
esa
HELIOS mini- Worksop, Köln, June 2016
NASA
Solar Orbiter
Exploring the Sun-Heliosphere Connection
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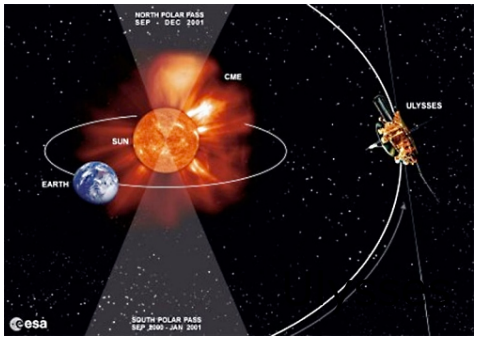
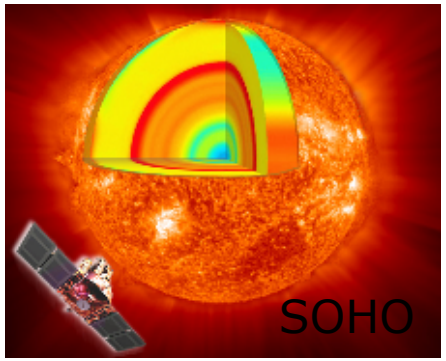
Solar Orbiter
Exploring the Sun-Heliosphere Connection

Solar Orbiter

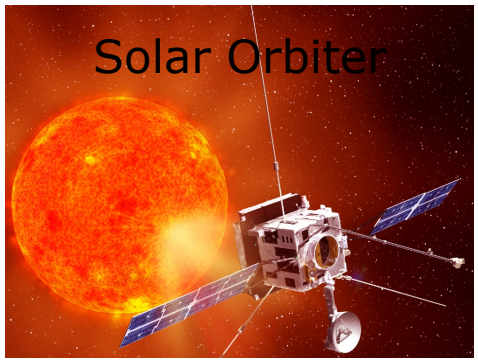
- First medium-class mission of ESA's Cosmic Vision 2015-2025 programme, implemented jointly with NASA. Launch date : Oct 2018
- Dedicated payload of 10 remote-sensing and in-situ instruments measuring from the photosphere into the solar wind





Talk Outline

- Science Objectives and Mission Overview
- Spacecraft & Payload
- Science Synergies
- Brief description of the RPW instrument

