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JAXA

SOLAR-C Mission

energy transport and dissipation of magnetic energy

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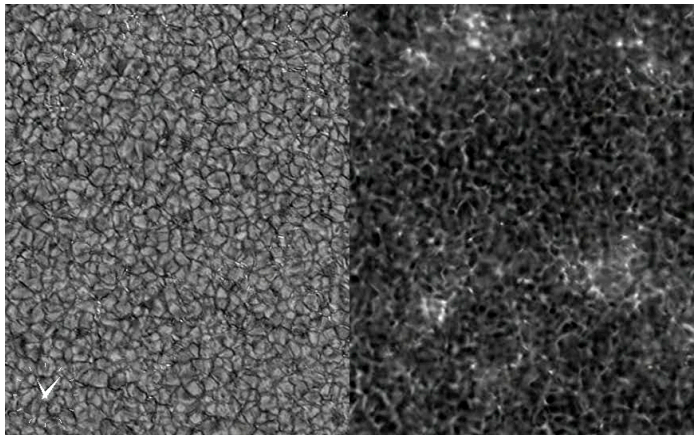

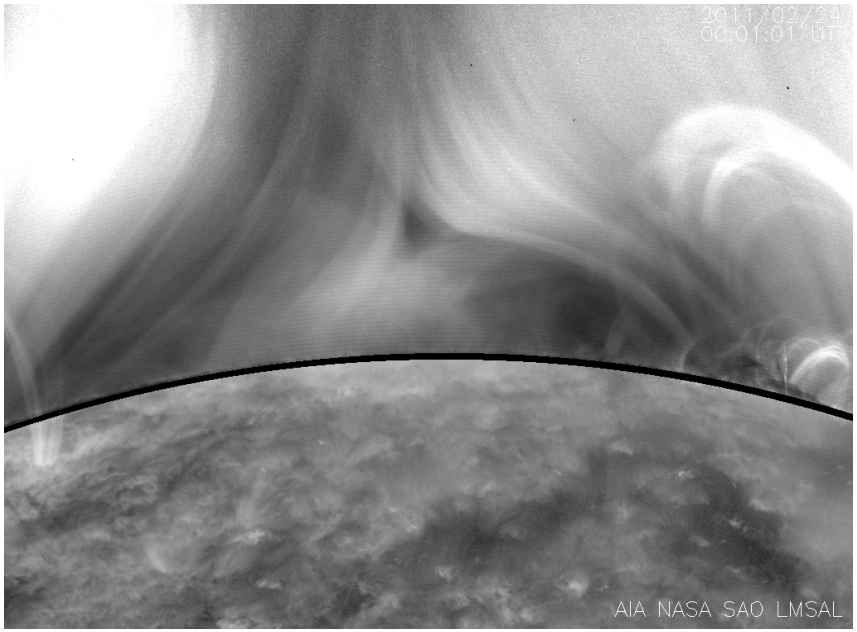

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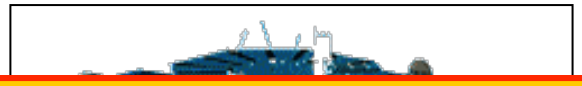
JAXA Solar Physics missions with NASA and ESA participation: What is next?

