The Solar-C Science Meeting

9-Sep-2016

The Meeting Agenda

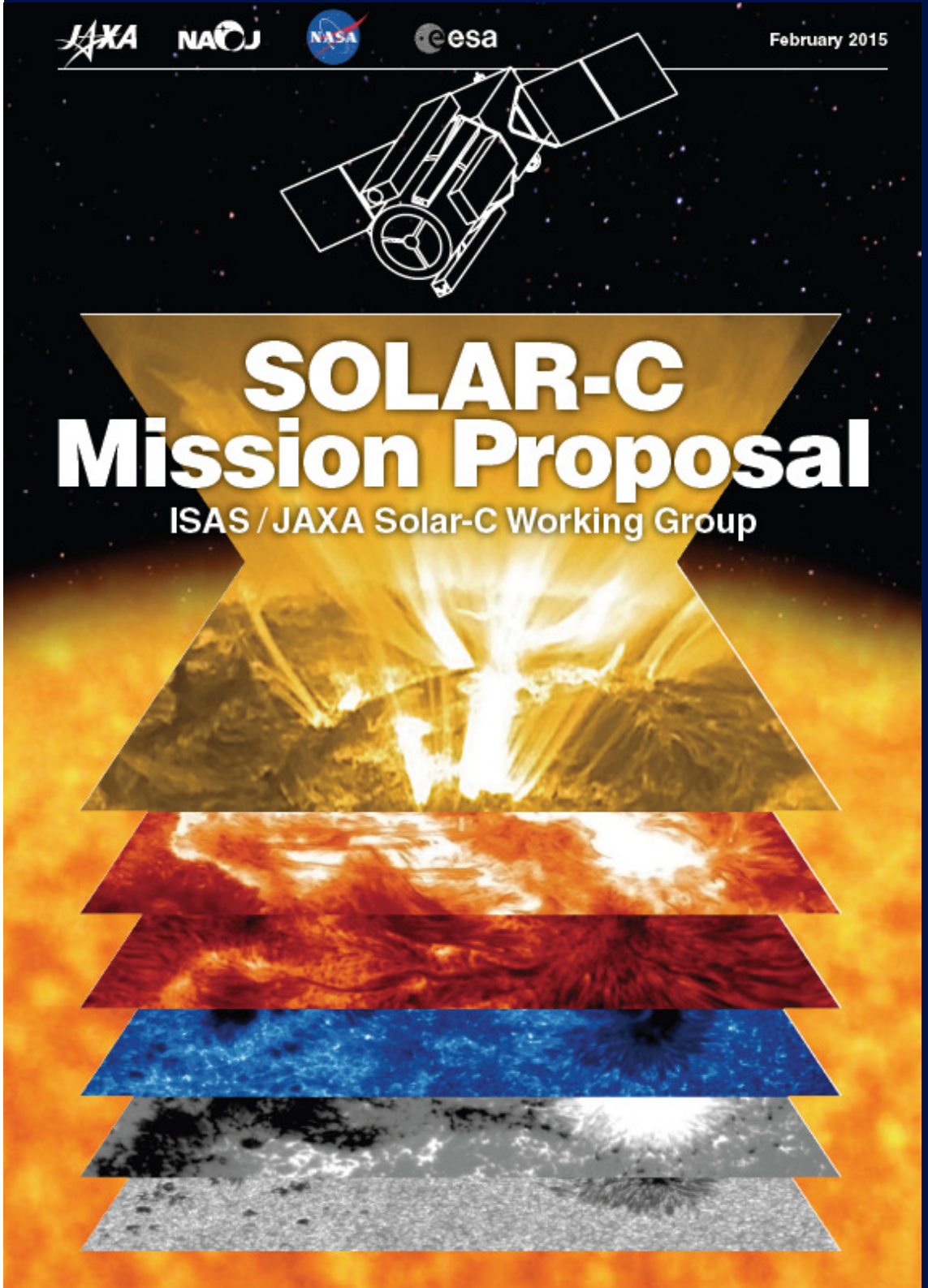
1. Solar-C WG: Progress report: Tetsuya Watanabe (15 min)

2. Science Objectives Team of Next Generation Solar Physics Mission (NGSPM-SOT): Aims and activity report: Toshifumi Shimizu (20 min)

