanishi, K.: 2002, Hydrodynamics Modeling of a Protostellar Flare Loop Connecting a Central Star with its Accretion Disk, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 433-434.
Ito, H., Furuta, T., Hirota, Y., Ishibashi, T., Hirata, A., Nagatsuma, T., Matsuo, H., Noguchi, T., and Ishiguro, M.: 2002, Photonic Millimeter-Wave Emission at 300 GHz Using and Antenna-Integrated Uni-Travelling-Carrier Photodiode, Electronics Letters, 38, 989-990.
Iwata, T., Sakai, T., Kono, Y., Hanada, H., Kawano, N. and Namiki, N.: 2002, Results of the Critical Design for the Selenodetic Mission using Differential VLBI Methods by SELENE, IVS General Meetings Proc., 377-380.
Iwata, T., Sasaki, T., Izumi, T., Kono, Y., Hanada, H., Kawano, N., and Takano, T.: 2002, Properties of the release mechanism of SELENE relay satellite and their influences for the lunar gravity observation, 23nd Int. Symp. Space Technology and Science.
Iye, M.: 2002, Active and Adaptive Optics of the 8.2m Subaru Telescope and future telescopes, Proc. CRL International Symp. on Light Propagation and Sensing Technologies for Future Applications, ed. Kunimori.
Iye, M.: 2003, Scientific results with the Subaru Telescope, Proc. SPIE, 4834, 288-301.
Kajino, T., Orito, M., Ichiki, K., and Mathews, G. J.: 2002, New constraint on massive degenerate neutrinos from Big-Bang nucleosynthesis and cosmic microwave background fluctuations, Proc. 4-th Heiderberg Conf. on Dark Matter (DARK2002), 435-440.
Kajino, T., Orito, M., Otsuki, K., and Terasawa, M.: 2002, Photo-Nuclear Reactions in the Big-Bang and Supernovae, Proc. Int. Symp. on Electromagnetic Interactions in Nuclear and Hadron Physics, 101-114.
Kajino, T., Orito, M., Otsuki, K., and Terasawa, M.: 2002, Cosmological and supernova nucleosynthesis, Proc. 4-th Italy-Japan Symp. on Heavy Ion Physics, 229-242.
Kajino, T.: 2002, Neutrinos in Explosive Nucleosynthesis: Big-Bang and Supernovae, Proc. Int. Symp. on Nuclear Electro-Weak Spectroscopy, eds. H. Toki and H. Ejiri, 320-326.
Kajino, T.: 2003, Prospects in Nuclear Cosmology: from the Big-Bang to Supernovae, Proc. Int. Symp. on Origin of Matter and Evolution of Galaxies, eds. T. Kajino, S. Kubono, K.-I. Nomoto, and I. Tanihata, 3-13.
Kamata, Y., Sato, T., and Kanzawa, T.: 2003, Evaluation of the thin film for mirror coating at Subaru Telescope, Proc. SPIE, 4837, 878-886.
Kameya, O., Kobayashi, H., and the VERA team: 2002, Current status of the VERA, Technology Development Center News, 21, 36-37.
Kameya, O., Kobayashi, H., Sato, K., Miyaji, T., Iwadate, K., Horiai, K., Sasao, T., Omodaka, T., and the VERA team: 2002, Construction and Current Status of The VERA Stations, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 15.
Kameya, O., Kobayashi, H., Sato, K., Miyaji, T., Iwadate, K., Horiai, K., Sasao, T., Omodaka, T., and the VERA team: 2002, Construction and Current status of the VERA Stations, The Proc. of the 8th IAU Asian-Pacific Regional Meeting Volume II, eds. S. Ikeuchi, J. Hearnshaw, T. Hanawa, 15.
Kameya, O.: 2003, Mizusawa 10m Antenna System for Study of Pulsating Stars, Mass-Losing Pulsating Stars and their Circumstellar Matter, eds. Y. Nakada, M. Honma, and M. Seki, 409-410.
Kandori, R., Dobashi, K., Uehara, H., Sato, F., and Yanagisawa, K.: 2002, Extensive Extinction Maps of Dark Clouds at Multiple Wavelengths, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 153-154.
Karlicky, M., and Shibasaki, K.: 2002, Radio Observations of the July 13, 2000 Transequatorial Eruptive Prominence, Proc. of 10th European Solar Physics Meeting, Solar Variability: from Core to Outer Frontiers, ESA SP-506, 657-660.
Kasuga, T., Tsuboi, M., Miyazaki, A., and Shinnaga, H.: 2002, Search for Polarization towards Sagittarius A* at 100 GHz, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 383.
Kawabata, K. S., Ebizuka, E., Sasaki, T., Sekiguchi, K., Iye, M., Aoki, K., Asai, R., Inata, M., Kashikawa, N., Kosugi, G., Misawa, T., Ohyama, Y., Okita, K., Ozawa, T., Saito, Y., Shimizu, Y., Taguchi, H.,

Takata, T., Yadoumaru, Y., Yoshida, M.: 2003, Properties of FOCAS optical components, Proc. SPIE, 4841, 1219-1228.

Kawabata, K. S., Jeffery, D. J., Iye, M., Ohyama, Y., Kosugi, G., Kashikawa, N., Ebizuka, N., Sasaki, T., Sekiguchi, K., Nomoto, K., Mazzali, P., Deng, J., Maeda, K., Aoki, K., Saito, Y., Takata, T., Yoshida, M., Asai, R., Inata, M., Okita, K., Ota, K., Ozawa, T., Shimizu, Y., Taguchi, H., Yadoumaru, Y., Misawa, T., Nakata, F., Yamada, T., Tanaka, I., Kodama, T.: 2003, Optical Spectropolarimetry of SN 2002ap: A High Velocity Asymmetric Explosion, Proc. the IAU 8th Asian-Pacific Regional Meeting, 2, eds. S. Ikeuchi, J. Hearnshaw, and T. Hanawa, ASP Conf. Ser., 289, 333-334.

Kawano, N., Hanada, H., Iwata, T., and Tsubokawa, T.: 2001, Japanese lunar explorer "SELENE" and geodetic observations of the Moon, Proc. of Symp. Astronomy and geodesy in new millenium, 157-160.

Kawano, N., Hanada, H., Iwata, T., Kono, Y., and Ping, J. S.: 2002, Japanese lunar explorer SELENE and precise positioning by VLBI, Proc. of the 3rd IVS meeting.

Kinoshita, H. and Nakai, H.: 2002, Dynamical Stability of Planetary System of GJ 876, Proc. 34th Symp. on Celest. Mech., eds. E. Kokubo, T. Itoh, and H. Arakida, 199-225.

Kobayashi, Y., Yoshii, Y., Minezaki, T., Enya, K., Aoki, T., Suganuma, M., Tomita, H., Doi, M., Motohara, K., Peterson, B. A., Smith, C., Little, J. K., Greene, B.: 2003, Automated observatory for multicolor active galactic nuclei monitoring (MAGNUM), Proc. SPIE, 4837, 954-964.

Koda, J., Sofue, Y., Kohno, K., Okumura, S. K., and Irwin, J. A.: 2002, A Weak Bar Potential and Massive Core in the Seyfert 2 Galaxy NGC 3079: CO (1-0) Observations Using the Nobeyama Millimeter Array, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 387-388.

Kodama, T., Arimoto, N., Barger, A., Aragon-Salamanca, A.: 2002, Evolution of the colour-magnitude relation of elliptical galaxies, "Cosmic Chemical Evolution", Proc. of the IAU Symp., 187, 226.

Komiyama, Y., Miyazaki, S. Yagi, M., Yasuda, N., Okamura, S., Sekiguchi, M., Doi, M., Shimasaku, K., Nakata, F., Furusawa, H., Kimura, M., Ouchi, M., Hamabe, M., Nakaya, H.: 2003, Suprime-Cam: Subaru prime focus camera, Proc. SPIE, 4841, 152-159.

Kono, Y., Hanada, H., Iwadate, K., Koyama, Y., Fukuzaki, Y., and Kawano, N.: 2002, precise Positioning of Spacecrafts by Multi-frequency VLBI, IVS General Meetings Proc., 179-183.

Kosugi, G., Mizumoto, Y., Sasaki, T., Ogasawara, R., Yagi, M., Takata, T.: 2002, Subaru Quality Control Trinity Progress Report Observatory Operations to Optimize Scientific Return III. Ed. by Quinn, P. J., Proc. SPIE, 4844, 537-543.

Kotani, T., Nishikawa, J., Sato, K., Yoshizawa, M., Ohishi, N., Fukushima, T., Torii, Y., Matsuda, K., Kubo, K., Iwashita, H., and, Suzuki, S.: 2002, Long-baseline optical fiber interferometer instruments and science, Interferometry for Optical Astronomy II, Proc. SPIE, 4838, 1370-1377.

Koyama, H., and Inutsuka, S.: 2003, Production and Dissipation Mechanisms of Interstellar Turbulence Driven by Thermal Instability, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, ASP Conf. Ser., 289, 159-160.

Kuno, N., Nakai, N., Sorai, K., Sato, N., Yamauchi, A., Tosaki, T., Shioya, Y., Vila-Vilaro, B., Nishiyama, K., Ishihara, Y., and Cepa, J.: 2002, Nobeyama CO Atlas of Nearby Spiral Galaxies, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 71-72.

Kusano, K., Maeshiro, T., Yokoyama, T., and Sakurai, T.: 2002, Helicity Injection into the Solar Corona, Multi-Wavelength Observations of Coronal Structure and Dynamics — Yohkoh 10th Anniversary Meeting, eds. P. C. H. Martens and D. P. Cauffman, COSPAR Colloq. Ser., 13, 151-152.

Lai, O., Ridgway, S., Lena, P., Perrin, G., Fahlman, G., Adamson, A., Tokunaga, A., Nishikawa, J., Wizinowich, P., Rigaut, F.: 2003, OHANA Phase III: scientific operation of an 800-meter Mauna Kea interferometer, Interferometry for Optical Astronomy II, Proc. SPIE, 4838, 1296-1303.