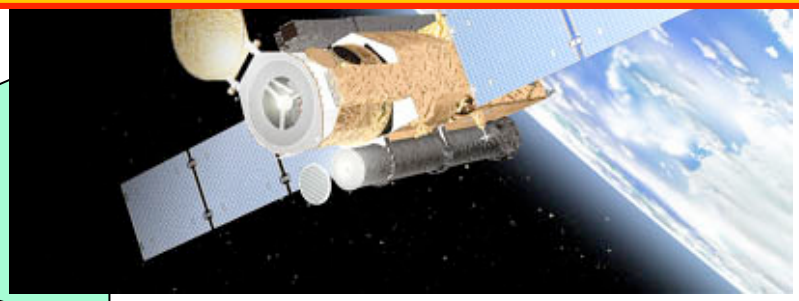
Yohkoh (1991- 2001)
With NASA/PPARC



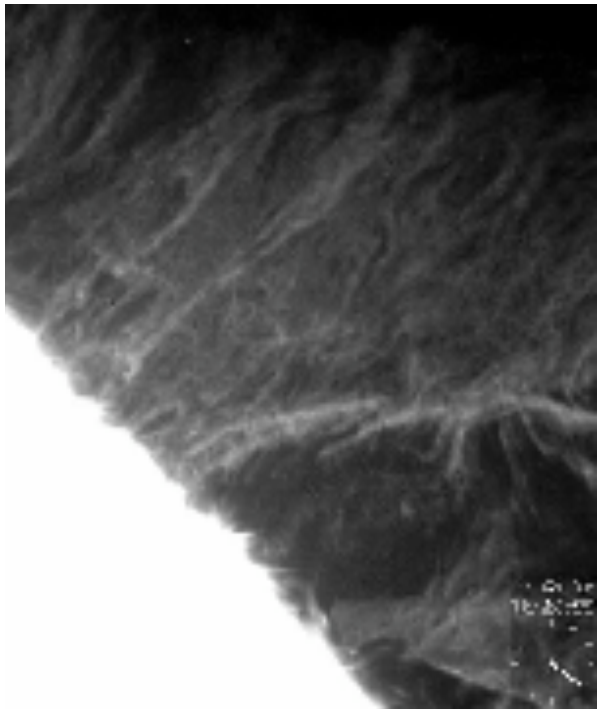
Open issues in solar physics

- ***Fundamental plasma processes (SOLARC)***
- ***Chromospheric and coronal heating (SOLAR-C)***
- ***Acceleration of fast solar wind (SOLAR-C)***
- ***Local dynamo process (SOLAR-C/D)***
- ***Internal structure and flow (SOLAR-D)***
- ***Global dynamo process (SOLAR-D)***

SOLAR-C launch
2019 winter
(provisional)