3. Scientific Objectives for NGSPM
I. Formation of dynamic atmosphere: Kiyoshi Ichimoto (20 min)
II. Large scale explosions & eruptions: Kanya Kusano (20 min)
III. Cyclic variation of solar magnetism: Hirohisa Hara (20 min)

4. Discussion
a. Possibility of MIDEX mission: James Klimchuk (20 min)
b. General discussion

5. AOB



The Solar-C Working Group

progress report

Tetsuya Watanabe (NAOJ)
Solar-C WG (ISAS/JAXA)
Office for Solar-C (NAOJ)

Scientific Objectives

Main Scientific Objectives	
Understand the plasma dynamics as a system that connects the solar surface to the solar corona and interplanetary space	
Investigate the elementary processes that take place universally in cosmic plasmas, the both of which also contribute to the comprehension and the prediction of solar activity that could give impact on the earth and the human	
Three Scientific Objectives for Study	
I	Investigate the formation mechanisms of the chromosphere, the corona, and the solar wind
II	Understand the physical origin of largescale-solar eruptions to extract the algorithm for prediction
III	Reveal the mechanism of solar spectral irradiance variation that could influence the climate change of the earth.

SOLAR-C S/C and Strawman Payloads

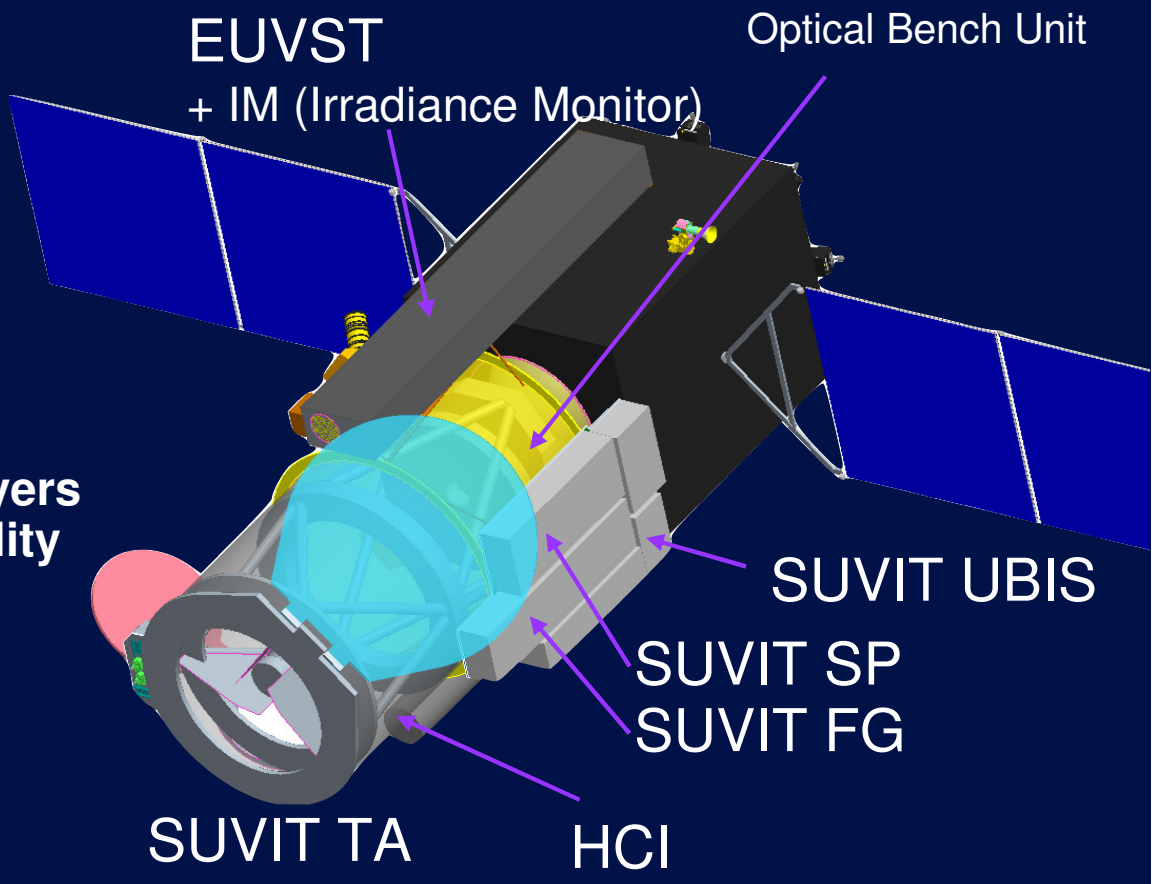
Three advanced telescopes

•SUVIT (Solar UV-Vis-IR Telescope)
Spectropolarimetry for photospheric & chromospheric magnetic fields with spatial resolution of 0.1”~0.2”
Aperture: ~1.4m (Hinode×3)

