LOI 12

飛翔体による
太陽偏光観測実験

Space-borne solar experiments with the polarization measurement

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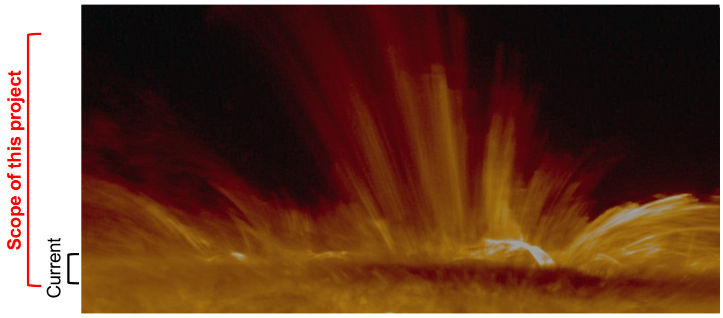
Science Goal & Objectives



Variety of magnetic phenomena and processes within the solar chromosphere

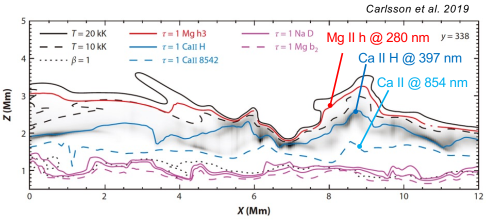
Reveal the temporal evolution and conversion processes of magnetic energy originating from MHD processes to understand the heating and acceleration mechanisms of the solar atmosphere

Seamless magnetic field measurements from the photosphere to the base of the corona by the **simultaneous multi-wavelength spectro-polarimetry**

➢ In this project, we aim to clarify and demonstrate the key technology and diagnostic tools to achieve it

Importance of observations from space

- There are several spectral lines that allow to access the upper atmospheric layers in the UV range
- Stable and continuous seeing-free observations (e.g. Hinode/SOT)
  - Critical for precise **B** measurements (MHD wave detections, jet evolution, polar field, etc…) and active region evolutions

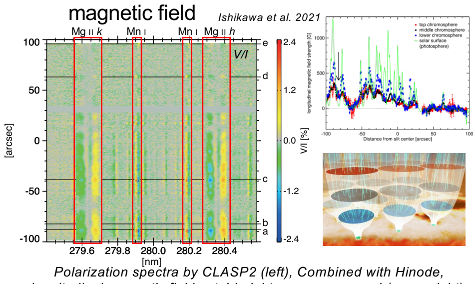


Formation heights for representative chromospheric lines from IR to UV

Two pioneering space-borne missions led by NAOJ

Sounding rocket CLASP (2015, 19, 21)

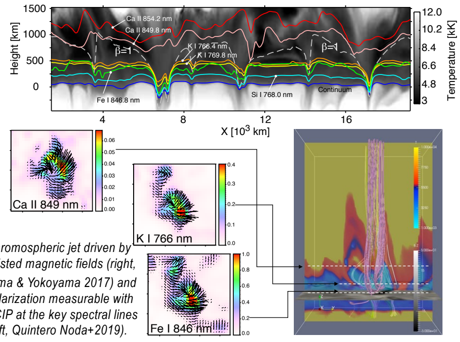
- Demonstrated the feasibility of the high-precision UV spectro-polarimetry
- Demonstrated the 280 nm range (Mg II h & k and Mn I lines) enabling to reveal the 3D magnetic field



Polarization spectra by CLASP2 (left), Combined with Hinode, longitudinal magnetic fields at 4 heights were measured (upper right), revealing expanding flux tubes in the active region (lower right)

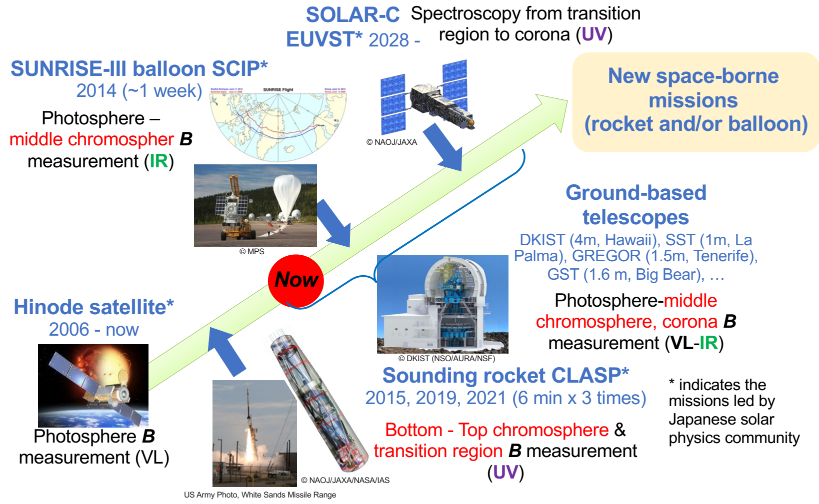
SCIP aboard SUNRISE-III balloon (2024)

- Will carry out the first spectro-polarimeteric observations from the space in IR with high spatial and temporal resolutions



Chromospheric jet driven by twisted magnetic fields (right, Iijima & Yokoyama 2017) and polarization measurable with SCIP at the key spectral lines (left, Quintero Noda+2019).

Science Investigations



➢ Based on the scientific and technological knowledge obtained from previous missions, we will conduct a new space-borne experiment to demonstrate the technologies and methods necessary to answer the Science Goal above.

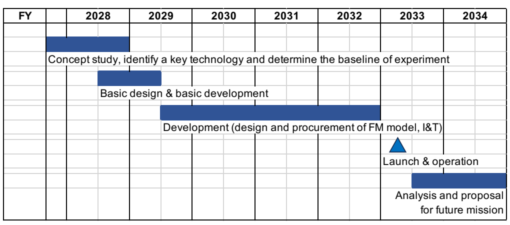
Key observation: **simultaneous spectro-polarimetry** in **multi-spectral lines** with **high spatial** resolution

- Sharpen the science goal (should be dedicated for observing time of 6 min – 1 week)
  - What kind of observations (suitable spectral lines, space vs. ground, spatial & temporal resolutions) are required to tackle the remaining issue after pre-existing observing facilities?
- Establish the diagnostic tools to derive the magnetic field information (inversion with multi-lines by taking into account the Zeeman, Hanle, and Magneto-Optical effects)
- Clarify new key observational technologies (under discussion)
  - High time cadence: large format camera with on-board process
  - High spatial resolution: control of micro-vibration, deformable mirrors, …
  - High throughput: new UV coating
  - Large FOV: Integral field spectro-polarimetry from space

➢ Finally, we aim to establish a team to propose a satellite mission after Solar-C including the possibility of supplying the instrument to missions led by foreign countries

Implementation Plan

Timeline



Roles of NAOJ

Science investigations

➢ Led by Solar Science Observatory (SSO) in NAOJ with Japan Solar Physics Community (JSPC)
- Determine science goals and requirement
- Study a basic concept of the experiment

Development of the instrument

➢ Led by SSO with significant support from Advanced Technology Center (ATC) as in CLASP and SUNRISE-III
- Design and fabrication of the instrument
- Testing and integrations in the clean room at ATC

Budget

- We are considering that we cover the most of the development costs with external funding (JSPS Kakenhi and ISAS/JAXA budget)
- We would like NAOJ to cover 3-5 million yen for hiring support staff and operating the CR at ATC