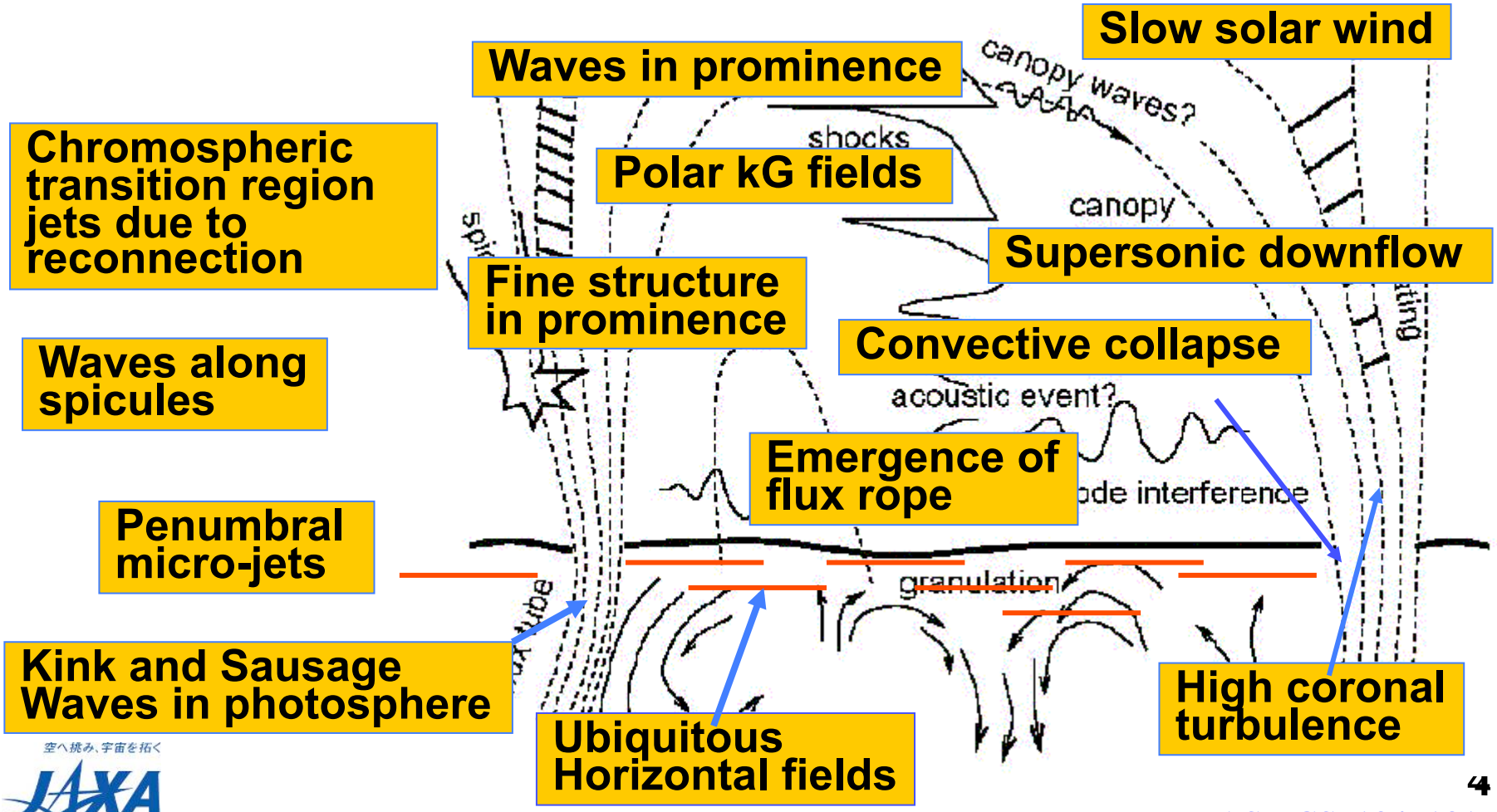
Solar-C science goals



- to understand energy transport and dissipation of magnetic energy by revealing the magnetic and plasma structures of the whole solar atmosphere from the photosphere throughout the corona.
- Our guiding principle here is that ***small scale plasma processes*** such as waves, shocks, turbulence, and magnetic reconnection ***dictate the evolution of the global structure of the Sun and the heliosphere***.

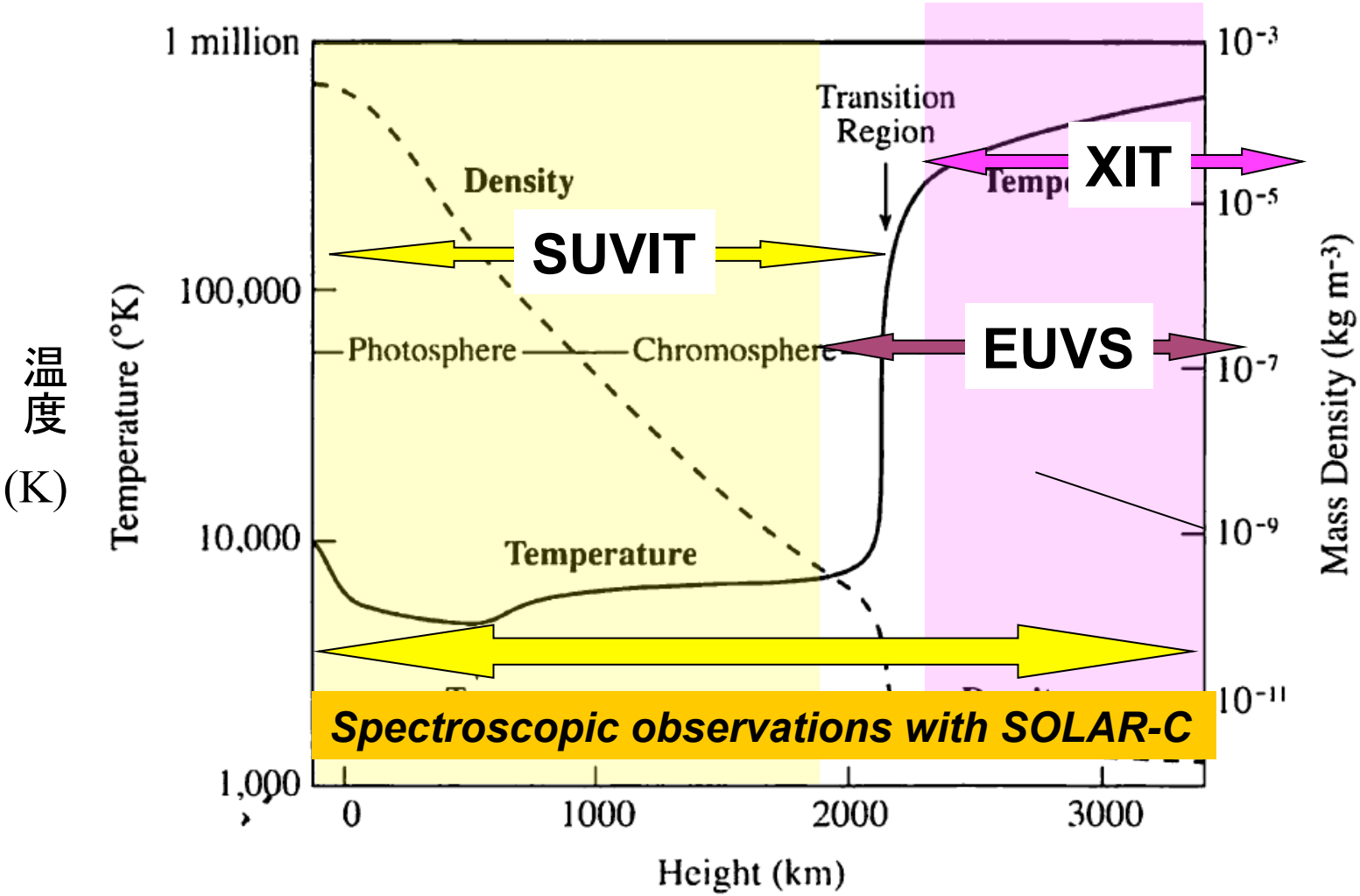
Linking through the atmosphere consistently and spectroscopically