•EUVST (EUV Spectroscopic Telescope)
Spectroscopy for upper atomospheric layers with increased plasma diagnostic capability
Spatial resolution: Hinode×5
Sensitivity: Hinode×10

•HCI (High resolution Corona Imager)
Wide FOV coronal imaging with spatial resolution of 0.3”
Spatial resolution: Hinode×10

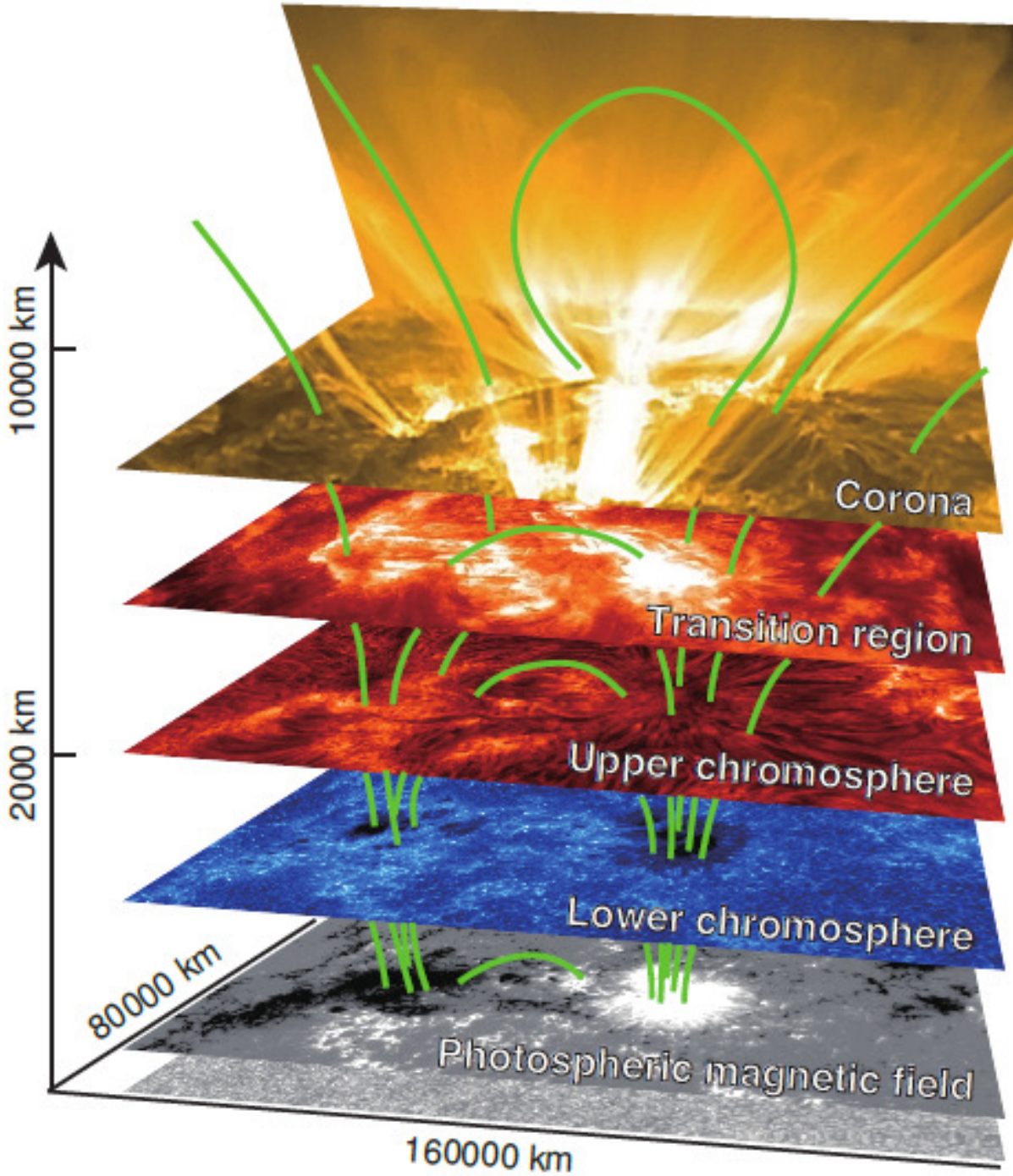
・IM (Irradiance Monitor)
Total & UV spectral irradiance monitor



weight	**2300 kg (w/o fuel)**
size	**3.5 m x 3.0 m x 7.3 m**
Data rate & Data volume	**8 Mbps (ave) (Hinode×20) DR ～200 GB**
Orbit	**Geo-synchronous**