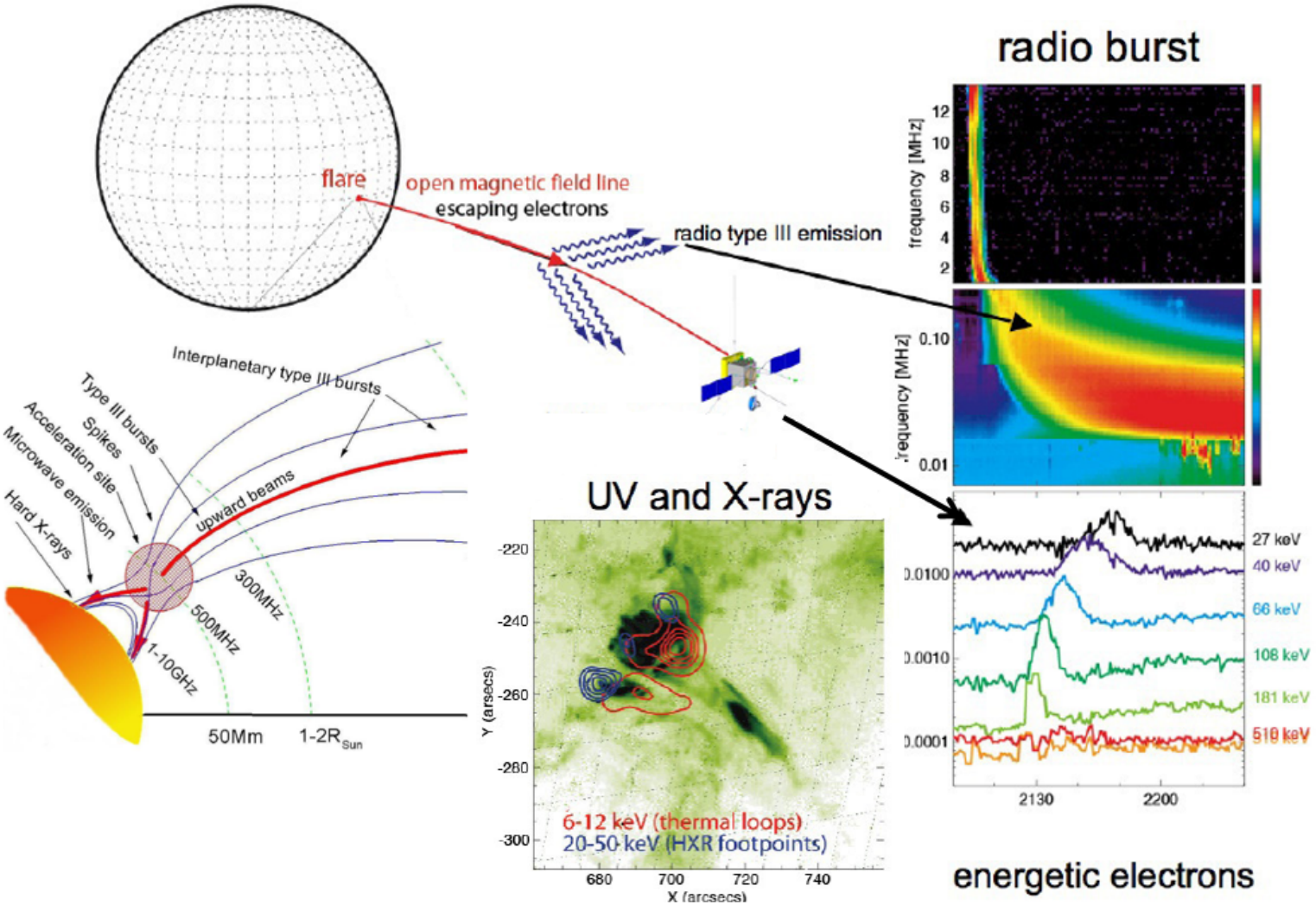


Solar Orbiter Science Focus:

How does the Sun create and control the Heliosphere – and why does solar activity change with time ?

- What drives the solar wind and where does the coronal magnetic field originate from?
- How do solar transients drive heliospheric variability?
- How do solar eruptions produce energetic particle radiation that fills the heliosphere?