Machida, M., Tomisaka, K. Matsumoto, T.: 2002, Non-axisymmetric Evolution of Cloud Cores and Mass Outflows -MHD Nested Grid Simulation, ASP Conf. Ser., 289, 163-164.

Manabe, S., Imai, H., Jike, T., and VERA Group: 2002, Astrometric and Geodetic Analysis System of VERA, IVS General Meetings Proc., 372-376.

Masaki, M. and Kinoshita, H.: 2002, Orbital Theory of an Eccentric Extrasolar Planet Disturbed by a Massive Inner Planet, Proc. of IAU 8th Asian-Pacific Regional Meeting, eds. S. Ikeuchi, J. Hearnshaw, and T. Hanawa, 51-52.

Masaki, Y. and Kinoshita, H.: 2002, Orbital Theory of a Highly Eccentric Satellite Disturbed by a Massive Inner Satellite, Proc. 34th Symp. on Celest. Mech., eds. E. Kokubo, T. Itoh, and H. Arakida, 303-329.

Masuda, S., Yamamoto, T., Yoshida, K., Tanuma, S., Yokoyama, T., and Shimojo, M.: 2002, Hard X-ray and Microwave Imaging Observations of the 18-July-2002 Flare, American Geophysical Union Fall Meeting 2002, abstract #SH52A-0473.

Matsumoto, K., Heki, K., and Hanada, H.: 2002, Global lunar gravity field recovery from SELENE, Proc. 2nd. IVS General Meeting, 381-385.

Melnikov, V. F., Reznikova, V. E., Yokoyama, T., and Shibasaki, K.: 2002, Spectral Dynamics of Mildly Relativistic Electrons in Extended Flaring Loops, Proc. of 10th European Solar Physics Meeting, Solar Variability: from Core to Outer Frontiers, ESA SP-506, 339-342.

Melnikov, V. F., Shibasaki K., and Reznikova, V. E.:

2002, Constraints on Electron Acceleration /Injection from NoRH Observations, Proc. of 10th European Solar Physics Meeting, Solar Variability: from Core to Outer Frontiers, ESA SP-506, 257-260.

Miyagoshi, T., and Yokoyama, T.: 2002, Formation of Coronal Magnetic Structure by Emergence of a Twisted Flux Tube Studied by Three-Dimensional MHD Numerical Simulations, Proc. of the IAU 8th Asian-Pacific Regional Meeting, V. II, 447-448.

Miyawaki, R., Hasegawa, T., and Hayashi, M.: 2002, Cluster of Massive Stars and Hot Cores in W49A, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 171-172.

Miyoshi, M., and Kameno, S.: 2002, A Proposal for Constructing a New Sub-mm VLBI Array, Horizon Telescope - Imaging Black Hole Vicinity, IVS General Meetings Proc., 199-202.

Mizumoto, Y., Ohishi, M., Yasuda, N., Shirasaki, Y., Tanaka, M., Masunaga, Y., Miura, K., Monzen, H., Kawarai, K., Ishihara, Y., Yamaguchi, Y., Yanaka, H.: 2003, Construction of the Japanese Virtual Observatory (JVO), Astronomical Data Analysis Software and Systems XII, ASP Conf. Ser., 295, 96.

Morita, K.-I., Nakai, N., Takahashi, T., Miyazawa, K., Ohishi, M., Tsutsumi, T., Takakuwa, S., Ohta, H., and Yanagisawa, K.: 2003, COSMOS-3: The Third Generation Telescope Control Software System of Nobeyama Radio Observatory, Astronomical Data Analysis Software and Systems XII, eds. H. E. Payne, R. I. Jedrzejewski, and R. N. Hook, ASP Conf. Ser. 295, 166.

Murakawa, K., Suto, H., Tamura, M., Takami, H., Takato, N., Hayashi, S. S., Doi, Y., Kaifu, N., Hayano, Y., Gaessler, W., Kamata, Y.: 2003, Near-infrared coronagraph imager on the Subaru 8m telescope, Proc. SPIE, 4841, 881-888.

Murakawa, K., Tamura, M., Suto, H., Miyata, T., Gledhill, T. M., and Hough, J. H.: 2003, Near-infrared high imaging polarimetry of the Red Rectangle, Proc. SPIE, 4843, 196-199.

Nagashima, M., and Yoshii, Y.: 2002, Formation and Evolution of Dwarf Galaxies in a Hierarchical Galaxy Formation Model, ASP Conf. Ser., 289, 279-280.

Nakamura, K., 1 author: 2002, Oscillatory behaviors of gravitating Nambu-Goto membranes - General relativistic gauge invariant perturbation on the flat spacetime background -, Proc. of Eleventh Workshop on General Relativity and Gravitation.

Nakamura, T., Nakai, H., Yoshida, F.: 2002, Objects filling Kirkwood gaps as a source of near-Earth asteroids, Bull. AAS, 34, 3, 14.08.

Nakanishi, K., Saito, M., Furuya, R. S., Shinnaga, H., and Momose, M.: 2003, Flaring Object in Orion Cluster, ed. Green, D. W. E., IAU Circ., 8060, 2.

Nakano, M., Sugitani, K., and Morita, K.-I.: 2002, A Dense Shell Surrounding NGC 2264 IRS1, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 181-182.

Nakata, F., Kodama, T., Shimasaku, K., Doi, M., Furusawa, H., Hamabe, M., Kimura, M., Komiyama, Y., Miyazaki, S., Okamura, S., Ouchi, M., Sekiguchi, M., Yagi, M., and Yasuda, N.: 2003, Environmental Dependence of the Galaxy Population in the Lynx Supercluster Region at z～1.27, Proc. of the IAU 8th Asian-Pacific Regional Meeting, II, ASP Conf. Ser., 289, 283-284.

Nishikawa, J.: 2002, Status report on Mitaka optical and InfraRed Array (MIRA-I.2), Proc. SPIE, Interferometry for Optical Astronomy II, 4838, 101-107.

Oasa, Y., Tamura, M., Nakajima, Y., and Itoh, Y.: 2003, A SUBARU Deep Near-Infrared Survey of the S106 Star-forming Region - the Substellar Population and Mass Function, The Proc. of the IAU 8th Asian-Pacific Regional Meeting, Volume II, Eds. by Ikeuchi, S., Hearnshaw, J., and Hanawa, T., ASP Conf. Ser., 289, 189-190.

Ogasawara, R., Kosugi, G., Takata, T., Mizumoto, Y., Yasuda, N., Yagi, M., Kawarai, K., Kawai, A.: 2002, Peta Byte Data Hierarchy Supporting Real Time Feedback to the Observation by Subaru Telescope: STN-II Observatory Operations to Optimize Scientific Return III. Ed. by Quinn, P. J., Proc. SPIE, 4844, 188-196.

Ogasawara, R., Kosugi, G., Takata, T., Noumaru, J., Sasaki, T., Chikada, Y., Mizumoto, Y., Yagi, M., Yasuda, N., Ichikawa, S., Yoshida, M., Kawarai, K., Ishihara, Y., and Kawai, A.: 2003, The Subaru Telescope Software Trinity System, Astronomical Data Analysis Software and Systems XII, eds. H. E. Payne, R. I. Jedrzejewski, and R. N. Hook, ASP Conf. Ser., 295, 142.

Ogasawara, R., Kosugi, G., Takata, T., Yagi, M., Chikada, Y., Mizumoto, Y., Chiba, K., Inoue, G., Furuichi, M., Iwashita, D.: 2002, Distributed storage and control system of Subaru Telescope on the high-speed wide-area connection Advanced Global Communications Technologies for Astronomy II. ed. R. I. Kibrick, Proc. SPIE, 4845, 8-12.

Ogawa, H., Yonekura, Y., Asayama, S., Kimura, K., Mizuno, A., Mizuno, N., Minamidani, T., Maeda, H., Suzuki, K., Fukui, Y., Andoh, H., Sekimoto, Y., and Noguchi, T.: 2002, ALMA Front-End System for Band 4, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 23-24.

Ohishi, N., Matsuda, K., Torii, Y., Nishikawa, J., Yoshizawa, M., Sato, K., Kubo, K., Iwashita, H., Kotani, T., and, Fukushima, T.: 2002, Wavefront tilt correction system for MIRA-I.2, Proc. SPIE, Interferometry for Optical Astronomy II, 4838, 736-747.

Ohyama, Y., Taniguchi, Y., Iye, M., Yoshida, M., Sekiguchi, K., Takata, T., Saito, Y., Kawabata, K. S., Kashikawa, N., Aoki, K., Sasaki, T., Kosugi, G., Okita, K., Shimizu, Y., Inata, M., Ebizuka, N., Ozawa, T., Yadomaru, Y. Taguchi, H.: 2003, Decomposition of the Superwind in M82, the IAU 8th Asian-Pacific Regional Meeting, ASP Conf. Ser., 289, 285-286.