EPIC for ESA/M4

Strawman Payload



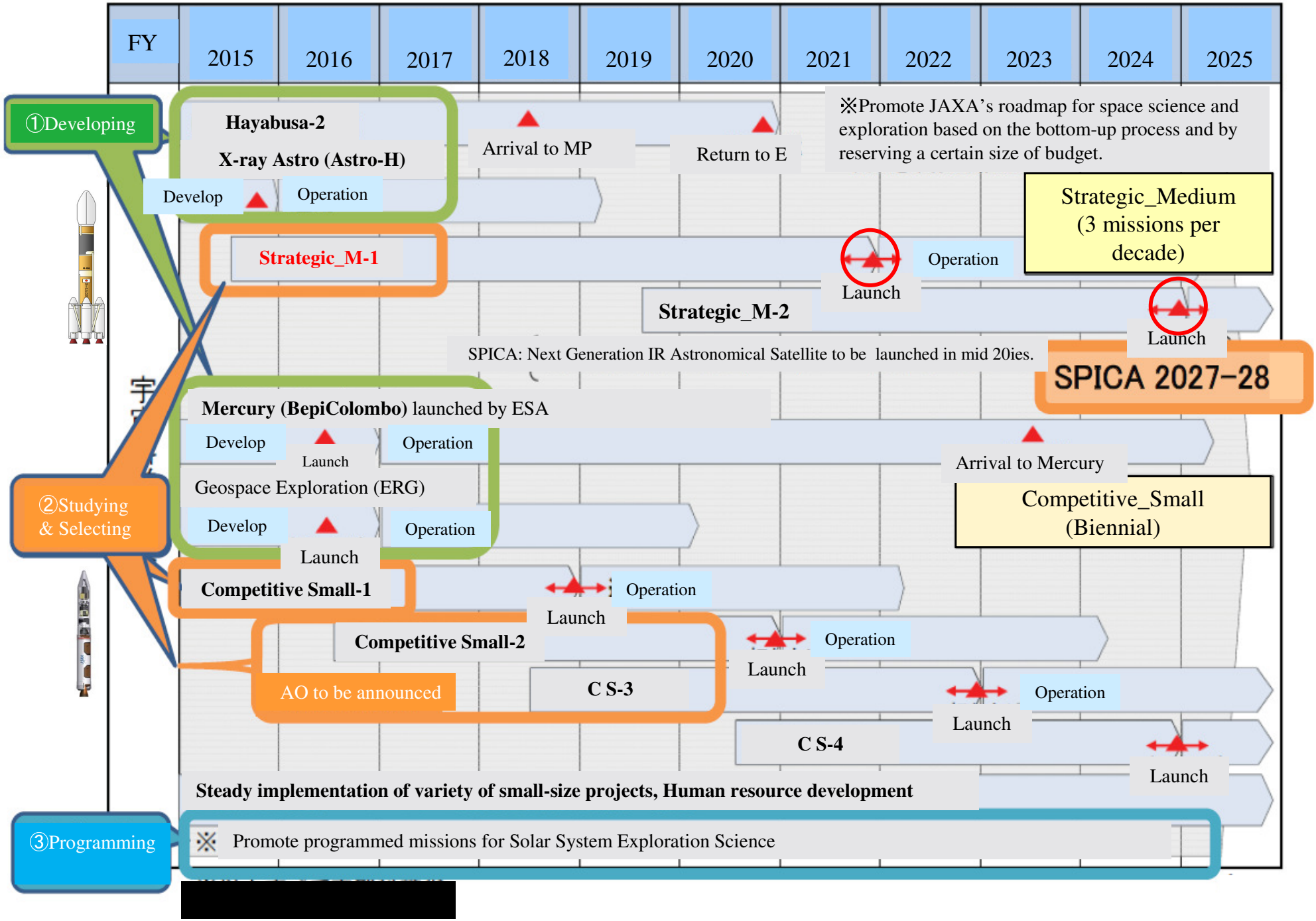
HCI
- Imaging of corona and flares
- 0.1" spatial sampling

