

Future Plan of Japan Solar Physics Community (JSPPC) 太陽研究者連絡会(太陽研連)の将来計画

Masumi Shimojo (President, JSPPC)

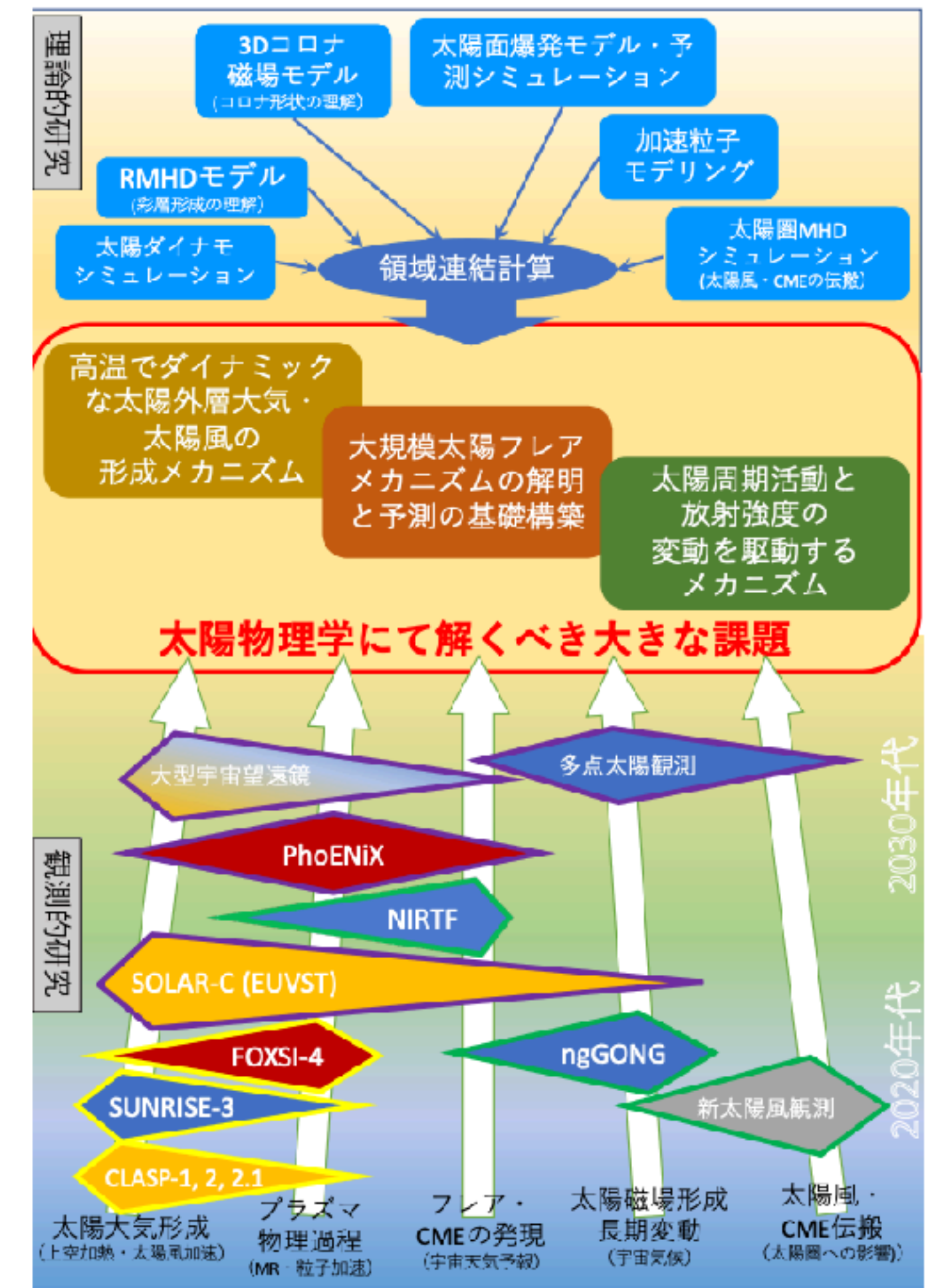
下条圭美 (太陽研連 会長)