Ohyama, Y., Taniguchi, Y., Kawabata, K., Shioya, Y., Murayama, T., Nagao, T., Nishiura, S., Takata, T.,

Iye, M., and Yoshida, M.: 2002, On the origin of Lyman-alpha Blobs at High Redshift: Kinematic Evidence for a Hyperwind Galaxy at z=3.1, Bull. AAS, 201, 7904.
Ohyama, Y., Yoshida, M., Kawabata, K. S., Saito, Y., Saga, A. D., Harasawa, S., Kosugi, G., Mizumoto, Y., Iye, M., Ogasawara, R., and 15 coauthors: 2002, GRB020305: Subaru optical observations, GCN, 1271, 1.
Omukai, K., Palla, F.: 2002, On the Formation of Massive Primordial Stars, ApSS, 281, 71.
Onodera, S., Sofue, Y., Koda, J., Nakanishi, H., and Kohno, K.: 2002, CO (J=1-0) Observations of the Non-Barred Seyfert 2 Galaxy NGC 4501, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 199-200.
Otsuki, K., Kajino, T., Wanajo, S., and Tagoshi, H.: 2003, R-process nucleosynthesis in neutrino-driven wind: General relativistic effects and short dynamic timescale model, Proc. Int. Symp. on Origin of Matter and Evolution of Galaxies, eds. T. Kajino, S. Kubono, K.-I. Nomoto, and I.Tanihata, 374-377.
Perrin, G., Lai, O., Woillez, J., Guerin, J., Reynaud, F., Ridgway, S., Lena, P., Wizinowich, P., Tokunaga, A., Nishikawa, J., Rigaut, F., Adamson, A., Guyon O.: 2003, OHANA phase II: a prototype demonstrator of fiber-linked interferometry between very large telescopes, Interferometry for Optical Astronomy II, Proc. SPIE, 4838, 1290-1295.
Quimby, R., Aldering, G., Nugent, P., Amanullah, R., Astier, P., Blanc, G., Burns, M. S., Conley, A., Deustua, S., Doi, M., Ellis, R., Fabbro, S., Folatelli, G., Fruchter, A., Garavini, G., Gibbons, R., Goldhaber, G., Goobar, A., Groom, D. E., Hardin, D., Hook, I. M., Howell, D. A., Irwin, M., Kim, A., Knop, R. A., Lidman, C., McMahon, R., Mendez, J., Nobili, S., Pain, R., Panagia, N., Pennypacker, C. R., Perlmutter, S., Raux, J., Regnault, N., Ruiz-Lapuente, P., Schaefer, B., Schahmaneche, K., Spadafora, A. L., Walton, N., Wang, L., Wood-Vasey, W. M., Yasuda, N., Supernova Cosmology Project Collaboration: 2002, The Host Galaxies of Type Ia Supernovae at High Redshift, Bull. AAS, 201, 23.05.
Saad, A. S. and Kinoshita, H.: 2002, An Analytical Theory of Motion of Nereid, Proc. of US/European Celestial Mechanics Workshop, eds. Pretka-Ziomek et al., 197-204.
Saito, Y., Ohyama, Y., Kashikawa, N., Yoshida, M., Sasaki, T., Kosugi, G., Takata, T., Shimizu, Y., Inata, M., Okita, K., Kawabata, K. S., Sekiguchi, K., Iye, M., Aoki, K., and Ebizuka, N.: 2003, Multi-object spectroscopy of FOCAS: software and its performance, Proc. SPIE, 4841, 1180-1188.
Sakamoto, S.: 2002, Comparison of the Pampa La Bola and Llano de Chajnantor Sites in Northern Chile, Proc. of a workshop "Astronomical site evaluation in the visible and radio range: IAU Technical Workshop", eds. J. Vernin, Z. Benkhaldom, C. Munoz-Tunon, ASP Conf. Ser., 266, 440-447.
Sakamoto, S.: 2002, Detailed Structure and Kinematics of Low-Density Molecular Gas in Nearby Molecular Cloud Edges, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 203-204.
Sakamoto, T., Chiba, M., Beers, T. C.: 2002, New Limits on the mass of the Milky Way, In: Dynamical friction strikes back. Proc. of the 34th Symp. on Celestial Mechanics, eds. E. Kokubo, T. Ito, and H. Arakida, 38-77.
Sakamoto, T., Chiba, M., Beers, T. C.: 2003, New Limits on the mass of the Milky Way, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, eds. S. Ikeuchi, J. Hearnshaw, and T. Hanawa, ASP Conf. Ser., 289, 291-292.
Sakurai, T., and Suematsu, Y.: 2002, Observational Solar Cycle Studies at the National Astronomical Observatory of Japan, International Solar Cycle Study (ISCS), ed. M. A. Shea, Adv. Sp. Res., 29, 1565-1568.
Sakurai, T., Choudhary, D. P., and Venkatakrishnan, P.: 2002, Useful Aspects of Chromospheric Magnetic Field Data, "Solar-Terrestrial Magnetic Activity and Space Environment", eds. H. N. Wang and R. L. Xu, COSPAR Colloq. Ser., 14, 37-40.
Sakurai, T., Ichimoto, K., Raju, K. P., and Singh, J.: 2002, Spectroscopic Observations of Coronal Oscillations, "Multi-Wavelength Observations of Coronal Structure and Dynamics — Yohkoh 10-th Anniversaty Meeting", eds. P. C. H.Martens and D. P. Cauffman, COSPAR Colloq. Ser., 13, 25-26.
Sakurai, T., Yokoyama, T., Kusano, K., and Maeshiro, T.: 2002, Magnetic Helicity Injection, Free Energy Loading, and Solar Flares, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, eds. S. Ikeuchi, J. Hearnshaw, and T. Hanawa, 459-460.
Sato, F., Hasegawa, T., Dobashi, K., Kandori, R., and Whiteoak, J. B.: 2002, Chemical Evidence for a Large-Scale Cloud Collision in Sagittarius B2, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 205-206.
Sato, K., Nishikawa, J., Yoshizawa, M., Ohishi, N., Fukushima, T., Torii, Y., Matsuda, K., Kubo, K., Iwashita, H., Suzuki, S., Kotani, T., and Yokoi, T.: 2002, The instrumentation, object stars and the first observations of MIRA-I.2 (Mitaka optical and Infra-Red Array), Proc. SPIE, Interferometry for Optical Astronomy II, 4838, 1072-1079.
Sato, T., Tamura, Y., Matsumoto, K., Imanishi, Y., and McQueen, H.: 2002, Parameters of the fluid core resonance estimated from superconducting gravimeter data, Marees Terrestres Bulletin D'Informations, 136, 10751-10759.
Sawada, T., Hasegawa, T., Handa, T., Morino, J., Usuda, K. S., Sorai, K., Oka, T., Seta, M., Sakamoto, S., Hayashi, M., Booth, R., Bronfman, L., Luna, A. C., Nyman, L. Å., Shaver, P., and Cohen, R.: 2002, Physical Conditions and Structure of Molecular Gas in the Galactic Center, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 207-208.
Sawada-Satoh, S., Inoue, M., Shibata, K. M., Kameno, S., Nakai, N., Migenes, V., and Diamond, P. J.: 2002, Proper Motion of a Nuclear Jet Relative to a Maser

Feature in NGC 3079, Proc. of the IAU Symp. 206, Cosmic MASERs: From Protostars to Blackholes, eds. V. Migenes and M. J. Reid, 404-407.
Schuh, S. L., Nagel, T., Deetjen, J. L., Dreizler, S., Handler, G., O'Brien, M. S., Riddle, R., Hurkal, O., Pakstiene, E., Klumpe, E., Lawrence, T., Vuckovic, M., Zola, S., Kawaler, S., Kanaan, A., Giovannini, O., Kepler, S. O., Mukadam, A., Provencal, J., Nitta, A., Shipman, H., Mullally, F., Grauer, A., Wood, M. A., Bradley, P. A., Kilic, M., Sekiguchi, K., Crowe, R., Sullivan, D., Rosen, R., Clemens, C., Xiaojun, J., Janulis, R., O'Donoghue, D., Ogloza, W., Baran, A., Silvotti, R., Marinoni, S., Vauclair, G., Dolez, N., Chevreton, M., Gonzalez, J. M., Solheim, J.-E., Ulla, A., Burleigh, M., Good, S., Metcalfe, T., da Costa, A. F. M., Costa, J. E. S., Kim, S.-L., Lee, H., Sergeev, A., Akan, C., Cakirli, Ö., Paparo, M., Viraghalmy, G.: 2003, Preliminary results of the WET Xcov22 campaign at Calar Alto Observatory, White Dwarfs, NATO Science Series II - Mathematics, Physics and Chemistry, 105, 263.
Sekiguchi, T., Hasegawa, H., Sunada, K., Ukita, N., Kawakita, H., Watanabe, J., and Krishna Swamy, K. S.: 2002, HCN observations of C/Ikeya-Zhang using the NRO 45 m telescope, Proc. Asteroids, Comets, Meteors - ACM 2002., ESA SP-500, 701-703.
Sekii, T., and Shibahashi, H.: 2003, On Averaged Time-Distance Autocorrelation Diagrams, SOHO12 / GONG +2002: Local and Global Helioseismology: The Present and Future, ed. H. Sawaya-Lacoste, ESA Publication Division, 389-392.
Sekii, T., Shibahashi, H., and Kosovichev, A. G.: 2003, Autocorrelation Analysis of MDI High-Frequency Data, SOHO12 /GONG +2002: Local and Global Helioseismology: The Present and Future, ed. H. Sawaya-Lacoste, ESA Publication Division, 385-388.
Sekimoto, Y., Ueda, A., Okuda, T., Bryerton, E., Sugimoto, M., Matsuo, H., Yokogawa, S., Noguchi, T., Ishiguro, M., Ito, H., Nagatsuma, T., Hirata, A., and Payne, J. M.: 2003, Noise Evaluation of Hybrid Photonic Local Oscillator at 500 GHz, ALMA memo, 449.
Shibasaki, K.: 2002, A New Solar Flare Scenario: High-Beta Plasma Disruption, Proc. of 10th European Solar Physics Meeting, Solar Variability: From Core to Outer Frontiers, ESA SP-506, 749-751.
Shibata, K. M., Asada, K., Mochizuki, N., Kameno, S., Kuno, N., Umemoto, T., Sunada, K., Mikoshiba, H., Bushimata, T., Kobayashi, H., Inoue, M., Chung, H. S., Roh, D. G., Kim, K. D., Han, S. T., Kim, H. G., Minh, Y., and Cho, S. H.: 2002, Millimeter-Wave VLBI Observations Between TRAO 14-m and NRO 45-m Radio Telescopes, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 29-30.
Shimizu, T.: 2002, Connection between Photospheric Magnetic Fields and Coronal Structure /Dynamics, Multi-Wavelength Observations of Coronal Structure and Dynamics — Yohkoh 10th anniversary Meeting, eds., P. C. H. Martens and D. Cauffman, COSPAR Colloq. Ser., 13, 29-38.
Shimizu, T.: 2002, Solar-B, Solar Variability and Solar Physics Missions, eds. C. Fröhlich, J. M. Pap, L. Damé, and E. Marsch, Adv. Space Res., 29, 2009-2015.
Shimojo, M., Hara, H., and Kano, R.: 2002, The Temperature Analysis of Yohkoh/SXT Data Using the CHIANTI Spectral Database, eds. P. C. H. Martens and D. P. Cauffman, COSPAR Colloq. Ser., 13, 419-420.
Shin, J., and Sakurai, T.: 2002, The Point Spread Function of Yohkoh Soft X-Ray Telescope, Multi-Wavelength Observations of Coronal Structure and Dynamics — Yohkoh 10-th Anniversaty Meeting, eds. P. C. H. Martens and D. P. Cauffman, COSPAR Colloq. Ser., 13, 421-422.
Shirasaki, Y., Kawai, N, Yoshida, A., Tamagawa, T., Torii, K., Sakamoto, T., Matsuoka, M., Fenimore, E. E., Galassi, Mark C., Lamb, D. Q., Graziani, C., Donaghy, T. Q., Vanderspek, R. K., Yamauchi, M., Tagagishi, K., Hatsukade, I.: 2003, In-orbit performance of wide-field x-ray monitor on HETE-2, X-Ray and Gamma-Ray Telescopes and Instruments for Astronomy, eds. Joachim, E. T., Harvey, D. T., Proc. SPIE, 4851, 1310-1319.
Slysh, V. I., Voronkov, M. A., Val'tts, I. E., Migenes, V., Shibata, K. M., Umemoto, T., and Inoue, M.: 2002, Space-VLBI Observations of OH Masers, Proc. of the IAU Symp. 206, Cosmic MASERs: From Protostars to Blackholes, eds. V. Migenes and M. J. Reid, 105-111.
Suda, H., Honma, M., Kobayashi, H., Kawaguchi, N., Sasao, T., and VERA team: 2002, Instrumental Delay Calibration in the VERA System, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 31-32.
Sudou, H., Iguchi, S., Murata, Y., and Taniguchi, Y.: 2002, Measurements of the Black-Hole Position in Active Galactic Nuclei by Phase-Referencing VLBI Observations, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 403-404.
Sugano, T., and Heki, K.: 2002, High resolution lunar gravity anomaly map from the Lunar Prospector line-of-sight acceleration data, Proc. 35th ISAS Lunar Planet. Symp., 223-226.
Sugimoto, M., Hasegawa, T., Handa, T., Sawada, T., Yamamoto, F., and Naito, S.: 2002, Comparison of Properties of Clumps in the Inner Galaxy with Those in the Solar Neighborhood, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 211-212.
Sugitani, K., Tamura, M., Nakaya, H., Nakajima, Y., Nagashima, C., Nagayama, T., Baba, D., Nagata, T., Sato, S., Nakano, M., Pickles, A. J., Kawamura, A., Sunada, K., and Ogura, K.: 2003, Deep Near-IR and $H^{13}CO^+$ (J=1-0) Observations of BRC38 (IC1396N), Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, Eds. by Ikeuchi, S., Hearnshaw, J., and Hanawa, T., ASP Conf. Ser., 289, 213-214.
Sugiyama, N.: 2002, CMB can Probe Dark Ages, Int. Conf. on "High-z Clusters, Missing Baryons, and CMB Polarization", ASP Conf. Ser., 257, 259-270.
Suzuki, T. K., Yoshii, Y., Kajino, T., and Beers, T. C.:

2003, Light elements in inhomogeneous early Galaxy and their astrophysical interests, Proc. Int. Symp. on Origin of Matter and Evolution of Galaxies, eds. T. Kajino, S. Kubono, K.-I. Nomoto, and I. Tanihata, 23-30.

Takagi, T., and Arimoto, N.: 2002, The spectral evolution of elliptical galaxies in FIR and beyond, Cosmic Chemical Evolution, Proc. of the IAU Symp 187, 237.

Takami, H., Takato, N., Hayano, Y., Gaessler, W., Iye, M., Kamata, Y., Kanzawa, T., Minowa, Y.: 2003, Performance of Subaru adaptive optics system and the scientific results, Proc. SPIE, 4839-03.

Takami, H., Takato, N., Hayano, Y., Iye, M., Kamata, Y., Minowa, Y., Kanzawa, T., Gaessler, W.: 2003, Performance of Subaru adaptive optics system and the scientific results, Proc. SPIE, 4839, 21-31.

Takata, T., Yagi, M., Yasuda, N., Ogasawara, R.: 2002, Distributed data archive systems for Subaru Telescope, Observatory Operations to Optimize Scientific Return III., Proc. SPIE, 4844, 242-249.

Takato, N., Usuda, T., Tanaka, W.: 2003, Performance of active mirror support of the Subaru Telescope, Proc. SPIE, 4837, 675-680.

Tamura, M., Fukagawa, M., Murakawa, K., Suto, H., Itoh, Y., and Doi, Y.: 2003, Near-infrared polarimeter for the Subarau telescope, Proc. SPIE, 4843, 190-195.

Tamura, Y., and VERA Group: 2002, Geodetic Observation System in VERA, International VLBI Service for Geodesy and Astrometry, General Meeting Proc., eds. N. R. Vandenberg, and K. D. Baver, 167-170.

Terasawa, M., Sumiyoshi, K., Kajino, T., Tanihata, I., Mathews, G. J., and Langanke, K.: 2002, The critical role of Light neutron-rich nuclei in the r-process nucleosynthesis, Proc. Int. Symp. on Origin of Matter and Evolution of Galaxies, eds. T. Kajino, S. Kubono, K.-I. Nomoto and I. Tanihata, 378-380.

Tosaki, T., Shioya, Y., Kuno, N., Nakanishi, K., and Hasegawa, T.: 2002, Detection of Molecular Clouds in the Interarm Region of Flocculent Galaxy NGC5055, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 221-222.

Tsujimoto, M., Koyama, K., Imanishi, K., Kobayashi, N., Saito, M., and Tsuboi, Y.: 2002, Radio Centimeter Emissions at a Protostellar Core in OMC-3 and its Association with X-ray and NIR, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 223-224.

Tsujimoto, T., Shigeyama, T., and Yoshii, Y.: 2002, The site for r-process nucleosynthesis, Astrophys. and Spa. Sci. 281, 221-222.

Tsujimoto, T., Yoshi, Y., and Kawara, K.: 2002, Age problem based on the abundance ratio from a high-redshift QSO, Cosmic Chemical Evolution, IAU Symp. 187, 153-157.

Tsutsumi, T., Miyazaki, A., and Tsuboi, M.: 2002, Flares from Sagittarius A* at Millimeter Wavelengths, American Astronomical Society Meeting, 200, #44.09.

Uehara, H., Dobashi, K., Kandori, R., and Sato, F.: 2002, A Museum of Dark Clouds on the Internet, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 109-110.

Ujihara, H., Chikada, Y., and Nakahira, K.: 2002, Aperture Efficiency of 90-cm Film Lens Antennas, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 33-34.

Umemoto, T., Imai, H., Furuya, R. S., Kitamura, Y., and Kawabe, R.: 2002, VLBI Observations of H_2O Masers in the LkH α 234 Star-Forming region, Proc. of the IAU Symp. 206, Cosmic MASERs: From Protostars to Blackholes, eds. V. Migenes and M. J. Reid, 76-79.

Umemoto, T., Kamazaki, T., Sunada, K., Kitamura, Y., and Hasegawa, T.: 2002, Fragmentation in the r Ophiuchi Cluster Forming Region, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 229-230.

Uraguchi, F., Takato, N., Miyashita, A., Yanagisawa, K., and Okada, N.: 2003, DIMM with large aperture separation and simultaneous seeing measurements at Mauna Kea, Proc. SPIE, 4837, 864-871.

Usuda, T., Takato, N., Morino, J., Kosugi, G., Miyashita, A., Noumaru, J., Kanzawa, T., Hayashi, S. S., Letawsky, M., Yamashita, T., Itoh, N., Tanaka, W.: 2003, Subaru Telescope: Current Performances and Future Upgrade Plans, Proc. SPIE, 4837, 831-842.

Usui, F., Ishiguro, M., Kwon, S. M., Fujino, M., Lee, C., Nakamura, R., Sekiguchi, K., Miyashita, A., Nakagiri, M., Ueno, M., Mukai, T.: 2003, WIZARD: A New System for Observing Zodiacal Light, The Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, eds. S. Ikeuchi, J. Hearnshaw, and T. Hanawa, ASP Conf. Ser., 289, 231-232.

Vazdekis, A., Salaris, M., Arimoto, N., and Rose, J. A.: 2002, 47 Tucanae: the Spectroscopic versus CMD Age Discrepancy, Extragalactic Star Clusters, Proc. of the IAU Symp. 207, 610.

Wajima, K., Kawaguchi, N., Murata, Y., and Hirabayashi, H.: 2002, Radiation Testing of High-Speed LSIs for the Next Generation Space VLBI Satellite, Proc. of the 5th International Workshop on Radiation Effects of Semiconductor Devices for Space Applications, 145-148.

Wajima, K., Kawaguchi, N., Murata, Y., and Hirabayashi, H.: 2002, Radiation Testing of High-Speed LSIs for the next Space VLBI Mission, Proc. of New Technologies in VLBI, 41-44.

Wajima, K., Kawaguchi, N., Murata, Y., and Hirabayashi, H.: 2002, Radiation Testing of High-Speed LSIs for the Next Space VLBI Satellite, Proc. of URSI General Assembly, J8, 5.

Watanabe, J., and Kawakita, H.: 2002, Comets as fossils for exploring the solar nebula - implication from spin temperature of cometary molecules, Proc. Asteroids, Comets, Meteors - ACM 2002., ESA SP-500, 779-782.

Watanabe, J., Tabe, I., Hasegawa, H., Hashimoto, T., Fuse, T., Yoshikawa, M., Abe, S., and Suzuki, B.: 2002, Meteoroid clusters - evidence of fragmentation in space, Proc. Asteroids, Comets, Meteors - ACM 2002., ESA SP-500, 277-279.