Energy transport and dissipation of magnetic energy – linkage through the atmosphere is critical to progress.

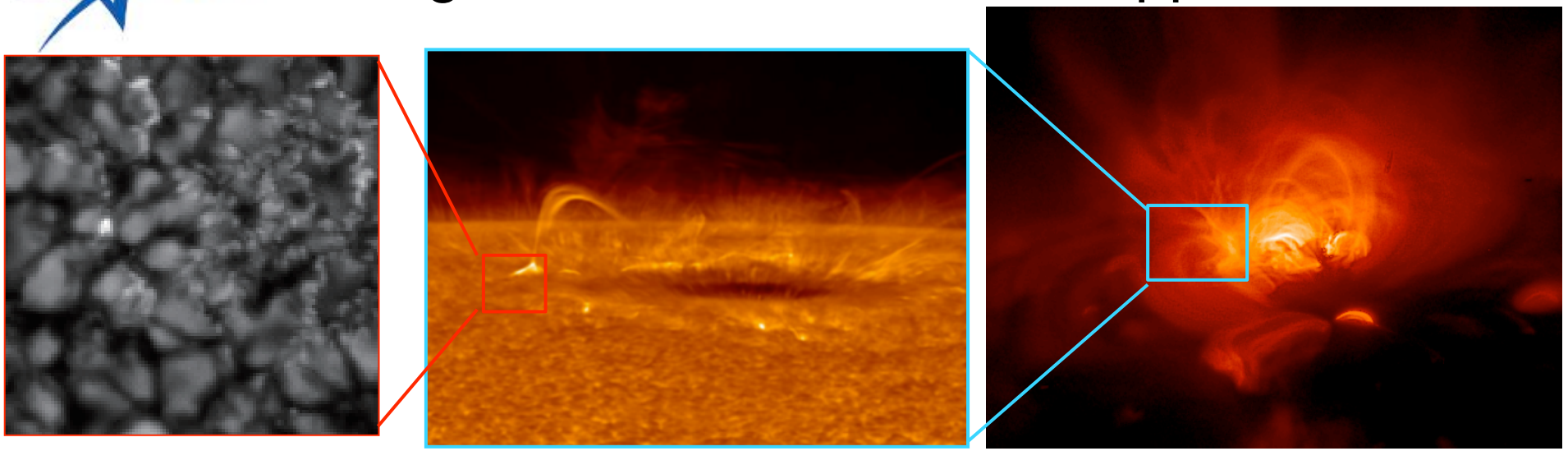


Rutten, R., ASP-CS, 184, 181, 1999

Observing the whole atmosphere



How do we observationally connect these regions with such different appearances?



Photosphere

Interface region
Chromosphere

2-5MK corona

Questions to be addressed in the SOLAR-C design

- ***How do we determine chromospheric magnetic structure?***
- ***How do we determine coronal magnetic structure?***
- ***How are they related?***
- ***What is the source of EIS line broadening; flows or turbulence?***
- ***What is the smallest scale size inferred from filling factors in all layers?***
- ***How do we confirm or reject the Parker conjecture on nano-flares?***

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Approach to implement objective

- is through ***High³*** (spatial resolution, cadence, and throughput) ***imaging spectroscopy*** for the entire solar atmosphere without gaps in temperature coverage where plasma might escape detection because of lack of instrumental sensitivity.
- Hinode clearly showed that the ***combination of high spatial resolution and spectroscopy*** (including spectro-polarimetry) is a powerful tool for obtaining magnetic and plasma information.
- This is inevitably achieved with **larger telescopes with highest possible throughput** for more photons and higher spatial resolution. High S/N is critical in order to retrieve information from spectral profiles.