2025/12/02 NAOJ Future Planning Symposium 2025

Current Science Targets of Solar Physics

現状の太陽物理学のサイエンスターゲット

- **Understanding solar long-term variation (太陽の長期変動の理解)** = Generation, amplification and transfer of magnetic energy in the interior of the Sun.
- **Understanding the formation of the chromosphere, corona, and solar wind (高温外層大気と太陽風形成の理解)** = Propagation and dissipation of magnetic energy in the solar atmosphere with significantly changing of physical parameters.
- **Understanding of flares and CMEs (太陽大気で起こる爆発現象[フレア・CME]の理解)** = Accumulation and sudden dissipation of magnetic energy in solar corona, and particle acceleration.
- Additionally, **Space Weather** Operation. It is not a purely science target. However, considering the demand from society, the contribution to it should be done by our community.



The order of the items is the time-scale of the phenomena. It is not priority.

Current Status of JSPC's Observing Projects

太陽研連における観測計画の現状

- Extended Operation of **Hinode**(ひので衛星の運用延長) : Sep. 2006 ~JFY2033
- Established the **SOLAR-C** project as the JAXA project. (Mar. 2024)
 - At present: SOLAR-C is under development and we started making the instruments for tests and flight.
- Sounding rocket and balloon experiments
 - Succeeded the **CLASP** rocket experiments (UV telescope & spectro-polarimeter provided by Japan, 1:Sep 2015, 2:Apr 2019, 2.1: Oct 2021)
 - Succeeded the **SUNRISE-III** balloon experiments (IR spectro-polarimeter provided by Japan, July 2024)
 - Succeeded the **FOXSI** rocket experiments (Soft/Hard X-ray photon-counting detectors provided by Japan, 3: Sep 2029, 4: Apr 2024) and planned next FOXSI rocket experiment (FOXSI-5 in 2026)
- Ground-base observations
 - **NAOJ Mitaka: solar optical telescopes** in operation
 - **Kyoto U. Hida obs.: Dome-less solar telescope and SMART** in operation
 - **Nagoya U. : Radio telescopes for Interplanetary Scintillation** (IPS: Solar Wind Obs.) : in operation and new one [phased-array antenna] under development based on KAKENHI-S and corroborating with companies
 - **NICT Yamgawa: Radio spectrometer** in dm—cm wavelength range for space weather
 - **Tohoku U. PPARC: IPRT-AMATERAS**, solar radio spectro-polarimeter
 - **NAOJ Nobeyama: Nobeyama Radio Polarimeters (NoRP)** for measuring the total flux in microwave range in operation (until JFY2027)
 - **National Defense Academy: new solar radio spectro-polarimeter at Yokosuka** in the commissioning phase as the successor of NoRP.

While we are operating and developing the satellite projects of JAXA/ISAS (Hinode, SOLAR-C), we are establishing new observing techniques using small-scale projects (rocket, balloon, ground-base).
As a result, we have **several unique techniques demanded from international partners.**

Currently, we need to begin seriously discussing future large-scale observing projects based on our unique techniques after launching SOLAR-C (Beyond the era of SOLAR-C).

But, the main target of this symposium is JFY2028~2033 [3~8yrs after].

- So, the priorities of our community (JSPC) in NAOJ's 5th middle-term plan period are follows:
 - **1st priority: Success of SOLAR-C project [launch: JFY2028]**
 - SOLAR-C Science Center will be established in ISEE/Nagoya-U. However, it does NOT mean that the importance of NAOJ for SOLAR-C project becomes small. Because the contribution of NAOJ staff to the development of SOLAR-C is significant and essential, and their work during the commissioning phase and in scientific operation is the key of the success of SOLAR-C project.
 - Other priorities
 - Continuous development of new unique observing techniques
 - Synoptic observations for investigating solar long-term variation

Future Projects beyond SOLAR-C: 1

To start the discussions of our future, we held JSPC Future Planning Symposium in this summer.