Yahagi, H., and Yoshii, Y.: 2003, Parallelization and

Vectorization of the AMR N-body code, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, ASP Conf. Ser., 289, 305-306.
Yamamoto, F., Hasegawa, T., Sawada, T., Sugimoto, M., Naitoh, S., Handa, T., and Sofue, Y.: 2002, Survey of Molecular Clouds around Galactic SNRs, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 235-236.
Yanagisawa, K., Nakada, Y., Izumiura, H., Watanabe, E., Shimizu, Y., Okada, N., Okita, K., Norimoto, Y., Okada T., Koyanao, H., and Yoshida, M.: 2002, Wide-field Monitoring of the Galactic Plane in the K- and H-band, The Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, eds. S. Ikeuchi, J. Hearnshaw, and T. Hanawa, 83-84.
Yano, T., Kan-ya, Y., and Gouda, N.: 2002, Dynamics of Stellar Orbits in Disk Galaxies, Disks of Galaxies: Kinematics, Dynamics and Peturbations, ASP Conf. Proc., 275, 173.
Yasuda, N., Prasad, V., Sainton, G., Smith, E., Spadafora, A., Doi, M., Nariai, K., Watanabe, M., Urata, Y., Kashikawa, N., Yamada, T., Ouchi, M., Murayama, T., Shimasaku, K.: 2002, Supernovae 2002fc, 2002fd, 2002fe, 2002ff, 2002fg, 2002fh, IAUC, 7971, 2.
Yokogawa, S., Kitamura, Y., Momose, M., and Kawabe, R.: 2002, Aperture Synthesis Observations of Protoplanetary Disks with the Nobeyama Millimeter Array, Proc. of the IAU Colloq. 181, Dust in the Solar System and Other Planetary Systems, eds. S. F. Green, I. P. Williams, J. A. M. McDonnell, and N. McBride, 217-220.
Yokogawa, S., Kitamura, Y., Momose, M., and Kawabe, R.: 2002, Deep ^{13}CO ($J=1-0$) Imaging of the Protostar Haro 6-5B: Discovery of Rotational Motion in the Protostellar Disk, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 239-240.
Yokoyama, T., and Shibata, K.: 2002, MHD Simulation of a Solar Flare and Derived Scaling Law between the Temperature and the Emission Measure of Stellar / Solar Flares, Proc. of a Symp. Stellar Coronae in the Chandra XMM-Newton Era, eds. F. Favata, and J. J., Drake, ASP Conf. Ser., 277, 615-619.
Yokoyama, T.: 2002, MHD Simulation of a Solar Flare Based on the Magnetic Reconnection Model, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, 473-474.
Yoon, T. S., Yoo, K. H., Kim, K. M., Kang, Y. H., Kim, J. H., Lee, O. K., Lee, J. A., Kim, S. H., Son, D. H., Izumiura, H., and Tamura, S.: 2002, Spectroscopic and Photometric Observations of Symbiotic Stars in South Korea and Japan, Proc. of the IAU 8th Asian-Pacific Regional Meeting, 2, eds. S. Ikeuchi, J. Hearnshaw, and T. Hanawa, 475-475.
Yoshida, M., Shimizu, Y., Watanabe, E., Yanagisawa, K., and Uraguchi, F.: 2002, New Control Software of the 188cm Telescope of Okayama Astrophysical Observatory, Proc. SPIE, 4848, 425-433.
Yoshizawa, M., Sato, K., Nishikawa, J., Ohishi, N., and, Kotani, T.: 2002, Large stellar interferometer MIRA-ST, Proc. SPIE, Interferometry for Optical Astronomy II, 4838, 1282-1289.

5. Presentations

Abe, S., Yano, H., Ebizuka, N., Kasuga, T., Watanabe, J., Ogasawara, R., and Fuse, T.: 2002, First detection of OH emission from meteor spectrum, 03-25 poster, Asteroids, Comets, Meteors - ACM 2002, (Germany, July 29-Aug. 2).

Abe, S., Yano, H., Ebizuka, N., Kasuga, T., Watanabe, J., Ogasawara, R., and Fuse, T.: 2002, UV video spectroscopy of Leonid fireballs and persistent trains, International Science Symposium on the Leonid Meteor Storms, (Tokyo, May 2-5).

Arai, K., and the TAMA collaboration: 2002, TAMA300: Status Report, Gravitational Wave Advanced Detector Workshop 2002, (Italy, May 20-25).

Arimoto, N.: 2002, Star Formation Histories of Galaxies derived from the Hess Diagram, Euro Conference Kiel 2002, The Evolution of Galaxies III. From Simple Approach to Self-Consistent Models, (Kiel, Germany, Jul. 16-20).

Barucci, M. A., Boehnhardt, H., de Bergh, C., Dotto, E., Doressoundiram, A., Lazzarin, M., Romon, J., Tozzi, G. P., Fornasier, S., Barrera, L., Birkle, K., Delsanti, A., Hainaut, O., Meech, K., Ortiz, J. L., Sekiguchi, T., Thomas, N., Watanabe, J., and West, R. M.: 2002, Visible and Infrared spectroscopy of the Centaurs and TNOs from ESO Large Program, 01-06 oral, Asteroids, Comets, Meteors - ACM 2002, (Germany, July 29-Aug. 2).

Barucci, M. A., Boehnhardt, H., Dotto, E., Lazzarin, M., Romon, J., de Bergh, C., Doressoundiram, A., Tozzi, G. P., Fornasier, S., Davies, J., Peixinho, N., Barrera, L., Birkle, K., Delsanti, A., Hainaut, O., Meech, K., Ortiz, J. L., Sekiguchi, T., Thomas, N., Watanabe, J., and West, R. M.: 2002, #07.07, ESO Large Program: Results from Visible and Infrared spectroscopy of Centaurs and TNOs, American Astronomical Society, 34th DPS meeting, (U.S.A., Oct. 6-11).

Famiano, M. A., Boyd, R. N., and Kajino, T.: 2002, Light Element Nucleosynthesis From Jet-Cloud Interactions in Active Galactic Nuclei, The 7th Int. Symp. on Nuclei in the Cosmos, (Japan, Jul. 7-12).

Fujii, T., Nakada, Y.: 2002, Near-Infrared Monitoring to study the Transition from AGB to Post-AGB Stars, Mass-losing Pulsating Stars and their Circumstellar Matter, (Sendai, May 13-16).

Fujita, Y., Sarazin, C. L., Kempner, J. C., Rudnick, L., Slee, O. B., Roy, A. L., Andernach H., and Ehle, M.: 2002, Chandra Observations of the Disruption of the Cool Core in Abell 133, Matter and Energy in Clusters of Galaxies, (Taiwan, Apr. 23-27).

Fujita, Y., Sarazin, C. L., Nagashima, M., and Yano, Y.: 2002, Analytical Approach to the Mass Distribution Function of Subhalos and Cold Fronts in Galaxy Clusters, IAU 8th Asian-Pacific Regional Meeting,

(Tokyo, Jul. 2-5).
Fujita, Y., Takizawa, M., and Sarazin, C. L.: 2002, Nonthermal Emissions from Particles Accelerated by Turbulence in Clusters of Galaxies, XXI Texas Symp. on Relativistic Astrophysics, (Florence, Italy, Dec. 9-13).
Fujita, Y.: 2003, The Age and Number of Galaxies in Clusters: Are Galaxy Groups Unvirialized Galaxy Clusters? Probes of Cosmological Structure and Galaxy Evolution, (Pasadena, U.S.A., Jan. 27-31).
Gouda, N., Tsujimoto, T., Kobayashi, Y., Nakajima, T., Yasuda, N., Kan-ya, Y., Matsuhara, H., Yano, T., Yamada, Y., and Ueno, M.: 2002, IR Space Astrometry, Mass-Losing Pulsating Stars and their Circumstellar Matter, (Sendai, May 13-16).
Hachisuka, K., Miyoshi, M.: 2002, Phase Reference VLBI Astrometry for Mira-Type Stars, Mass-losing Pulsating Stars and their Circumstellar Matter, (Sendai, May 13-16).
Hamane, T., Yano, H., Yoshida, M., and Watanabe, J.: 2002, Gas-to-dust ratio and chemical composition in comet 55P/Tempel-Tuttle, International Science Symposium on the Leonid Meteor Storms, (Tokyo, May 2-5).
Hasegawa, H., Sekiguchi, T., Ukita, N., Sunada, K., Matsuo, H., Kawakita, H., and Watanabe, J.: 2002, Radio Observations of Comets using NRO 45m, Solar System Science, Satellite Meeting IAU 8th Asian-Pasific Regional Meeting, (Tokyo, July 6).
Heki, K.: 2002, Seasonal crustal deformation in Japan, revisited, AGU Fall Meeting, (San Francisco, Dec. 6-10).
Heki, K.: 2002, Secular, transient and periodic crustal deformation observed in the Japanese nationwide GPS array, Weikko A. Heiskanen Symposium in Geodesy, (Ohio State University, Columbus, Oct. 1-4).
Heki, K.: 2002, Secular, transient and periodic crustal movements in Japanese subduction Zones, and dynamics underlying them. The Seismogenic Zone Experiment Revisited (SEIZE2003), (Snowbird, Mar. 16-20).
Honda, M., Yamashita, T., Kataza, H., Miyata, T., Okamoto, Y. K., Sako, S., Takubo, S., Onaka, T.: 2002, Mid-infrared Spectroscopic Observations of Old CTTSs, Chemistry as a Diagnostic of Star Formation, (Canada, Aug. 21-23).
Honda, S., Aoki, W., Ando, H., Kajino, T.: 2002, New Detections of r-Process Elements in Extremely Metal-Poor Stars with Subaru/HDS, Nuclei in the Cosmos VII, (Fujiyoshida, Jul. 8-12).
Ichiki, K., Yahiro, M., Kajino, T., Orito, M., and Mathews, G. J.: 2002, Constraints on Dark Radiation in Brane Cosmology, The 7th Int. Symp. on Nuclei in the Cosmos, (Japan, Jul. 7-12).
Ichiki, K., Yahiro, M., Kajino, T., Orito, M., and Mathews, G. J.: 2002, Constraints on the nature of cosmological constant: from Big-Bang Nucleosynthesis and CMB anisotropies, The 7th Int. Symp. on Nuclei in the Cosmos, (Japan, Jul. 7-12).
Imai, H., Deguchi, S., Nakashima, J., Miyazaki, A., Kameya, O., Fujii, T., Ita, Y., Nakada, Y., Izumiura, H., Glass, L. S.: 2002, SiO Maser Survey towards the Stellar Cluster at the Galactic Center, Mass-Losing Pulsating Stars and their Circumstellar Matter, (Sendai, May 13-16).
Imanishi, M.: 2002, 3-4 Micron Spectroscopy of Seyfert 2 Nuclei to Quantitatively Assess the Energetic Importance of Compact Nuclear Starbursts, IAU 8th Asian-Pacific Regional Meeting, (Japan, Jul. 2-5).
Imanishi, M.: 2002, 3-4 Micron Spectroscopy of Seyfert 2 Nuclei, Active Galactic Nuclei: from Central Engine to Host Galaxy, (France, Jul. 23-27).
Imanishi, M.: 2002, Buried AGNs in LINER-Type ULIRGs, Active Galactic Nuclei: from Central Engine to Host Galaxy, (France, Jul. 23-27).
Inoue, S., and Nagashima, M.: 2002, Gamma-rays from Large-Scale Shocks in the Universe, Int. Conf. "The Universe Viewed in Gamma-Rays", (Kashiwa, Japan, Sept. 26-28).
Inoue, S., and Nagashima, M.: 2002, Merger Shocks and Nonthermal Emission From Clusters: A Semi-analytic Approach, Internal Conf. on "Matter and Energy in Clusters of Galaxies", (Taipei, Apr. 25).
Inoue, S., and Suzuki, T. K.: 2002, Cosmic Ray Production of ^{6}Li by Structure Formation Shocks in the Early Galaxy, Int. Conf. "Nuclei in the Cosmos VII", (Fuji-Yoshida, Japan, Jul. 8-12).
Inoue, S., Iwamoto, N., Orito, M., and Terasawa, M.: 2002, Nucleosynthesis of Light and Heavy Elements in Failed Gamma-Ray Burst Fireballs, Int. Conf. "Gamma-ray Bursts in the Afterglow Era: 3rd Workshop", (Rome, Italy, Sept. 17-20).
Inoue, S.: 2003, High Energy Particles from Intergalactic Shocks, Int. Symp. "Toward Very High Energy Particle Astronomy", (Kashiwa, Japan, Mar. 19-21).
Ishiguro, M., Watanabe, J., Usui, F., Tanigawa, T., and Mukai, T.: 2002, First Detection of an Optical Dust Trail along the Orbit of 22P/Kopff, 07-35 poster, Asteroids, Comets, Meteors - ACM 2002, (Germany, July 29-Aug. 2).
Ishikawa, K., Ozawa, T., Yadoumaru, Y., Kinoshita, S., and Watanabe, J.: 2002, Leonids' movie taken with an electric-cooled color CCD camera, International Science Symposium on the Leonid Meteor Storms, (Tokyo, May 2-5).
Iwamoto, N., Mathews, G. J., Fujimoto, M. Y., Kajino, T., and Aoki, W.: 2002, A new model for s-process nucleosynthesis in low-mass, low-metallicity AGB stars, The 7th Int. Symp. on Nuclei in the Cosmos, (Japan, Jul. 7-12).
Izumiura, H.: 2002, Violet Spectra of Carbon Stars Associated with Silicate Features, Mass-Losing Pulsating Stars and Their Circumstellar Matter, (Sendai, Japan, May 13-16).
Izumiura, H.: 2003, A White Dwarf Companion to the Silicate Carbon Star BM Gem, International Symposium on New Trends of Physics, Part2, (Sapporo,

