# Next Generation Solar Physics Mission

## Science Objectives Team Report

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http://hinode.nao.ac.jp/SOLAR-C/SOLAR-C/Documents/NGSPM_report_170731.pdf

# Charter

- JAXA/ESA/NASA looking at a possible multi-lateral mission
- Primary role of SOT was to develop and document scientific priorities of such a mission within resources to be specified by the Agencies
- Post-2024 launch
- Mission likely to be JAXA-led
- Scope – broad. All categories of mission were discussed

# NGSPM-SOT members

## NASA-appointed Members

- David McKenzie, NASA, Marshall Space Flight Center
- Ted Tarbell, Lockheed Martin Solar and Astrophysics Laboratory
- John Raymond, Smithsonian Astrophysical Observatory
- Sarah Gibson, High-Altitude Observatory

## ESA-appointed Members

- Luis Ramon Bellot Rubio - Instituto de Astrofisica de Andalucia, Spain
- Mats Carlsson - UiO Institute of Theoretical Astrophysics, Norway
- Lyndsay Fletcher - University of Glasgow, UK
- Sami Solanki - MPS, Göttingen
- Laurent Gizon - MPS, Göttingen

## JAXA-appointed Members

- Kiyoshi Ichimoto, Kyoto University/NAOJ
- Kanya Kusano, Nagoya University
- Toshifumi Shimuzu, ISAS/JAXA, team chair
- Hirohisa Hara, NAOJ
- Takashi Sekii, NAOJ

# Top level view

- “Bottom-up” review of the current state of heliophysics
- Identified two broad avenues, both with distinct merits, for future research:
  i. global processes affecting/involving large fractions of the solar interior and/or atmosphere.
  ii. physical mechanisms on elemental (small) scales
- Expectations of resources available on timescale of NGSPM (~next decade) led SOT to favour (ii)

# NGSPM-SOT: Process

- Two phases of the team work
  - Phase 1: Review science objectives in solar physics
  - Phase 2: Prioritise the science objectives and assess mission design options to accomplish the objectives.

- Science objectives review
  - Discussions included ~20 solar physics topics.
  - Development of science objectives greatly enhanced and informed by the input of 34 White Papers (Nov 2016) from the community.

# White papers

Most popular topics based on the WPs: # of WPs in ()

- Coronal Heating (13)
- Magnetic geometry/topology/reconnection (10)
- Heating processes in flares/CMEs (9)
- Magnetic energy buildup leading to eruptions (5)
- Probing flare processes via particle acceleration (5)
- Solar dynamo and magnetic dynamics (4)
- Solar wind acceleration (3)
- Solar dynamo & internal structure (3)
- Space weather monitoring (1)

# White papers: Instrument concepts

Proposed observation concepts could be broadly classified as:

a. Spectroscopic observations
b. Magnetic field observations
c. Multi-platform observations

Science objectives broadly classified into:

- Formation mechanism of hot and dynamic outer atmosphere (coronal heating, solar wind and magnetic structure)
- Mechanism of large-scale solar eruptions and algorithm for prediction (flares, CMEs, reconnection, particle acceleration)
- Mechanism of solar cycle and irradiance variation that influence the climate of the earth

These were broken down further into ~20 sub-objectives

# Specific criteria used in establishing priorities

1. Relevance to NASA/JAXA/ESA objectives (++)
2. Scientific impact on solar physics (++)
3. Scientific impact on other disciplines
4. Inability of current/planned missions and facilities to accomplish (++)
5. Need for space observations (++)
6. Maturity of technology: measurements can be made (+)
7. Maturity of methodology: data can be inverted (+)
8. Widespread interest within the solar physics community

# Notional instrument set for elemental (high-res) solar science

- A combination of instruments was identified that would address a high number of the sub-objectives and maximise science return.
- The combination of these five instruments (in priority order) will address well over half of the required measurements:
  - 0.3” coronal/TR spectrograph <- considered the most urgent
  - 0.2” – 0.6” coronal imager
  - 0.1” – 0.3” chromospheric magnetograph
  - 0.1” photospheric magnetograph
  - 0.1” chromospheric spectrograph

  } Single instrument?
- A focussing HXR telescope was emphasised as a desirable addition

# Mission concepts identified

## 1. Large mission design

- 3 instruments onboard a single mission
- JAXA large-strategic mission (300M$) with Mission-of-opportunity contributions both from NASA (at SMEX-level, ~200M$) and ESA(50M€). Possibly insufficient for the 3 instruments.

## 2. Constellation of small/medium sized missions

- 3 instruments realised with multiple number of missions.
- JAXA's Epsilon opportunities (every 2 years), NASA's MIDEX and SMEX, and DLR's mission; with MoO contributions from another agencies.