- Candidates Observing Projects: 1
 - **PhoENiX (Focusing Soft/Hard X-ray imaging spectroscopy)**
 - Photon-counting detector for solar Soft/Hard X-ray developed in the FOXSI experiments is unique technology in the world.
 - CubeSat (might be realized in NAOJ's 5th middle-term planning period.). It is the part of the continuous development of new unique observing technique. Finally, they want to propose the project as a M-class satellite mission of JAXA/ISAS (公募型小型)
 - **ngGONG (Solar ground-base observing network for science and space weather, led by NSO/US: 2030's~)**
 - It is highest prioritized as the Large-class ground-base project in the US 2025 decadal survey of the solar and space physics.
 - The one of core observing techniques of ngGONG is the expansion of the IR spectro-polarimeter installed in the solar flare telescope at Mitaka.
 - **NIRTF (Near InfraRed Tunable Filter for DKIST: led by Kyoto-U.)**
 - Kyoto-U and NAOJ have been developing the tunable filter using Mitaka and Hida facilities.
 - Using the knowledge, the solar group of Kyoto-U. has the plan of the large aperture IR tunable filter for DKIST (4-m solar telescope at Maui Island, HW) to realize the filtergraph with IR spectro-polarimetry and wide field-of-view.
 - **New radio telescope for observing solar winds (IPS: led by ISEE/Nagoya-U.)**
 - ISEE/Nagoya-U is developing the new phased-array antenna based on KAKENHI and corroborating with companies for prototyping.
 - To realize the full-scale instrument, they need more budget. Hence, they need to support from not only JSPC and other communities (e.g. Geomagnetosphere community). They are getting such supports.

The order of the items does not indicate priority.

Future Projects beyond SOLAR-C: 2

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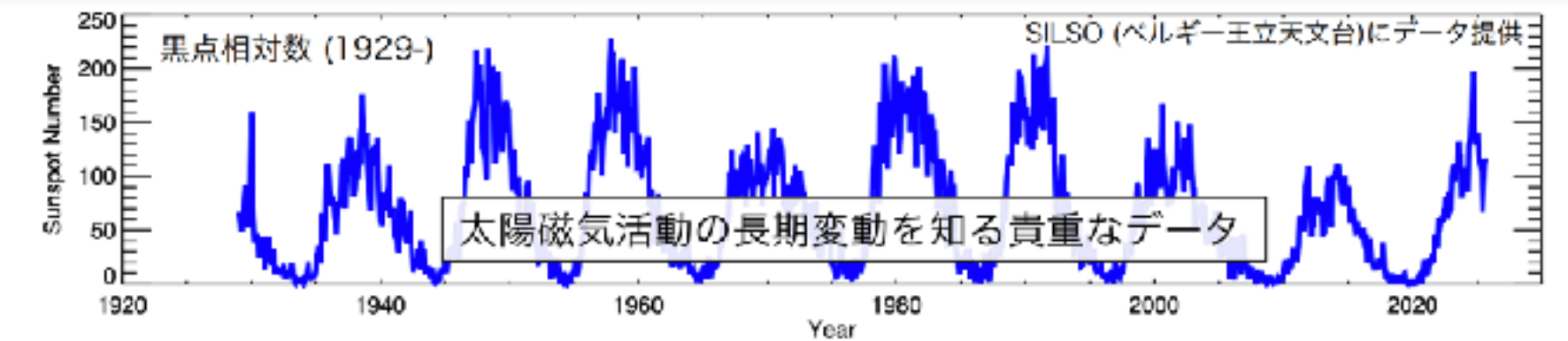
- Candidates Observing Projects: 2
 - **Solar Space Telescope**
 - IR-Optical-UV spectro-polarimeter for measuring magnetic field vectors in photosphere and chromosphere.
 - It is the evolutional project of CLASP and SUNRISE-III.
 - **Multi-vantage Point Solar Observation Mission**
 - Observing the Sun from multi-vantage points includes, L4, L5, or out-of-ecliptic plane, mainly for helioseismology
 - Filter magnetograph (Optical-IR spectro-polarimeter) is an essential instrument for the project.
 - Research Group (RG) was established under the RIGAKU-IINKAI(理学委員会), JAXA/ISAS for developing and evaluating the project in this year.

The order of the items does not indicate priority.