EUVST
- Spectroscopy of transition region, coronae, and flares
- 0.14" spatial sampling

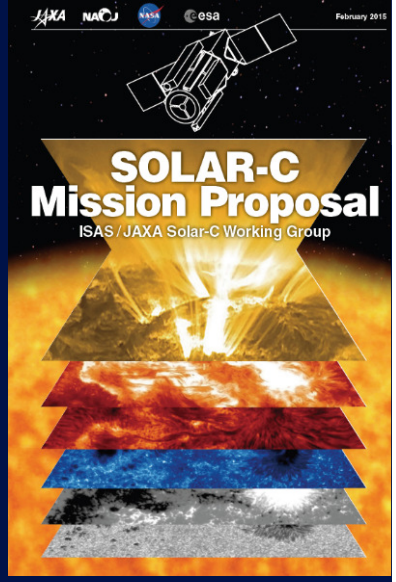
SUVIT
- Imaging and vector magnetogram of photosphere and chromosphere
- 0.03" spatial sampling

Space Science Roadmap (2015/01/09)

Science, exploration, and manned-activity



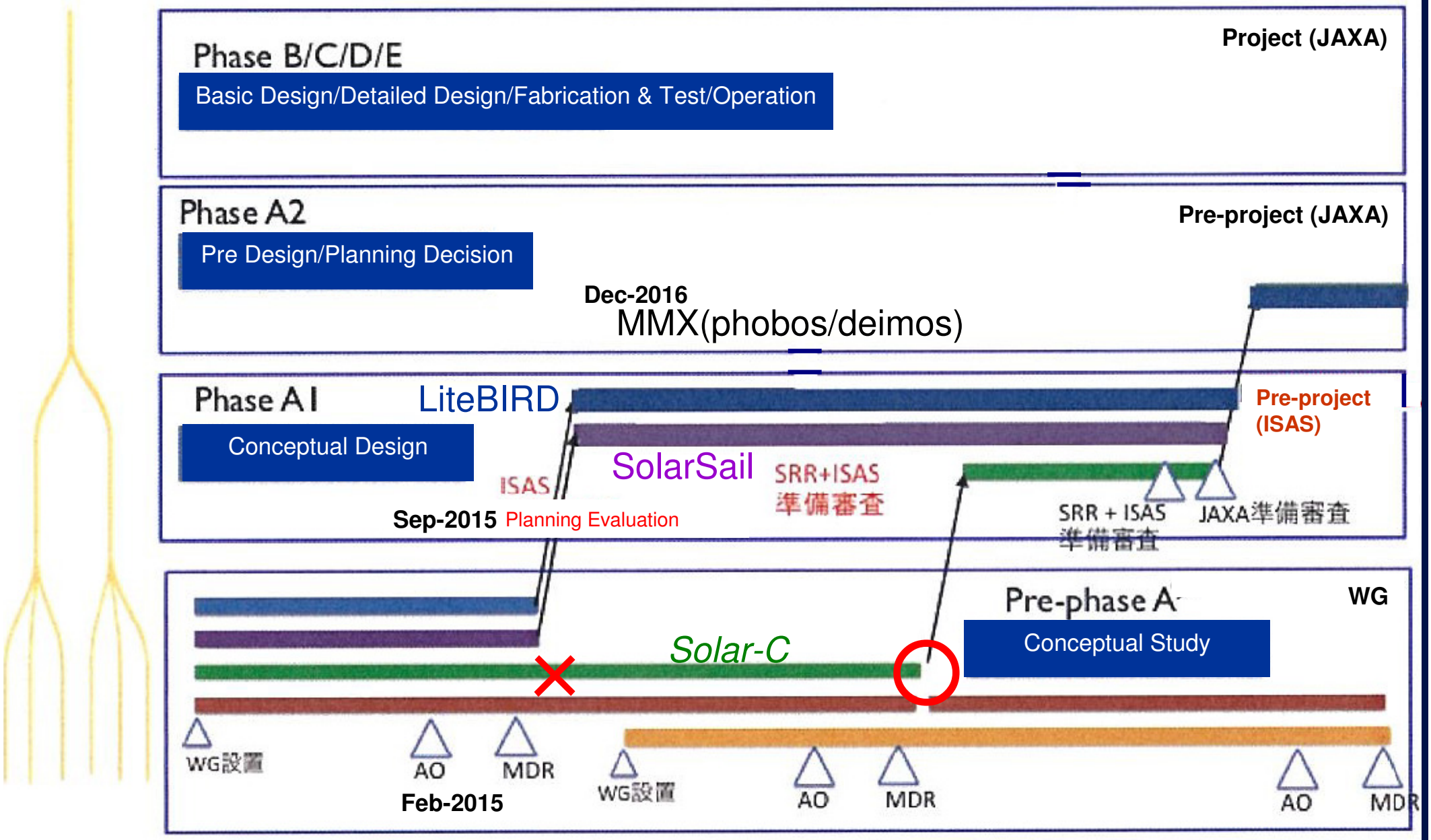
Solar-C WG programmatic chronology



SOLAR-C for strategic medium 1

16-Feb-2015	Submission of proposal
25-Feb-2015	MDR (mission definition review) under SSC
~ E/Apr-2015	
13-May-2015	ISAS/JAXA Evaluation Committee (EC) starts up
4/5-Jun-2015	EPIC for ESA/M4 - not selected
9-Jun-2015	Space policy subcommittee: Start up of strategic-med missions
26-Jun-2015	Final Report from SSC
Sep-2015	Assessment of EC: Re-study @WG→resubmit proposal (to clear MDR)

Schematic Project Structure



Solar-C WG

☆ Early Preparation of "*Nominal*" Plan

Nominal: [JAXA – Str. Med (L)

\+ ESA & NASA – MoOs levels]

Cost reduction with Focused science

Synergy with other missions/facilities
(SOLO, DKIST, …)

☆ Promotion of International Collaboration