Japan, Mar. 17-19).

Ji, J., Liu, L., Li, G., Kinoshita, H., and Nakai, H.: 2002, Stability Mechanism of the HD 82943 Planetary System, IAU Colloq. 189, (Nanjin).

Kajino, T., Ichiki, K., Orito, M., Yahiro, M., Otsuki, K., Mathews, G. J., and Wanajo, S.: 2002, Recent Progress in Cosmology and Nuclear Astrophysics, XVI Particle and Nuclei Int. Conf., (Japan, Sept. 30-Oct. 4).

Kajino, T.: 2002, New Paradigms in Primordial Nucleosynthesis: Implications in CMB, GW, and Brane Cosmology, INT-02-1 Nucleosynthesis Program, (USA, Mar. 25-Jun. 28).

Kajino, T.: 2002, Quest for supernova r-process: New data in astronomy and nuclear physics, and theoretical modeling, The 7th Int. Symp. on Nuclei in the Cosmos, (Japan, Jul. 7-12).

Kajino, T.: 2002, Ultra-High Energy Neutrinos from Cosmic Sites, Int. Collaboration Meeting on the Observatory for Multi Flavour Neutrinos from Supernovae, (U.S.A., May 23-24).

Kameya, O.: 2002, Mizusawa 10m Antenna System for Study of Pulsating Stars, Symp. on Mass-losing Pulsating Stars and their Circumstellar Matter-Newest Results of Observations and Theory-, (Sendai, Japan, May 13-16).

Kasuga, T., Ebizuka, N., Abe, S., Yano, H., Fujiwara, A., Watanabe, J., and Yamamoto, T.: 2002, High definition TV spectra of 1999-2001 Leonids in Vis-UV region, International Science Symposium on the Leonid Meteor Storms, (Tokyo, May 2-5).

Kawabata, K., Tanikawa, K., and Sôma, M.: 2002, TT−UT in the 7th century derived from astronomical records in the Nihongi and the Suishu, Astronomical Instruments and Archives from the Asia-Pacific Region, (Cheongju, Korea, July 2-5).

Kawakita, H., and Watanabe, J.: 2002, Ortho-to-para Ratio of Cometary Ammonia in Comet Hale-Bopp: What is indicated by Ortho-to-para ratio of Cometary Molecules?, B1.1-0043-02 poster The World Space Congress, 34-th Scientific Assembly of the Committee on Space Research (COSPAR), (U.S.A., Oct. 10-19).

Kawakita, H., and Watanabe, J.: 2002, Revised g-factors of Cometary NH_2: Ammonia abundances in Comets, 21-04 oral, Asteroids, Comets, Meteors - ACM 2002, (Germany, July 29-Aug. 2).

Kawakita, H., and Watanabe, J.: 2002, Unidentified Molecular Bands in Comet Ikeya-Zhang (C/2002 C1), 21-18 poster, Asteroids, Comets, Meteors - ACM 2002, (Germany, July 29-Aug. 2).

Kawakita, H., Watanabe, J., and Fuse, T.: 2002, Ortho-to-Para Ratio of Cometary Ammonia, Solar System Science, Satellite Meeting IAU 8th Asian-Pasific Regional Meeting, (Tokyo, July 6).

Kawamura, S.: 2002, Bridging the Gap between Terrestrial Detectors and LISA, Gravitational Wave Advanced Detector Workshop, (Italy, May 19-26).

Kawamura, S.: 2002, Deci-hertz Interferometer Gravitational Wave Observatory (DECIGO), 7th Gravitational Wave Data Analysis Workshop, (Kyoto, Japan, Dec. 17-19).

Kawamura, S.: 2002, Resonant Sideband Extraction (RSE) with the Third Harmonic Demodulation, Gravitational Wave Advanced Detector Workshop, (Italy, May 19-26).

Kawamura, S.: 2002, Status and Plans for Future Generations of Ground-based Interferometric Gravitational-Wave Antennas, 4th International LISA Symposium, (U.S.A., Jul. 19-24).

Kawamura, S.: 2003, DECIGO-Japanese Space Gravitational Wave Detector, International Workshop on GPS Meteorology, (Japan, Jan. 14-17).

Kinoshita, D., Yamamoto, N., Watanabe, J., Fuse, T., Ida, S., and Nagasawa, M.: 2002, Wide-Field Survey near the Ecliptic with Subaru Telescope, Solar System Science, Satellite Meeting of the International Solar System Science, Satellite Meeting IAU 8th Asian-Pasific Regional Meeting, (Tokyo, July 6).

Kodama, T.: 2002, Large Scale Environmental Effects in Clusters of Galaxies, Int. conf. on Matter and Energy in Clusters of Galaxies, (Taipei, Apr. 25).

Komiyama, Y.: 2002, Wide-Field Imaging Survey of the Dwarf Irregular Galaxy NGC6822, Lowell Workshop: The Outer Edges of Dwarf Irregular Galaxies, (U.S.A., Oct. 10-11).

Koyama, H., and Inutsuka, S.: 2002, A Mechanism of Energy Supply to Interstellar Turbulence, Star Formation Workshop, (Taiwan, Jun. 12-17).

Koyama, H., and Inutsuka, S.: 2002, Production and Dissipation Mechanisms of Interstellar Turbulence Driven by Thermal Instability, IAU Symposium, (Tokyo, Jul. 2-5).

Kurayama, T., Sasao, T.: 2002, Annual Parallax Measurements of Mira-Type Variables with Phase-Reference VLBI Observation, Mass-Losing Pulsating Stars and their Circumstellar Matter, (Sendai, May 13-16).

Machida, M., Tomisaka, K., Matsumoto, T.: 2003, Binary Star Formation and Mass Outflow in the Molecular Cloud Core - MHD Nested Grid Simulation -, The Eighth Int. Symp. on Simulation, (Hayama, Mar. 5).

Machida, M., Tomisaka, K., Matsumoto, T.: 2002, Nonaxisymetric Evolution of Cloud Cores and Mass Outflows −MHD Nested Grid Simulation−, The Int. Astronomical Union 8th Asian-Pacific Regional Meeting, (Tokyo, July 2).

Machida, M., Tomisaka, K., Matsumoto, T.: 2003, Binary Star Formation and Mass Outflows -MHD Nested Grid Simulations-, IAU Colloq. 191, The environment and evolution of double and multiple stars, (Mexico, Feb. 3).

Machida, M., Tomisaka, K., Matsumoto, T.: 2003, Non-axisymmetric evolution of molecular cloud core and fragmentation condition, Int. Symp. on New Trend of Physics, Part II, (Hokkaido, Mar. 18).