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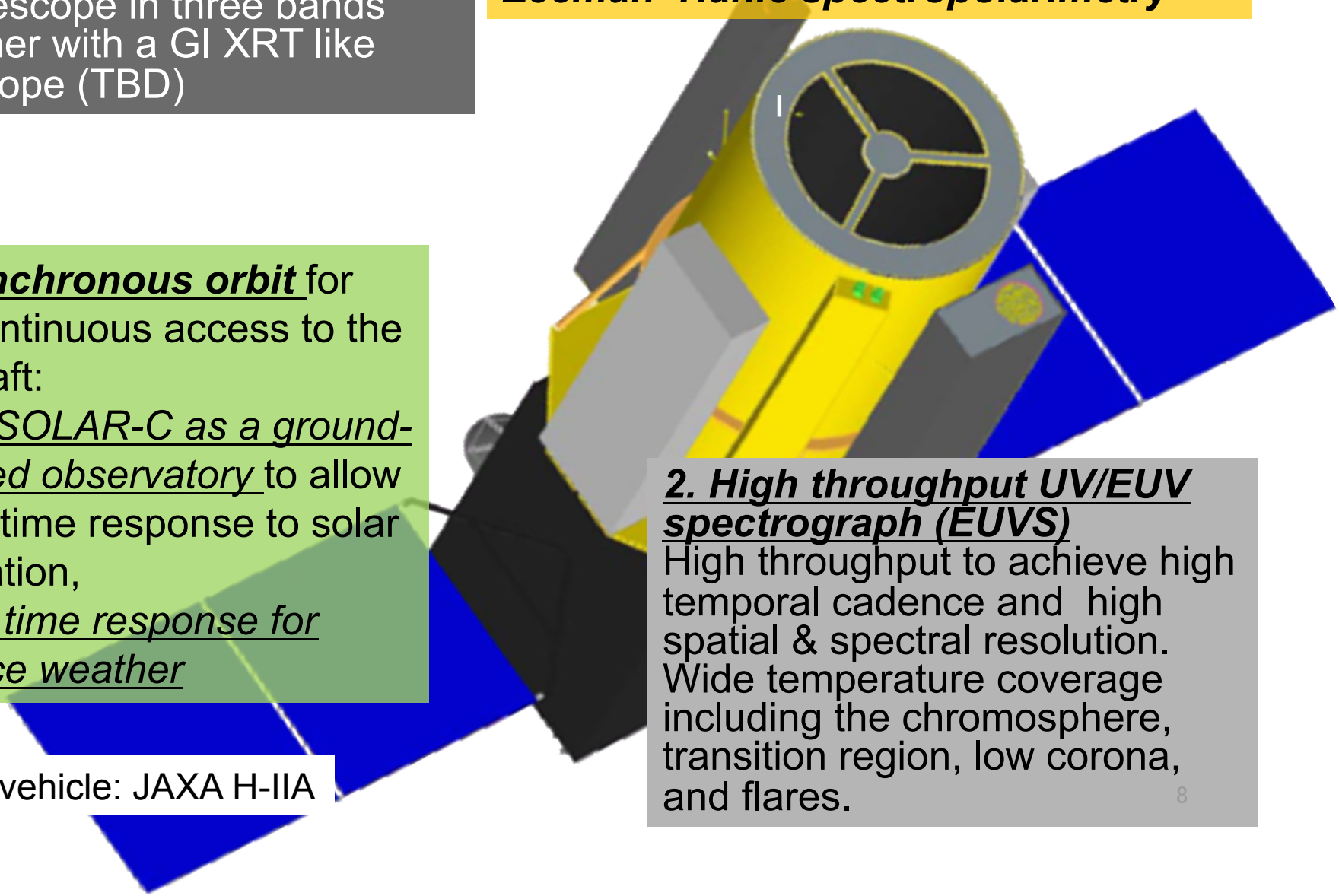
SOLAR-C Strawman instruments

1. UV-Visible-NIR telescope (SUVIT)
<1.5mϕ telescope with filtergraph and spectro-polarimeter. Wide wavelength coverage from photosphere to the upper chromosphere and transition region. ***Zeeman+Hanle spectropolarimetry***