- How does the solar dynamo work and drive connections between the Sun and the heliosphere?

Solar Orbiter = Linking in-situ and remote-sensing observations



Solar Orbiter
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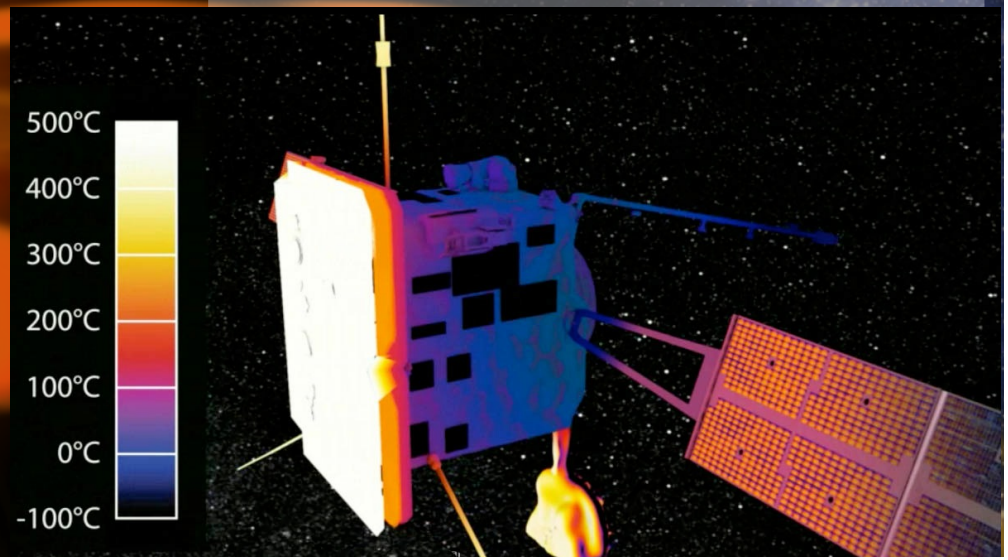
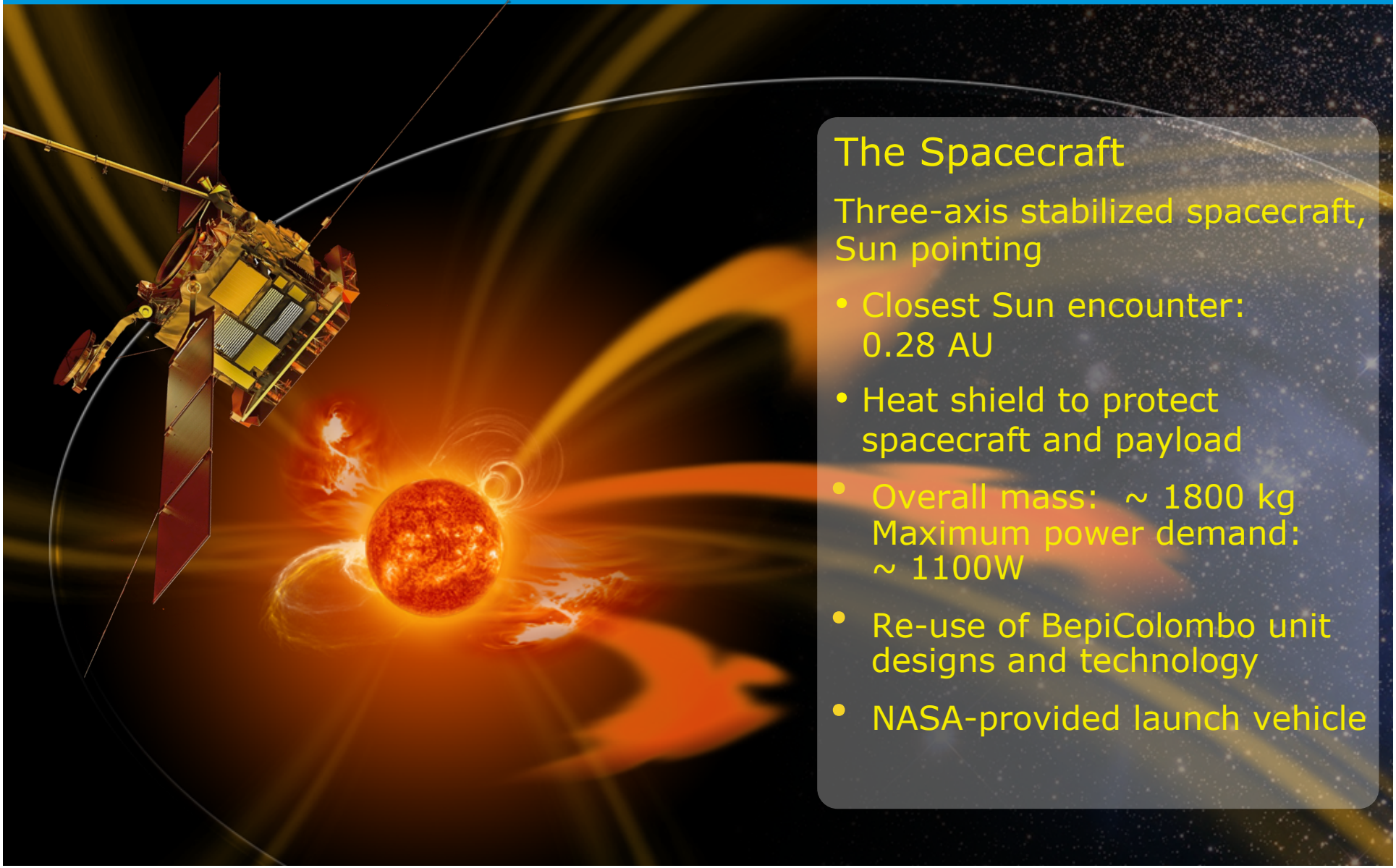
The Spacecraft