more feasible/affordable

NASA: Setup of STDT → JSSDT? → NGSPM-SOT

ESA: Seek for MoOs

→ MDrR (mission definition re-review)

Science objects of Solar-C (proposed in 2015)

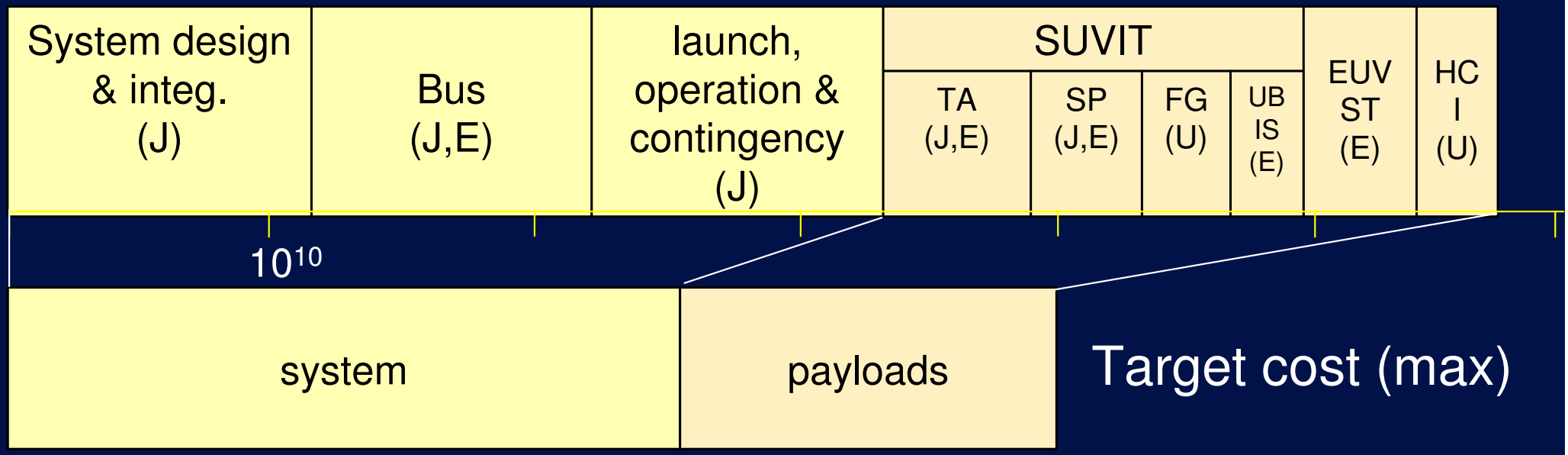
I. Formation mechanism of chromosphere, corona and solar wind		
I-1	Spicules	Foot point B topology, shock, twist, etc.
I-2	Nano-flare heating	Tiny brightening, non-thermal plasma
I-3	Wave heating	Wave mode, energy flux, dissipation
I-4	Solar wind acceleration	B topology in CH, Alfven wave in corona
I-5	Prominence	B field structure, mass circulation
II. Physical origin of large-scale eruptions and algorithm for prediction		
II-1	Energy storage	Photo./chrom. B field maps
II-2	Trigger mechanism	Emerging flux, interaction with chrom.B
II-3	Mechanism of explosion	Large scale dynamics, current system
II-4	Physics of fast reconnection	Current sheet, plasmoid, shock
III. Mechanism of solar spectral irradiance variation		
III-1	Mechanism of UV emission	UV emissions at fine scale B structure
III-2	TSS/SSI modeling	TSI/SSI, fulldisk B map