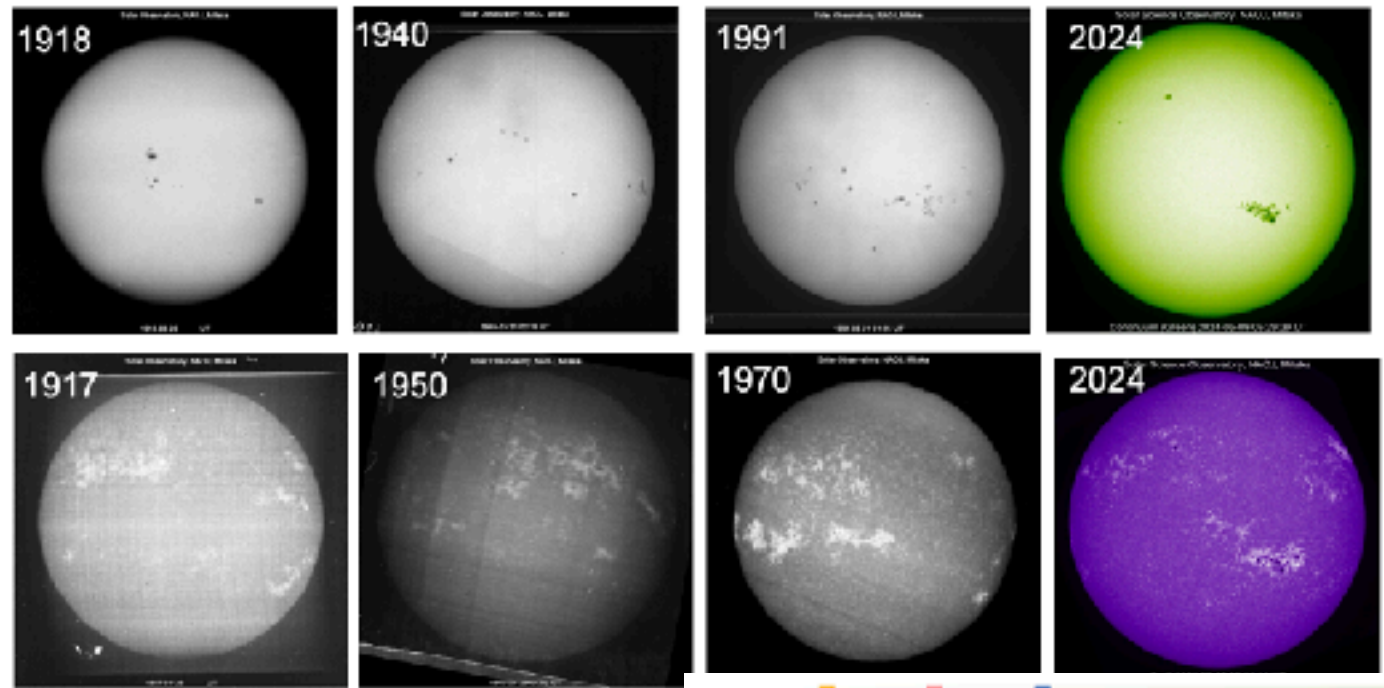
We should start making the future plan considering these projects strategically now. To discuss and realize these projects, the continuous development of unique observing technique (IR-Optical-UV spectro-polarimeter, X-ray photon-counting, phased-array antenna, etc.) is indispensable.

From the slides of Katsukawa-san's talk in JSPC Future Plan Symposium held in this summer