Three-axis stabilized spacecraft, Sun pointing

- Closest Sun encounter: 0.28 AU
- Heat shield to protect spacecraft and payload



Solar Orbiter
Exploring the Sun-Heliosphere Connection



The Spacecraft

Three-axis stabilized spacecraft, Sun pointing

- Closest Sun encounter: 0.28 AU
- Heat shield to protect spacecraft and payload
- Overall mass: ~ 1800 kg
  Maximum power demand: ~ 1100W
- Re-use of BepiColombo unit designs and technology
- NASA-provided launch vehicle

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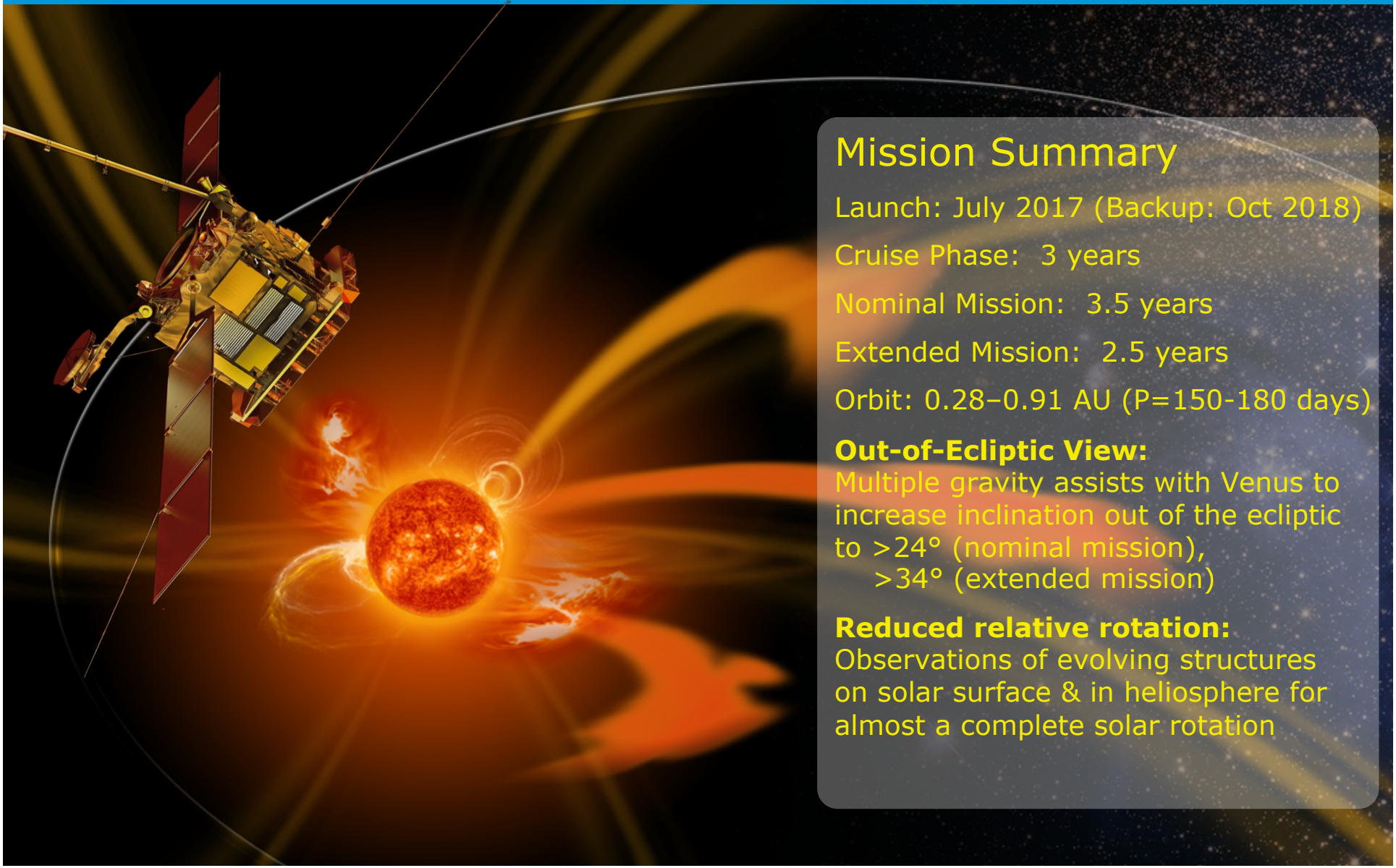