Science objects of Solar-C (being revised)

I. Formation mechanism of chromosphere, corona and solar wind		
I-1	Chromspheric jets and heating	Foot point B topology, shock, twist, etc.
I-2	Nano-flare heating	Tiny brightening, non-thermal plasma
I-3	Solar wind acceleration	B topology in CH, Alfven wave in corona
I-4	Mechanism of prominence	B field structure, mass circulation
I-5	Non ideal MHD effect	Effect of neutral atoms; B & v structures
II. Physical origin of large-scale eruptions and algorithm for prediction		
II-1	Energy storage	Photo./chrom. B field maps
II-2	Trigger mechanism	Emerging flux, interaction with chrom.B
II-3	Mechanism of explosion	Large scale dynamics, current system
II-4	Physics of fast reconnection	Current sheet, plasmoid, shock
II-5	Formation of δ spots	B fields
II-5	Particle acceleration	B fields, radio, hard X-rays, γ-rays
III. Origin of solar cycle and space climate variability		
III-1	Mechanism of UV variability	UV emissions at fine scale B structure
III-2	TSS/SSI modeling	TSI/SSI, fulldisk B map

Toward the new Solar-C; mission size issue

Total cost of 2015 proposed Solar-C ~ 5.8 x 10^{10} JPY



Target of mission size

- Reduce the total cost from 5.8 to 4 (JAXA + 2MoO), or even 3.5 or even 3!
  - JAXA 3 (target value), Astro-H 3.4 is the upper limit.
  - NASA Mo0 – 0.5, ESA Mo0 – 0.5
- Establish the firm scheme of international task share

Strategy

- Reduce the cost of launch vehicle (H-IIa → H-III) and bus components
- Reduce the cost of SUVIT（Φ~1.4m → 1m, combined SP+FG）
- Reduce payload by collaborating with other space missions

Cost estimate (as of 2016 Feb 11)

Unit: 10^8 JPY ~ 10^6 USD

	2015 proposed	2016 under study
SUVIT TA/IU	66	55
〃 SP	40	50
〃 FG	40	
〃 UBIS	40	
EUVST	70	55
HCI	40	
IM	3	
Management/system design	12	10
System/bus	123	113
Test/launch ope.	25	25
Ground facilitty, etc.	5	5
Operation	9	9
Contingency	19	20
Launcher	95	60
total	587	402

J-SP full cost 39
Plus US-FG TBD

Combined SP+FG (target)

(ESA only)
(Optional)

Plus Consortium 30
(includ. US contrib)

(for J-contribution BUS + SUVIT)

(H-III, geo-synchronous)

Space Policy Commission under cabinet office intends to guarantee predetermined ***steady annual budget*** for space science and exploration to maintain its scientific activities

2010 2020 2030

Strategic Medium Missions (300M$ class) for JAXA-led flagship science mission with HIIA vehicle (3 in ten years)

Competitively-chosen small-sized focused missions (<150M$ class) with Epsilon rocket (every 2 year)

Missions of opportunity for foreign agency-led mission

Astro-H (2016)

Phobos/Deimos (2022)

LiteBIRD, Solar-Sail, Solar-C (2025)

SPICA (2027-28)

Hisaki(2013)

ERG(2016)

SLIM(2020)

#4 (2022)

#5(2024)

Proposals being reviewed

BepiColombo (ESA, 2016)

JUICE (ESA, 2022)

WFIRST(NASA, 2025)

ATHENA(ESA, 2028)

NASA NewFrontiers2016