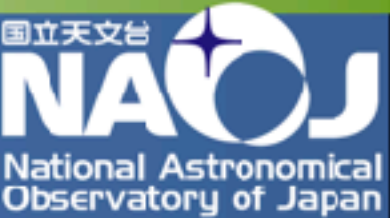
国立天文台における太陽観測
100年を超える観測データ



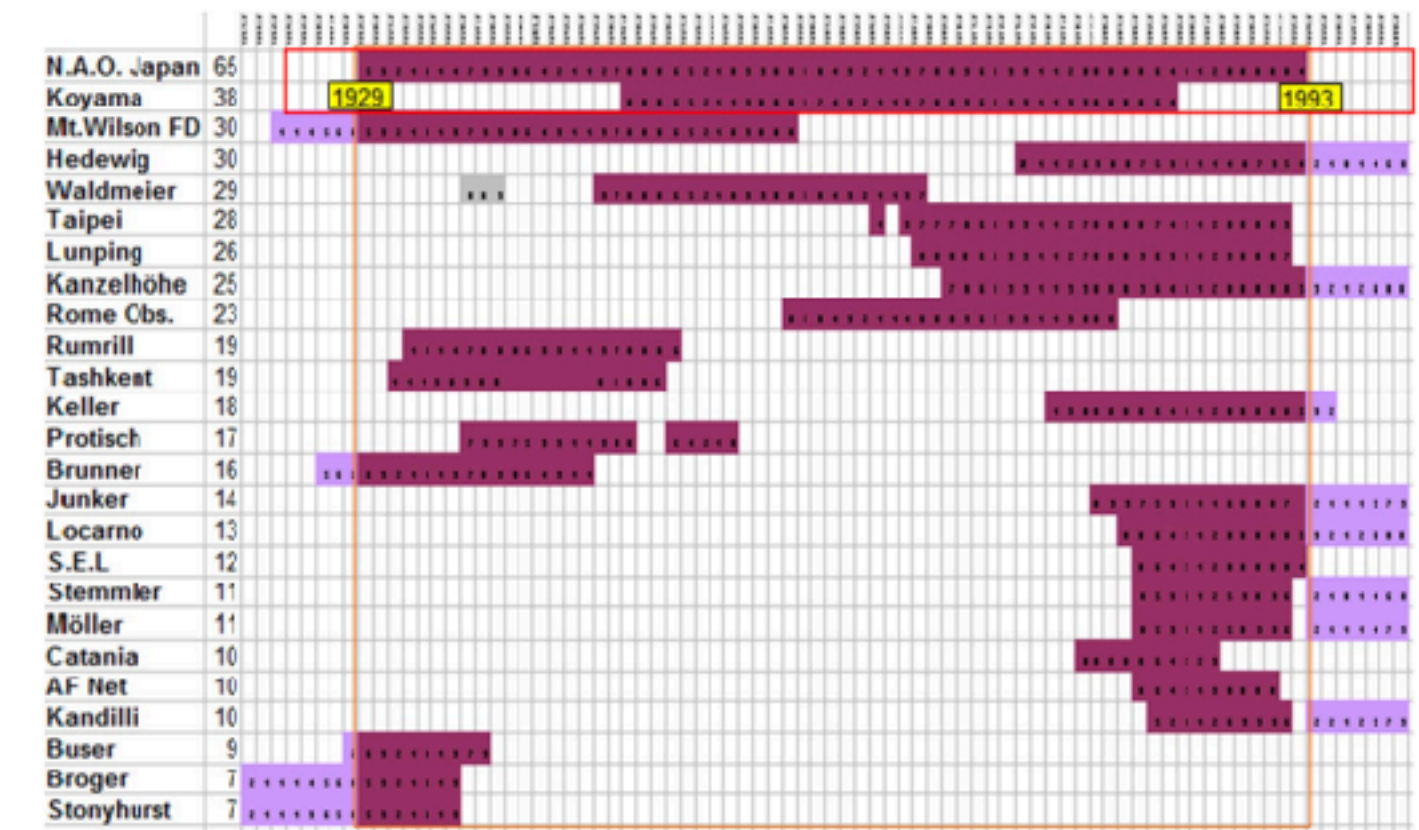
- 白色光 (1918-)
- 黒点スケッチ (1938-1998)
- Ca II K線 (1917-1974) (2015-)
- H α 線



長期観測継続の重要性



(Clette et al. 2014)