Miyoshi, M.: 2002, VLBA Observation of the v=1 and SiO J=1-0 Maser Emissions in VY CMa, Mass-

Losing Pulsating Stars and their Circumstellar Matter, (Sendai, May 13-16).
Mobasher, B., Bridges, T. J., Carter, D., Poggianti, B. M., Komiyama, Y., Kashikawa, N., Doi, M., Iye, M., Sekiguchi, M., and 3 authors: 2002, Galaxies in the Coma Cluster. V. Dependence of the Spectroscopic Properties on Location in the Cluster yCat, 21370279.
Mochizuki, N., Miyoshi, M.: 2002, A Comparison of the SiO Masers in Orion KL with Those of Late-Type Stars, Mass-Losing Pulsating Stars and their Circumstellar Matter (Sendai, May 13-16).
Nagataki, S.: 2002, Gamma-ray burst neutrino background and star formation history in the universe, The 7th Int. Symp. on Nuclei in the Cosmos, (Fuji-Yoshida, Japan, July 9).
Nakajima, T., Tsuji, T., and Yanagisawa, K.: 2002, H- and K-Band Methane Features in an L Dwarf, 2MASS 0920+35, "Brown Dwarf", IAU Symp. 211, (Kona, U.S.A., May).
Nakamura, T., Watanabe, J., Tsuda, T., and Sato, T., PSMOS/Japan group: 2002, Observation of Leonid meteor shower and middle/upper atmosphere with the MU radar, International Science Symposium on the Leonid Meteor Storms, (Tokyo, May 2-5).
Nakamura, T.: 2002, Global survey project of Japanese materials relating to astronomy and land-surveying made before the Meiji-era, European Association of Japanese resource specialists conference, (Paris, Sept. 25-28).
Nakamura, T.: 2002, Japanese heraldic marks relating to astronomy, International Conference on Astronomical Instruments and Archives from the Asia-Pacific Region, IAU/IUSPH, (Chengju, Korea, Jul. 2-5).
Ohishi, M., Nakajima, J., and Tokumaru, M.: 2003, Sharing Studies Between the Radio Astronomy Telescopes and the Power Line Communication Systems in the HF Region, International Symposium on Power Line Communications, (Kyoto, Mar. 28).
Ohishi, M.: 2003, An Application for the Data Grid: A Prototype of the Japanese Virtual Observatory System, Global Grid Forum 7, (Tokyo, Mar. 7).
Ohishi, M.: 2003, An Application for the Data Grid: A Prototype of the Japanese Virtual Observatory System, PRAGMA 3, (Fukuoka, Jan. 24).
Ohnishi, K., Ishikawa, T., Hattori, S., Maegawa, K., Watanabe, J., and Nakamura, T.: 2002, Leonid 2001 flux by radio observation using a beam antenna, International Science Symposium on the Leonid Meteor Storms, (Tokyo, May 2-5).
Ohnishi, K., Yanagisawa, T., Torii, K., Kohama, M., Hatsukade, Y., Chaya, M., Shibata, H., Kawai, N., Sato, R., Nishiura, S., Miyata, T., Nakata, Y., Dobashi, K., Watanabe, J., Agata, H., Koike, K., Usui, F., Ishiguro, M., Eiraku, M., Mitikami, T., Sugawara, A., Uehara, A., Takano, T., Yoshikawa, M., Abe, S., and Asher, D.: 2002, Radiant Observation Project of Leonid 2001, International Science Symposium on the Leonid Meteor Storms, (Tokyo, May 2-5).
Okamoto, T., and Nagashima, M.: 2002, Morphological evolution of cluster galaxies, Galaxy evolution: Theory and Observations, RevMexAA, (Cozumel, Apr. 8-12).
Otsuki, K., Kajino, T., Mathews, G. J., Honda, S., and Aoki, W.: 2002, Nuclear Cosmochronometry and Universality in the r-process, XVI Particle and Nuclei Int. Conf., (Japan, Sept. 30-Oct. 4).
Otsuki, K., Mathews, G. J., and Kajino, T.: 2002, Nuclear cosmochronometer and universality in the r-process abundance distribution, The 7th Int. Symp. on Nuclei in the Cosmos, (Japan, Jul. 7-12).
Otsuki, K., Mathews, G. J., Kajino, T., Aoki, W., Honda, S.: 2002, Cosmochronology and the Universality of r-process Abundances, AAS meeting 201, (U.S.A., Jan. 5-9).
Otsuki, K., Mathews, G. J.: 2002, Cosmochronology and Universality of r-process, APS/DNP2002, (U.S.A., Oct. 9-12).
Otsuki, K.: 2002, Cosmochronology and the r-process, INT-02-1 Nucleosynthesis Program, (U.S.A., Mar. 25 - Jun. 28).
Otsuki, K.: 2002, Cosmochronology and the Universality of the r-process, JINA Workshop02, (U.S.A., Oct. 6-8).
Otsuki, K.: 2003, Universality and the astrophysical site for the r-process, Carnegie Observatories Centennial Symp. IV, (U.S.A., Jan. 16-21).
Peixinho, N., Delsanti, A. C., Boehnhardt, H., Barucci, M. A., Barrera, L., de Bergh, C., Birkle, K., Davies, J., Doressoundiram, A., Dotto, E., Hainaut, O., Lazzarin, M., Meech, K., Ortiz, J. L., Romon-Martin, J., Rousselot, P., Sekiguchi, T., Thomas, N., Tozzi, G. P., Watanabe, J., and West, R.: 2002, #17.02, ESO Large Program on TNOs and Centaurs: Visible-IR Results, American Astronomical Society, 34th DPS meeting, (U.S.A., Octo. 6-11).
Ping, J., Heki, K., Matsumoto, K., and Tamura, Y.: 2002, To estimate the high orders and degrees spherical harmonic function model for Lunar topography. Int. Symp. on Geodesy, (Kanazawa, Oct. 28-30).
Sakurai, T., and Hagino, M.: 2003, Magnetic Helicity and Its Solar-Cycle Variations, "The Workshop on Current Issues in Solar and Space Physics," (Seoul, Feb. 10-12).
Sasao T., VERA Project Team: 2002, Astrometry of Mass-Losing Pulsating Stars with VERA, Mass-Losing Pulsating Stars and their Circumstellar Matter, (Sendai, May 13-16).
Sekiguchi, K., Charles, P., van Zyl, L., Woodhouse, G. F.: 2002, High-speed imaging and spectro-polarimetry with Subaru Telescope, IAU Col. 190: Magnetic Cataclysmic Variables, (Cape Town, S. Africa, Dec. 8-13).
Sekiguchi, T., Hasegawa, H., Sunada, K., Ukita, N., Kawakita, H., Swamy, K. S. Krishna, and Watanabe, J.: 2002, HCN observations of C/Ikeya-Zhang using NRO 45m, 21-20 poster, Asteroids, Comets, Meteors-ACM 2002, (Germany, July 29-Aug. 2).
Sekii, T.: 2003, Chromospheric Reflection Layer for High-Frequency Acoustic Wave, "The First Far East-