Mission Summary

Launch: July 2017 (Backup: Oct 2018)

Cruise Phase: 3 years

Nominal Mission: 3.5 years

Extended Mission: 2.5 years

Orbit: 0.28–0.91 AU (P=150-180 days)

Out-of-Ecliptic View:
Multiple gravity assists with Venus to increase inclination out of the ecliptic to >24° (nominal mission), >34° (extended mission)

Reduced relative rotation:
Observations of evolving structures on solar surface & in heliosphere for almost a complete solar rotation

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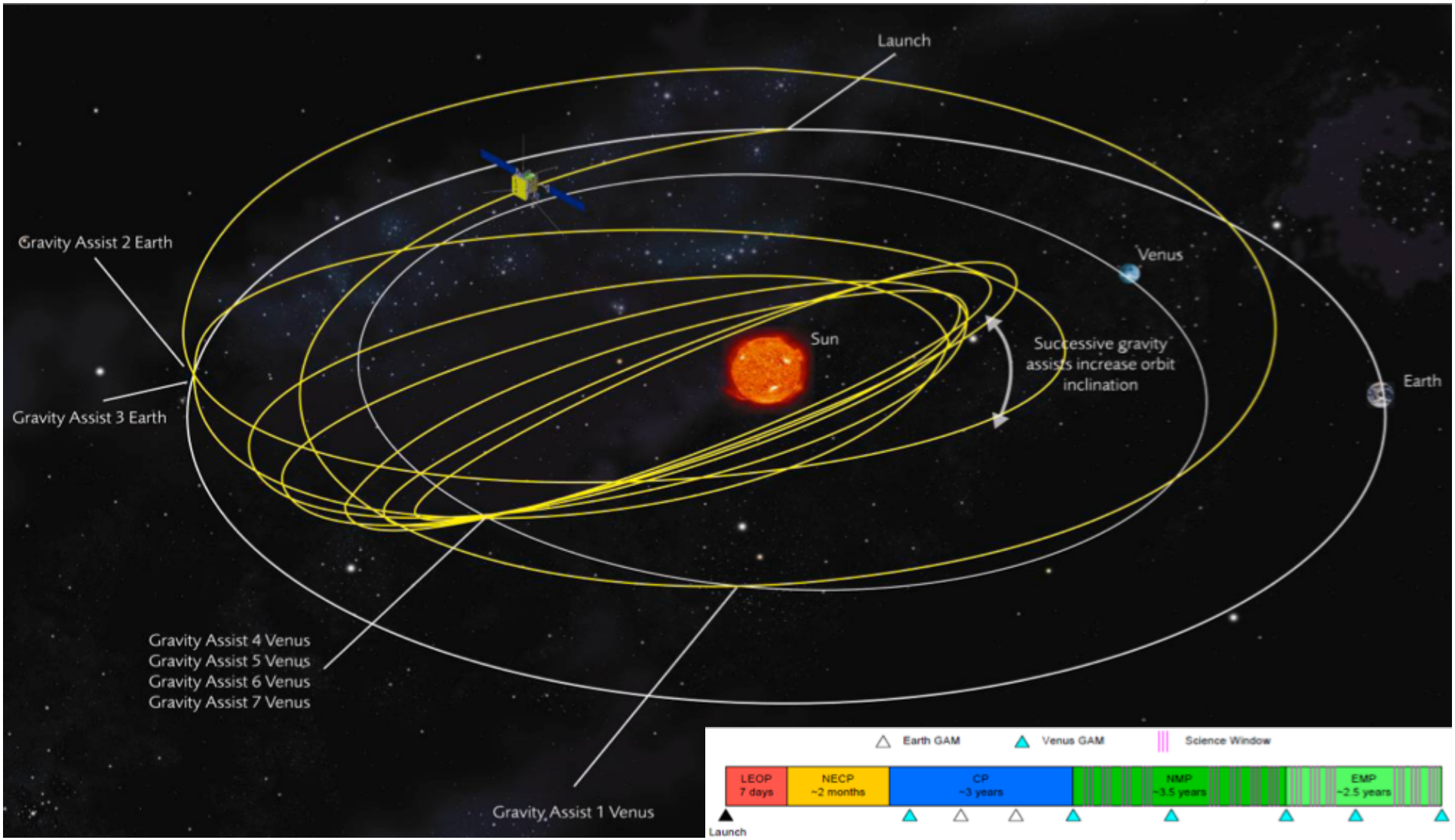
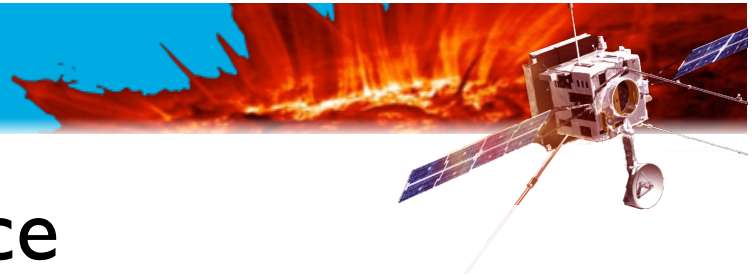
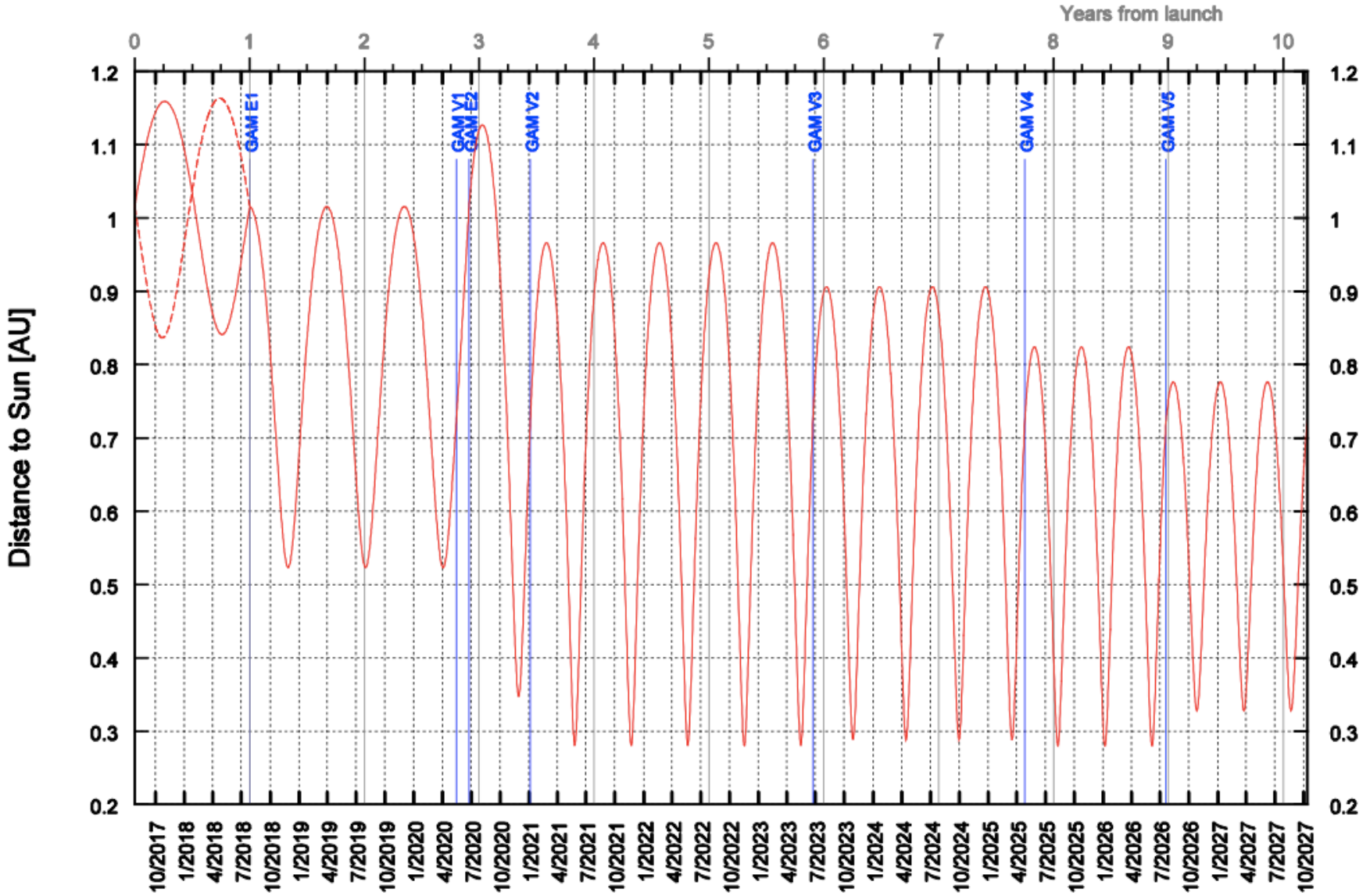
SOLAR ORBITER