3. Imager
NI telescope in three bands together with a GI XRT like telescope (TBD)

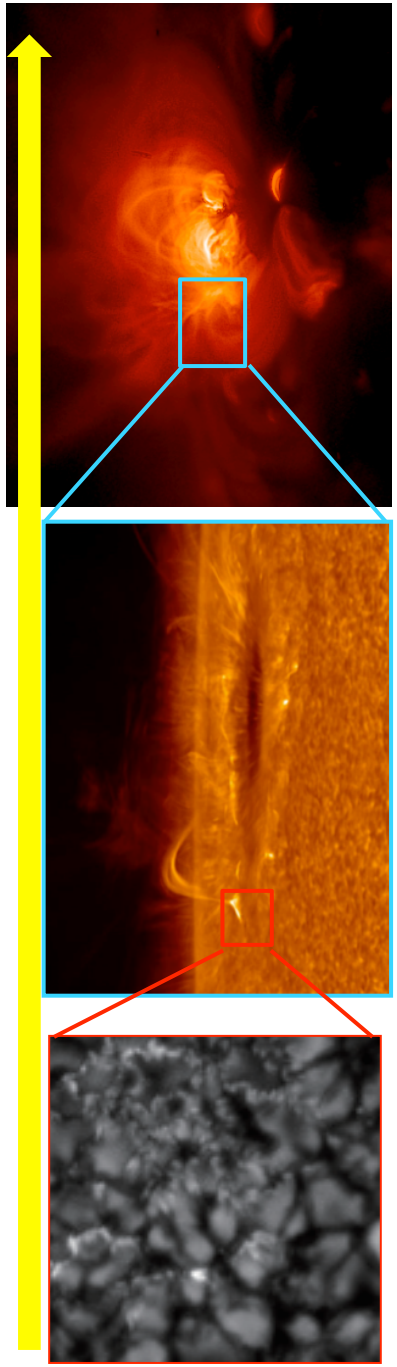


Geo-synchronous orbit for quasi-continuous access to the spacecraft:

1. *Use SOLAR-C as a ground-based observatory* to allow real-time response to solar situation,
2. *Real time response for space weather*

2. High throughput UV/EUV spectrograph (EUVS)
High throughput to achieve high temporal cadence and high spatial & spectral resolution. Wide temperature coverage including the chromosphere, transition region, low corona, and flares.

Launch vehicle: JAXA H-IIA



3. X-Ray spectrometer (XIS)
Grazing incidence telescope & normal incidence telescope.

2. High throughput UV/EUV spectrograph (EUVS)
Spatial resolution: ~0.3"
Time resolution:
- 1 - 5 s（0.33" sampling）
- 0.5 - 1 s（1.0" sampling）
- 15“ FOV with 0.3“step 25-50s cd.
- ***200“ FOV with 0.6“step 200s cd.***

FOV： > 300 " x 300" (0.3“)
LOS velocity resolution: < 3 km/s
LOS line broadening: < 10 km/s
Temperature coverage： 10(4) – 10(7)K

UV spectro-polarimetric observations: pending CLASP

1.UV-Visible-NIR telescope (SUVIT)
1. Spatial resolution: < 0.1" (UV & Visible), < 0.2" (near-IR)
2. Time resolution:> 0.1-1s (imaging), > 1-20s（spectro-polarimetry）FOV: > 180" x 180"
3. Wavelength: 280nm - 1.1μm including
   Mg II h/k 280nm, Ca II 854 nm, He I1083 nm, and photospheric lines
5. Spectro-polarimetric sensitivity:
   10(7) – 10(8) photons for chromospheric lines