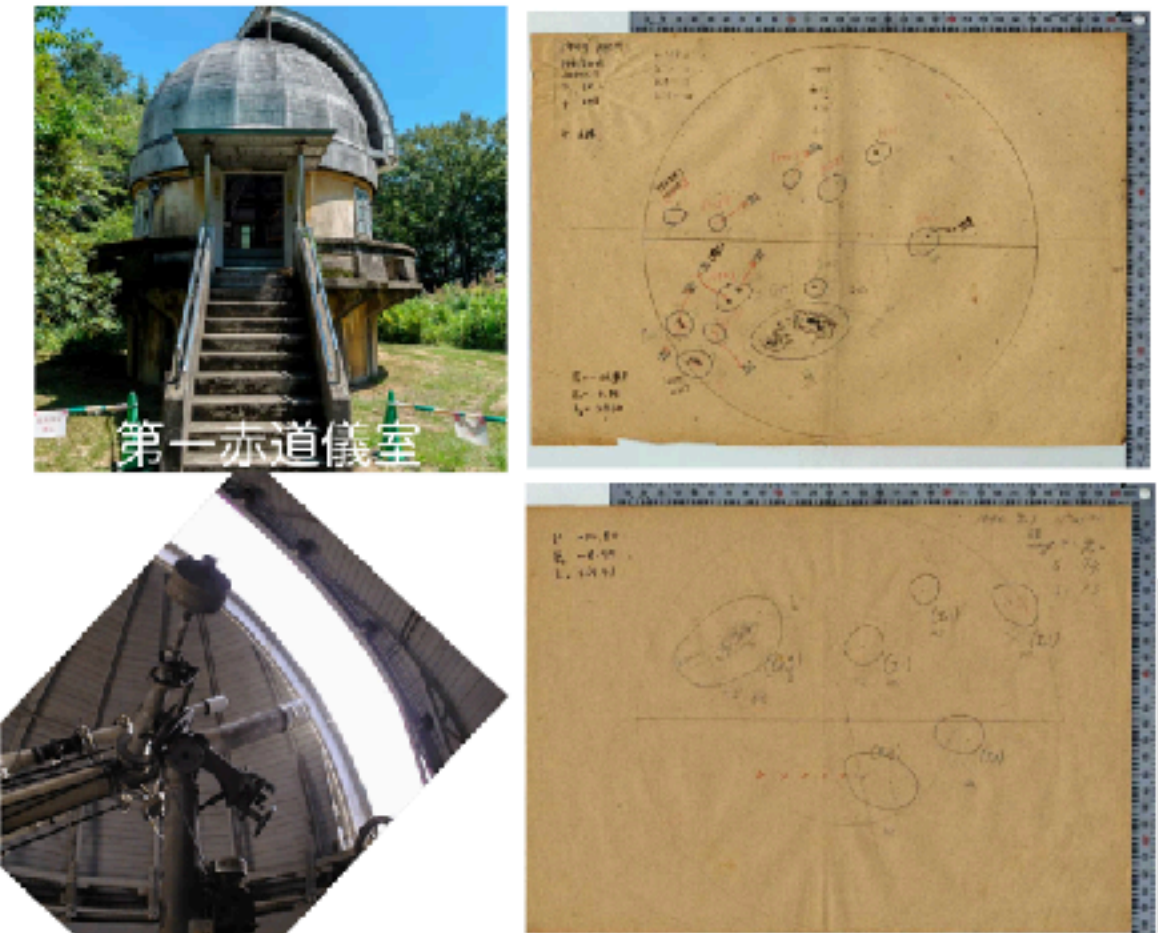


NAOJと小山(科博)による長期観測は、20世紀の黒点相対数の相互較正を確立する上で重要な役割をはたした

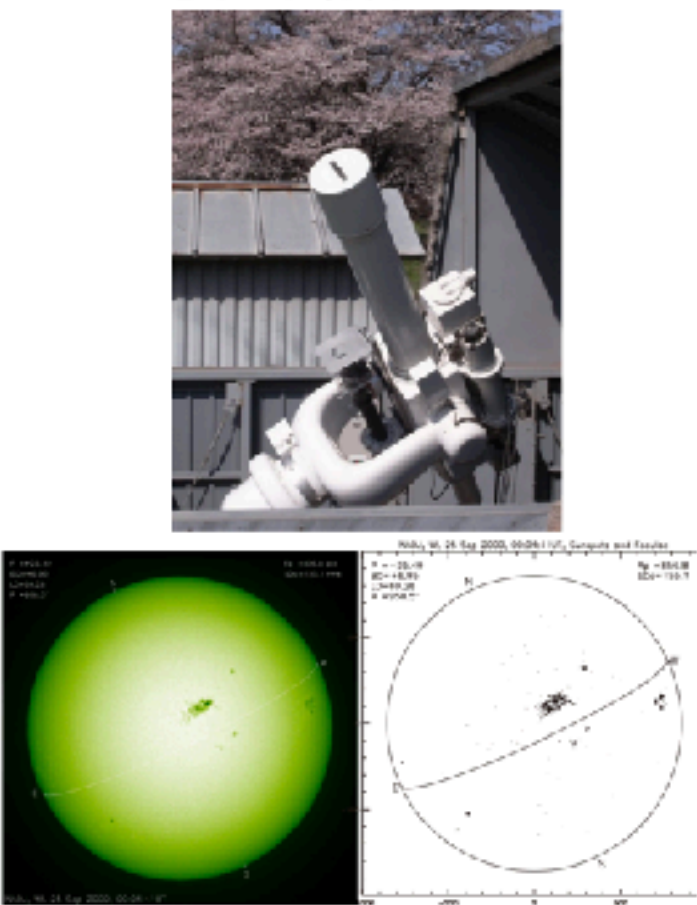
黒点観測



黒点スケッチ (1929-1998)