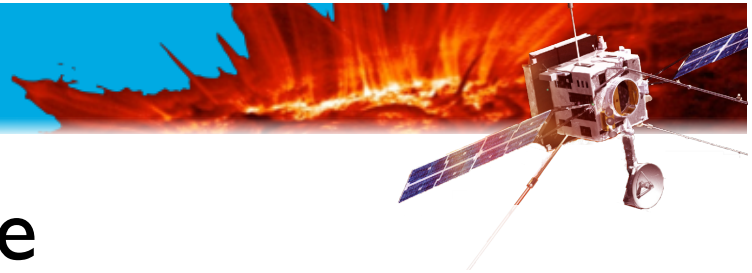
Mission Profile



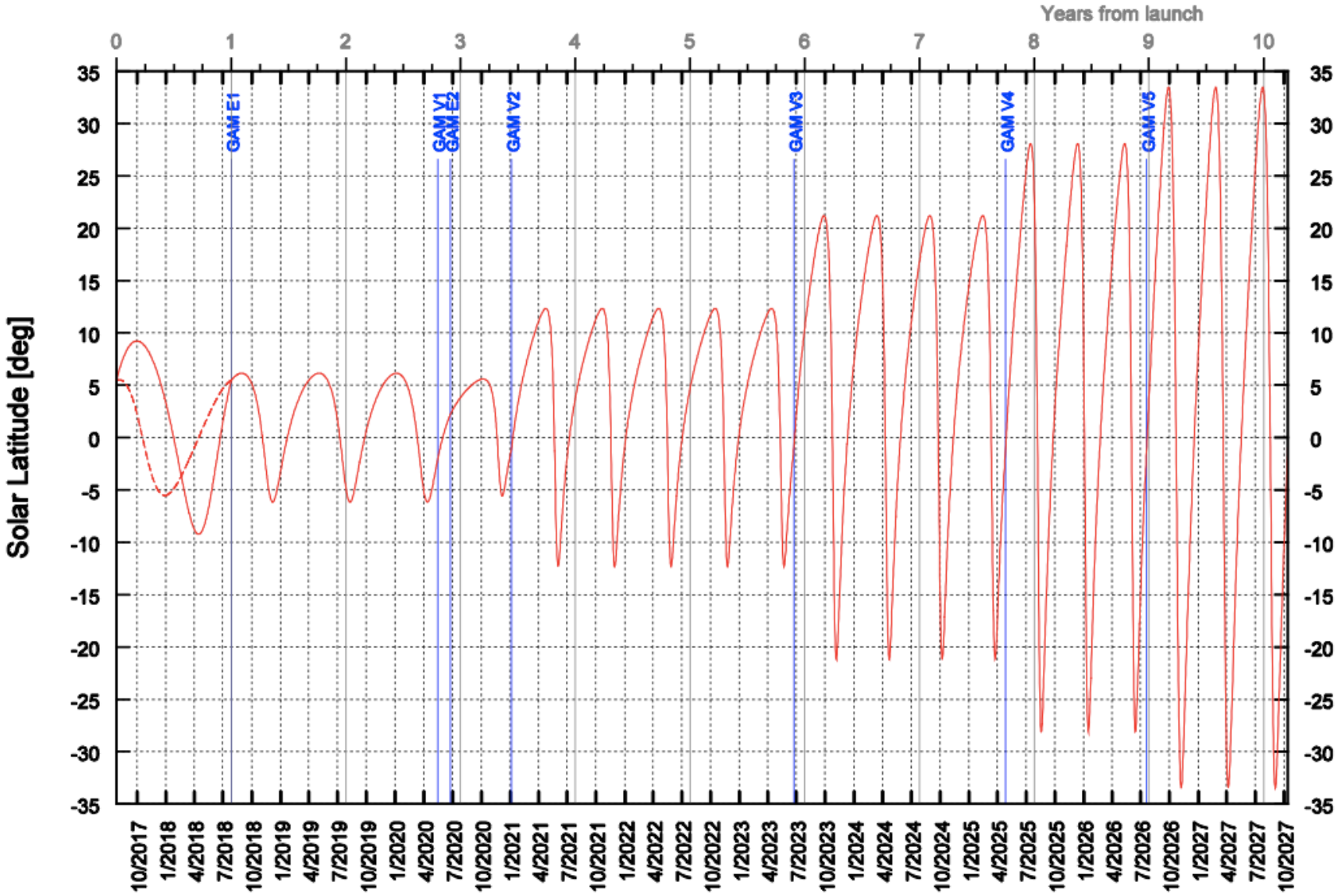


July 2017 Launch: Solar Distance





July 2017 Launch: Solar Latitude



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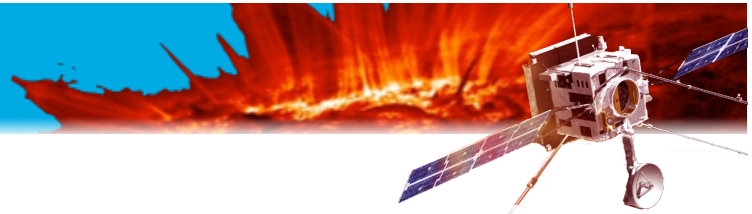
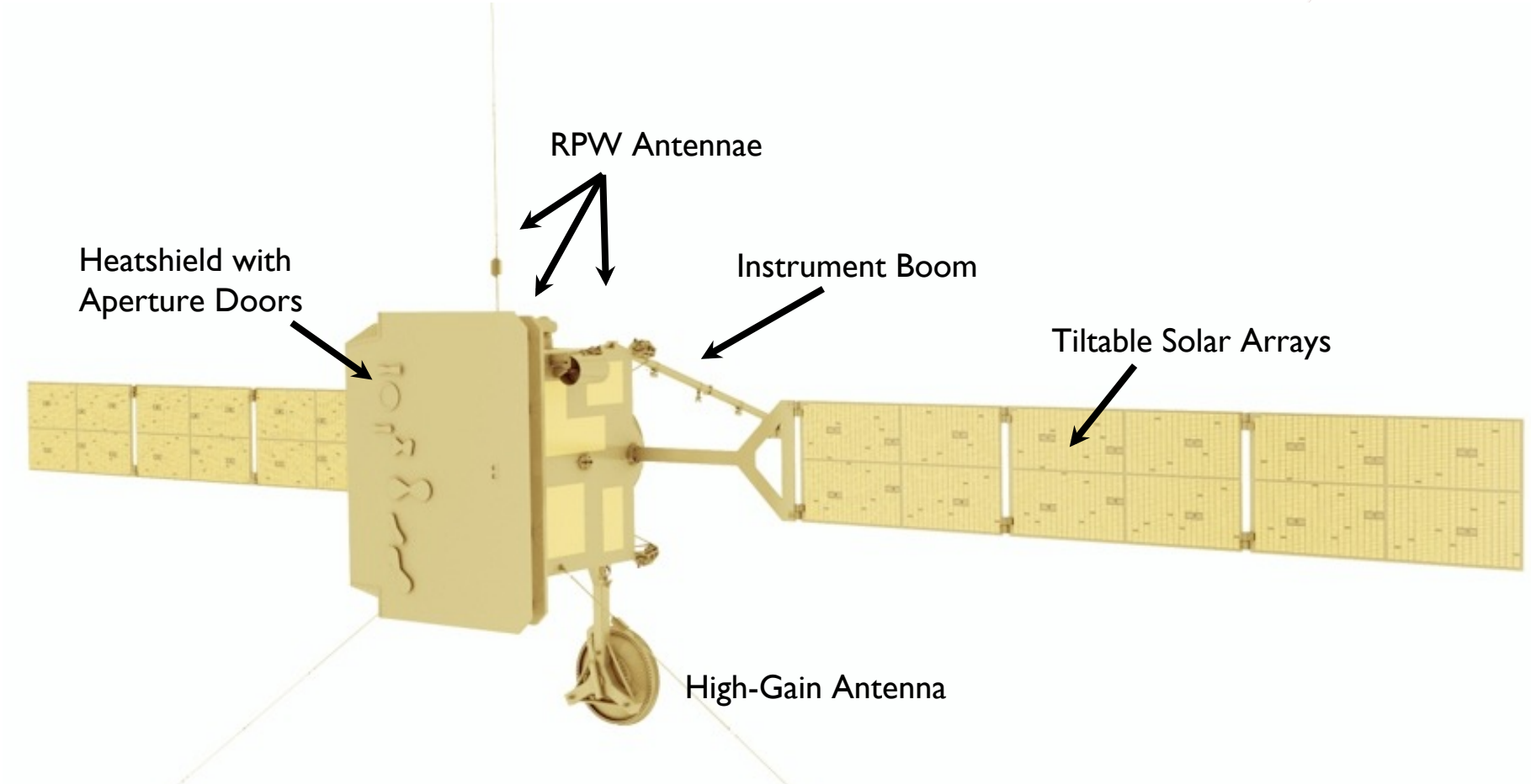