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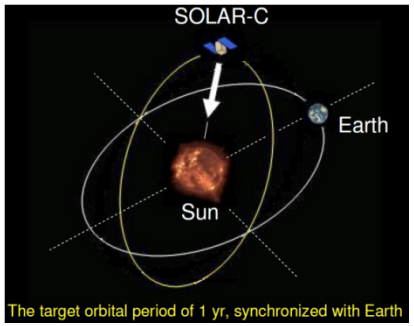
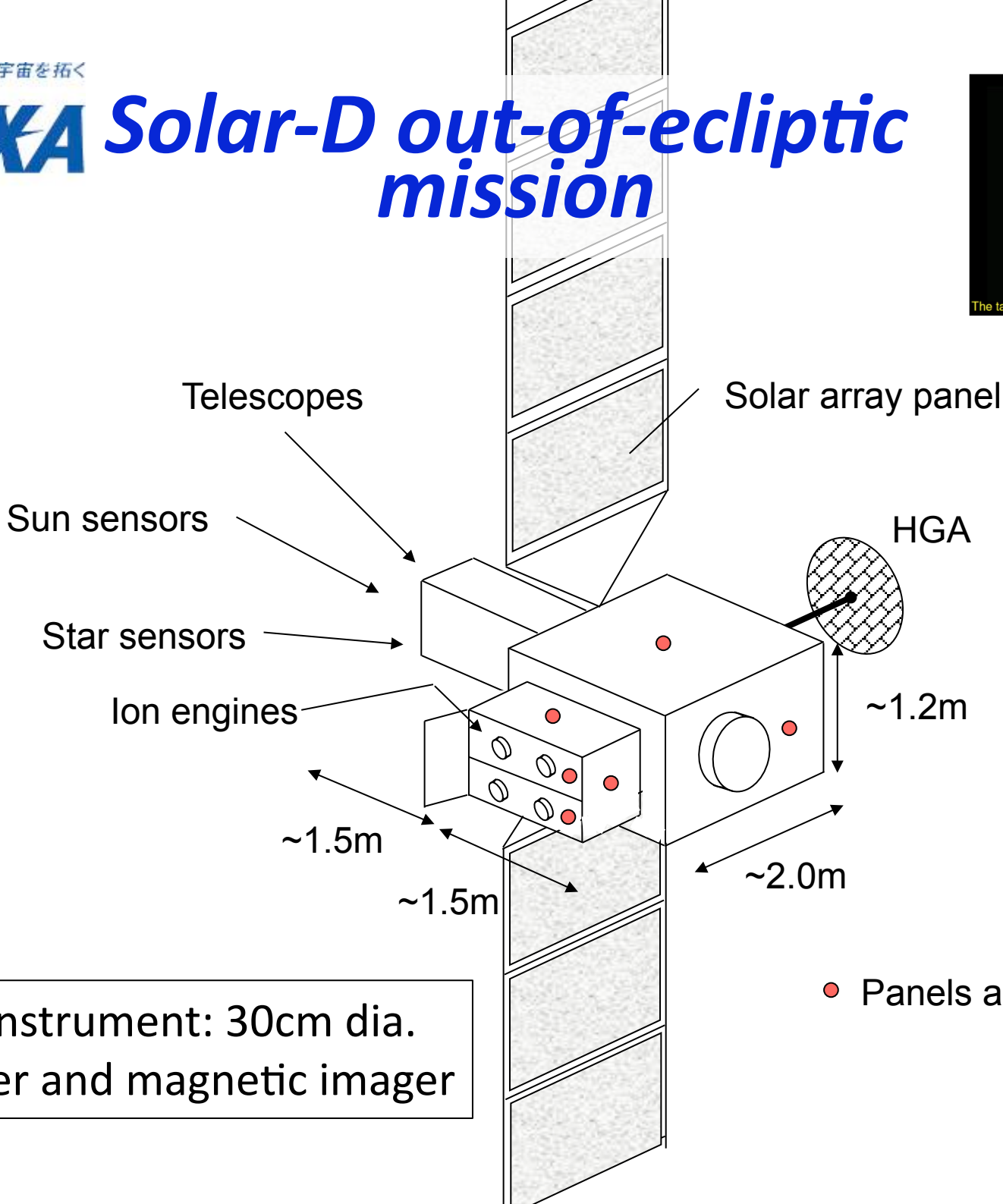
Solar-D out-of-ecliptic mission





- Panels act as radiators.