ern Workshop on Helioseismology : Sounding the Solar Interior ,' (Seoul , Mar . 14-16).
Shigeyama , T., and Tsujimoto , T.: 2003, A Merging Scenario for Globular Cluster Formation -Inhibition or Promotion of Self-Enrichment -, Globular Clusters : Formation , Evolution and the Role of Compact Objects , (Santa Barbara , Jan . 27-31).
Shirasaki , Y., Kawai , N., Sakamoto , T., Torii , K., Tamagawa , T., Yoshida , A., Suzuki , M., Matsuoka , M., Yamauchi , M., Takagishi , K., Hatsukade , I., Fenimore , E. E., Galassi , M., Lamb , D. Q., Graziani , C., Donaghy , T., Vanderspek , R., Ricker , G. R., and HETE-2 Science Team : 2002, In-orbit calibration of the HETE-2 WXM , Gamma Ray Bursts in the After-glow Era - Third Workshop , (Rome Italy , Sep . 17-20).
Sôma , M., Tanikawa , K., and Kawabata , K.-A: 2002, Earth's rotation in the 7th century derived from eclipse records in Japan and China , Proc . of JOURNEES 2002, Systemes de reference spatio-temporels , Astrometry from Ground and from Space , (Bucharest , Romania , Sept . 25-28).
Sugano , T., and Heki , K.: 2002, Lunar gravity studies from the Lunar Prospector line-of-sight acceleration data : isostatic compensation of medium sized craters , AGU Fall Meeting , (San Francisco , Dec . 6-10).
Sugano , T., and Heki , K.: 2002, Lunar gravity studies from the Lunar Prospector line-of-sight acceleration data : isostatic compensation of medium sized craters , Int . Symp . on Geodesy , (Kanazawa , Oct . 28-29).
Sugiyama , N.: 2002, From the Beginning to the End , -Towards the Precision Cosmology -, 7th Japan-Germany Science Symp ., (Dresden , Germany , Apr . 26-27).
Sugiyama , N.: 2003, Shine the Dark Ages : Probing Reionization with CMB Temperature and Polarization , International Workshop on The Cosmic Microwave Background Radiation and its Polarization , (Minneapolis , U.S.A., Mar . 19-22).
Takahashi , R., and the TAMA collaboration : 2002, Status of TAMA , 7th Gravitational Wave Data Analysis Workshop , (Kyoto , Japan , Dec . 17-19).
Tamura , M., Itoh , Y., Oasa , Y., Subaru Telescope team , and CIAO/CISCO/AO teams : 2002, Searches for Extrasolar Planets with the Subaru Telescope : Companions and Free-Floaters , IAU 8th Asian-Pacific Regional Meeting , (Tokyo , Jul . 2-5).
Tamura , M., Oasa , Y., Naoi , T., Nakjima , Y., Sugitani , K., and SIRIUS team : 2002, Deep Near-Infrared Surveys and Young Brown Dwarf Populations in Star-Forming Regions , IAU Symp . 211, Brown Dwarfs , (Kona , May 20-24).
Tamura , Y., Sato , T., Fukuda , Y., and Higashi , T.: 2002, Calibration of a superconducting gravimeter by means of absolute gravity measurements with FG5 at Esashi station , Int . Symp . on Geodesy , (Kanazawa , Oct . 28-30).
Tatematsu , K.: 2002, Millimeter and X-ray study of OMC-2/3, in "Formation and Evolution of Molecular Clouds : Recent Results from Single-Dish Millimeter and Submillimeter Astronomy and Prospects ".
Tatsumi , D., and the TAMA Collaboration : 2002, Current status of Pipeline process for binary coalescence search in TAMA300 , 7th Gravitational Wave Data Analysis Workshop , (Kyoto , Japan , Dec . 17-19).
Terasawa , M., Sumiyoshi , K., and Kajino , T.: 2002, R-process in neutrino-driven winds from a typical neutron star with $M = 1.4 M_\odot$, The 7th Int . Symp . on Nuclei in the Cosmos , (Japan , Jul . 7-12).
Terasawa , M.: 2002, R-process in neutrino-driven winds from a typical neutron star with $M = 1.4 M_\odot$, INT-02-1 Nucleosynthesis Program , (U.S.A., Mar . 25-Jun . 28).
Totani , T.: 2002, Deep Near-Infrared Universe Seen in the Subaru Deep Field , IAU APRM , (Tokyo , July 2-5).
Tsujimoto , T.: 2002, Chemical Evolution of Tidally Influenced Dwarf Spheroidal Galaxies , The Evolution of Galaxies . III - From Simple Approaches to Self-consistent Models , (Kiel , July 16-20).
Tsujimoto , T.: 2002, Inhomogeneous Chemical Evolution of the Galactic Halo and Dwarf Galaxies , Galaxy Evolution : Theory and Observations , (Cozumel , Apr . 8-12).
Tsujimoto , T.: 2003, Histories of the Milky Way Dwarf Spheroidal Galaxies and Omega Centauri , Origin and Evolution of the Elements , (Pasadena , Feb . 16-21).
Wada , K.: 2002, Fueling Gas to the Central Region of Galaxies , Coevolution of Black Holes and Galaxies , (Pasadena , Oct . 21-25).
Wada , K.: 2002, Obscuring Material around the Central Engine with Starbursts , Active Galactic Nuclei : from Central Engine to Host Galaxy , (Paris , July 23-27).
Wada , K.: 2002, Super Computer Center at NAOJ , Numerical Simulations in Astronomy 2002, (Tokyo , July . 5).
Watanabe , J., and Kawakita , H.: 2002, Comets as Fossils for Exploring the Solar Nebula : Implication from Spin Temperature of Cometary Molecules , 09-09 poster , Asteroids , Comets , Meteors - ACM 2002, (Germany , July 29-Aug . 2).
Watanabe , J., and Kawakita , H.: 2002, Comets as fossiles of the solar nebula : -Implication from spin temperature of cometary molecules - , IAU 8th Asian-Pasific Regional Meeting , (Tokyo , July 2-5).
Watanabe , J., and Kawakita , H.: 2002, Ortho-to-Para Ratio of Cometary Ammonia and Formation Circumstances , Invited talk SP51E-02, 2002 Western Pacific Geophysics Meeting , (New Zealand , July 9-12).
Watanabe , J., Kawakita , H., Furusho , R., and Fujii , M.: 2002, Sodium of Small Solar System Objects , B1.1-0019-02 Solicited talk at The World Space Congress , 34-th Scientific Assembly of the Committee on Space Research (COSPAR), (U.S.A., Oct . 10-19).
Watanabe , J., Tabe , I., Hasegawa , H., Fuse , T., Yoshikawa , M., Abe , S., and Suzuki , B.: 2002, Meteoroid clusters as Evidences of fragmentation of Meteoroids , 04-35 poster , Asteroids , Comets , Meteors - ACM 2002, (Germany , July 29-Aug . 2).
Watanabe , J., Tabe , I., Hasegawa , H., Fuse ,T., Yoshik -

awa, M., and Abe, S.: 2002, Meteoroid clusters: Evidence of fragmentation in space? International Science Symposium on the Leonid Meteor Storms, (Tokyo, May 2-5).

Yadoumaru, Y., Ozawa, T., Ishikawa, K., Kinoshita, S., and Watanabe, J.: 2002, Persistent meteoric trains in a movie of the Leonids storm 2001, International Science Symposium on the Leonid Meteor Storms, (Tokyo, May 2-5).

Yahagi, H. and Yoshii, Y.: 2002, Parallelization and Vectorization of the AMR N-body code, IAU 8th APRM, (Tokyo, July 2-6).

Yahagi, H., Nagashima, M., Gouda, N., Yoshii, Y.: 2002, Parallel N-body Code with Adaptive Mesh Refinement and Numerical Galaxy Catalog, the Eighth International Symposium on Simulation Science, (Hayama, Mar. 3-5).

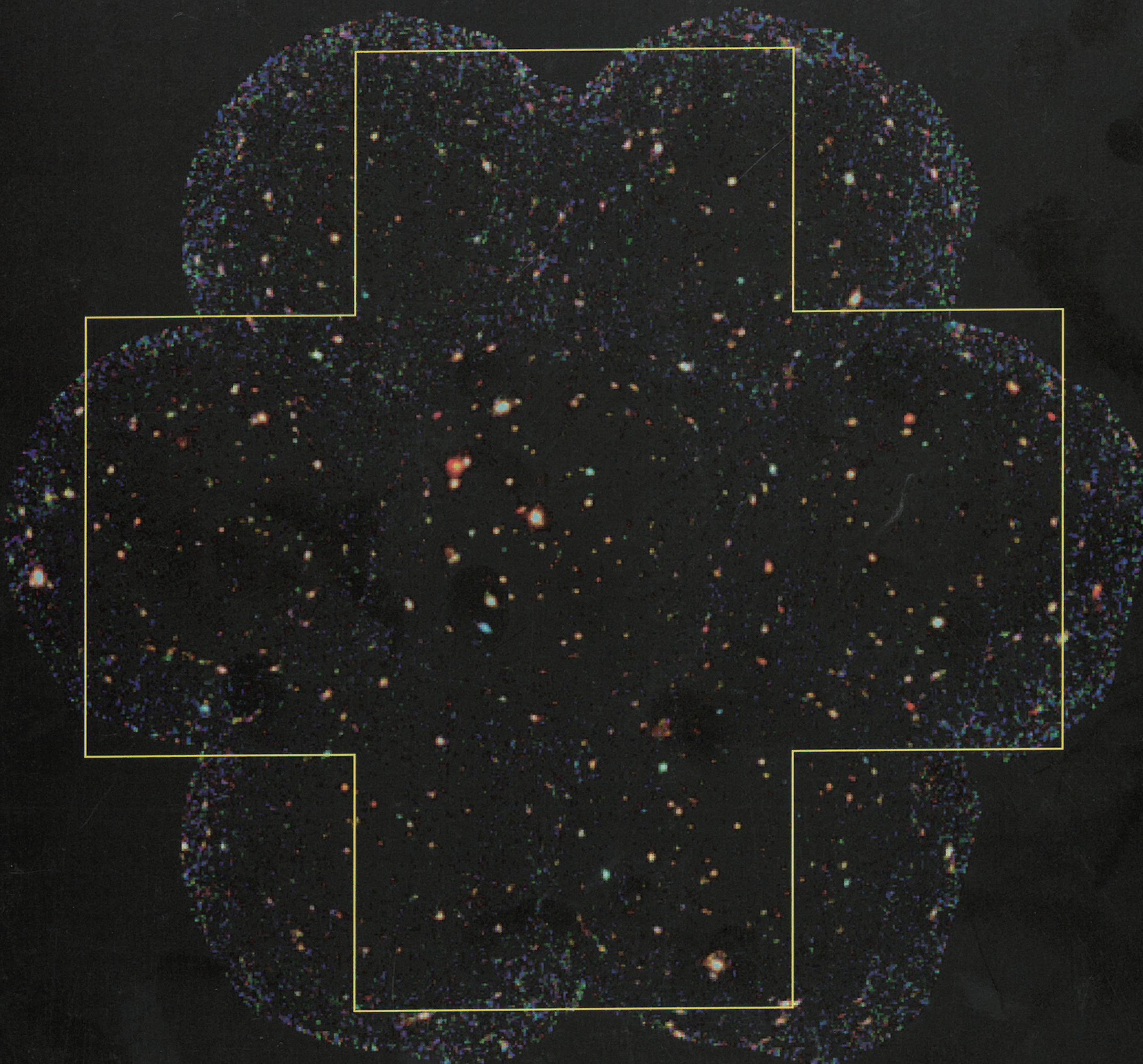
Yamamoto, N., Kinoshita, D., Fuse, T., Watanabe, J., and Kawabata, K.: 2002, A Deep Survey of EKBO with a Shift-and-Add Method, Solar System Science, Satellite Meeting IAU 8th Asian-Pasific Regional Meeting, (Tokyo, July 6).

Yano, H., Abe, S., Yoshikawa, M., Kasuga, T., Kadowaki, M., Ebizuka, N., and Watanabe, J.: 2002, On the Evaluation of Satellite impact risks by meteoroid streams, C1.2-B1.5-0001-02 Solicited talk, The World Space Congress, 34-th Scientific Assembly of the Committee on Space Research (COSPAR), (U.S.A., Oct. 10-19).

Yano, H., Abe, S., Yoshikawa, M., Kasuga, T., Kadowaki, N., Ebizuka, N., and Watanabe, J.: 2002, Satellite impact hazard assessment from Leonid meteoroid size and spatial distributions in 1998-2001, International Science Symposium on the Leonid Meteor Storms, (Tokyo, May 2-5).

Yoshida, M., Shimizu, Y., Watanabe, E., Yanagisawa, K., and Uraguchi, F.: 2002, New Control Software of the 188cm Telescope of Okayama Astrophysical Observatory, Advanced Telescope and Instrumentation Control Software II, (Hawaii, U.S.A., August).

Yoshida, M., Yagi, M., Okamura, S., Aoki, K., Ohyama, Y., Komiyama, Y., Yasuda, N., Iye, M., Kashikawa, N., Doi, M., Furusawa, H., Hamabe, M., Kimura, M., Miyazaki, M., Miyazaki, S., Nakata, F., Ouchi, M., Sekiguchi, M., Shimasaku, K., and Ohtani, H.: 2002, Very Extended Emission-Line Region around the Seyfert 2 Galaxy NGC 4388, IAU 8th Asian-Pacific Regional Meeting, (Tokyo, Japan, July).



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