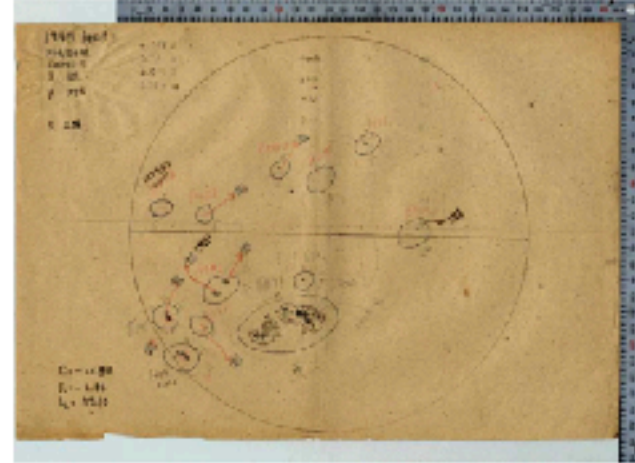
黒点望遠鏡(1998-)
電子的観測



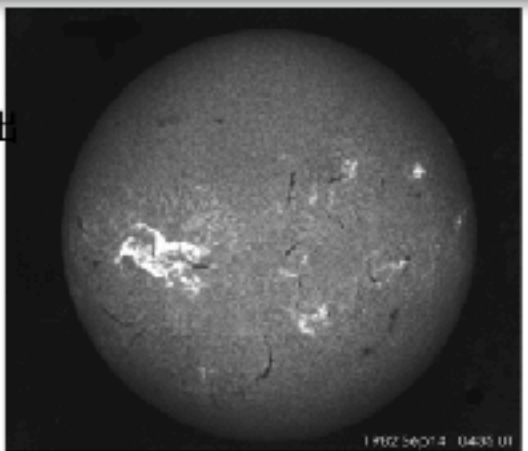
大イベントをとらえる



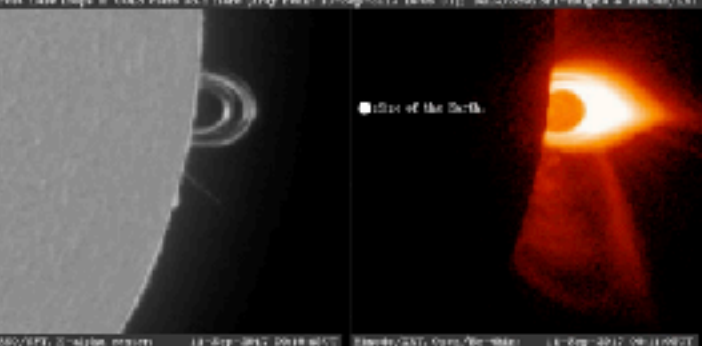
最大黒点1947/4/8 RGO14886



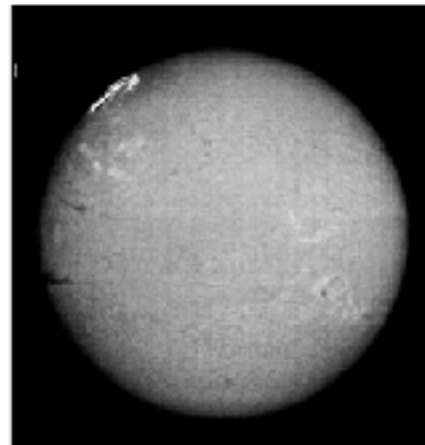
1982/9/4
M4フレア
フィラメント噴出



2017/9/10 X8フレア



1991/6/4
X12フレア



キャリントン級フレア(>X50)も数10年~100年で起きる

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- Other priorities

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And, the data analysis and theoretical study environments (MDAS/ADC and Super computer/CfCA) are essential generally, not only for our community.