Main instrument: 30cm dia.
Doppler and magnetic imager

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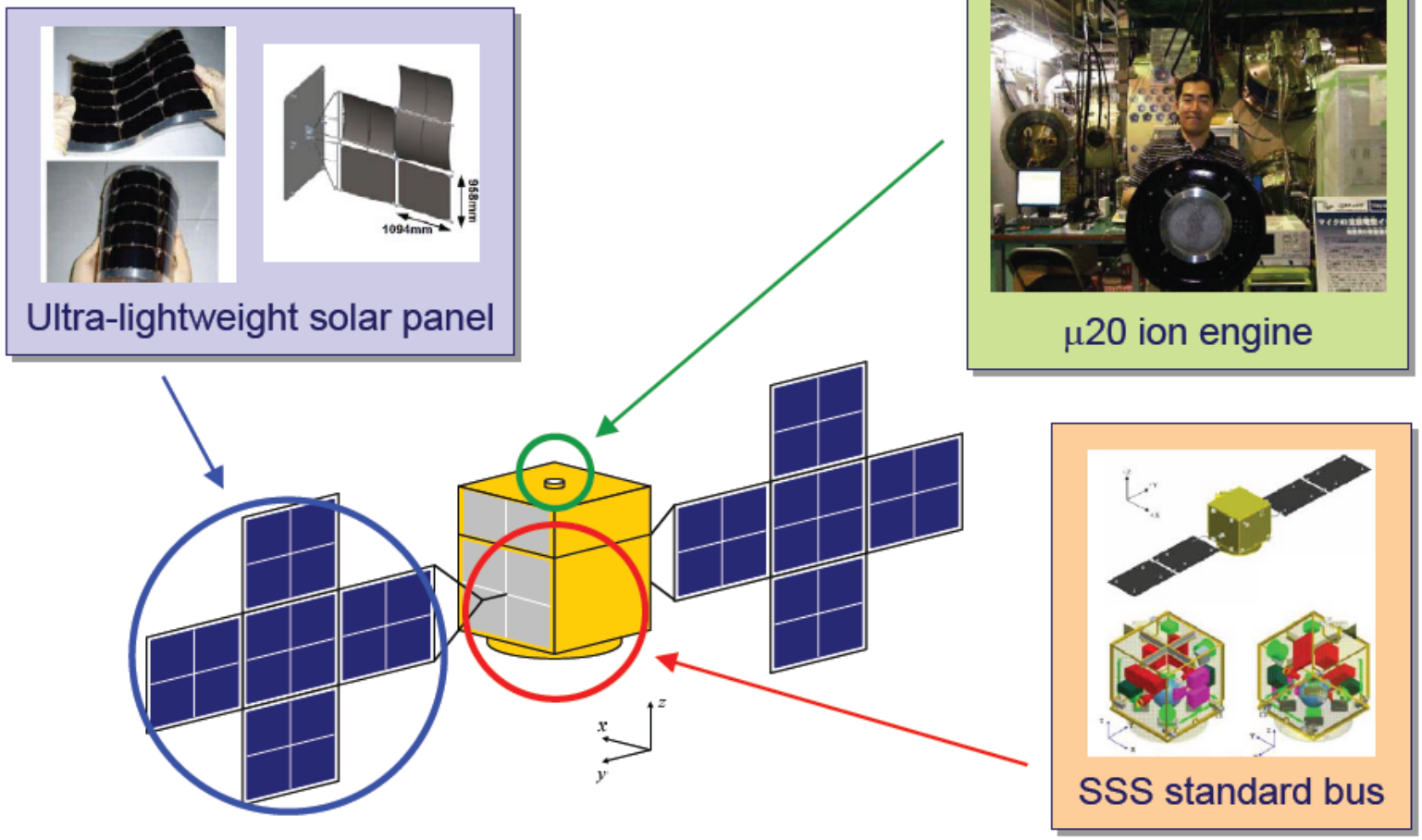
SOLAR-D Technology demonstration with JAXA small mission

DESTINY Spacecraft (tentative)



SOLAR-C development Calendar (Japan **FY** starting April 1)

- JFY2011
  - Proposal preparation
  - Technology development
- JFY2012
  - Mission proposal to ***ISAS SCSS***
  - Review(MDR&SRR) by ***ISAS SCSS***
  - Approved by ***ISAS SCSS***
  - Technology development (continued)
- JFY2013
  - Technology development (continued)
  - ***Phase A*** (pre-project) study
  - RFP/RFQ, SDR by ***JAXA***
  - Final review by ***JAXA***
  - ***Government*** approval
- JFY2014-2018 (5 years)
  - ***Phase B/C***
- JFY2018 (2019 winter)
  - Launch

Summary

- SOLAR-C is a fundamentally new way of viewing the solar atmosphere because it observes the entire atmosphere with the same high spatial and temporal resolution, in addition to performing high resolution spectroscopic measurements over all atmospheric regions. Solar-C should finally solve many outstanding solar physics problems such as chromospheric/coronal heating, solar wind acceleration, and storage and energy release in flares and CMEs.
- SOLAR-C is a very challenging mission to design, scientifically and technically. Therefore, collaborations among the JAXA SOLAR-C project, theory/simulation, and ground-based observations are very important.
- The flowdown from scientific purpose all the way to the instrument and spacecraft specifications, while considering available technology/money/ manpower, has to be extensively studied in the coming months.

Areas of Collaboration with NASA, ESA and European nations

- ***JAXA***
  - Visible light telescope
  - Part of focal plane package (FPP) for the visible light telescope
  - Contribution to X-ray telescope
  - Spacecraft and launch
- ***NASA***
  - Major portion of FPP for the visible light telescope
  - Main part of X-ray telescope
  - Contribution to UV telescope
- ***ESA & European nations***
  - Major part of UV telescope
  - Primary/secondary mirror system for for the visible light telescope
  - Contribution to FPP for the visible light telescope

SOLAR-C 2019

Next Solar-C meeting is 13th August 2012 in St Andrews