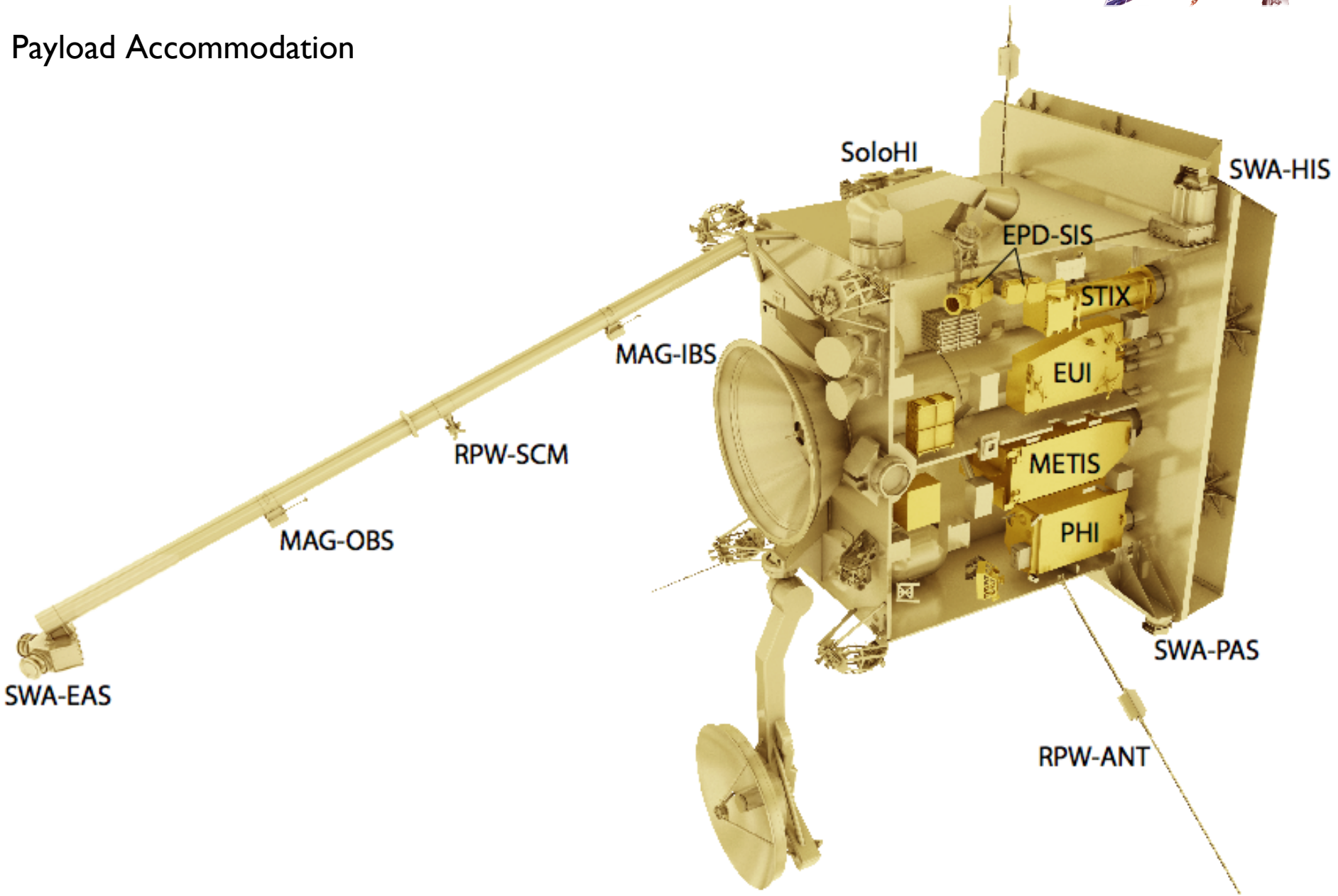
Payload

In-Situ Instruments			
EPD	Energetic Particle Detector	J. Rodríguez-Pacheco	Composition, timing and distribution functions of energetic particles
MAG	Magnetometer	T. Horbury	High-precision measurements of the heliospheric magnetic field
RPW	Radio & Plasma Waves	M. Maksimovic	Electromagnetic and electrostatic waves, magnetic and electric fields at high time resolution
SWA	Solar Wind Analyser	C. Owen	Sampling protons, electrons and heavy ions in the solar wind
Remote-Sensing Instruments			
EUI	Extreme Ultraviolet Imager	P. Rochus	High-resolution and full-disk EUV imaging of the on-disk corona
METIS	Multi-Element Telescope for Imaging and Spectroscopy	E. Antonucci	Imaging and spectroscopy of the off-disk corona
PHI	Polarimetric & Helioseismic Imager	S. Solanki	High-resolution vector magnetic field, line-of-sight velocity in photosphere, visible imaging
SoloHI	Heliospheric Imager	R. Howard	Wide-field visible imaging of the solar off-disk corona
SPICE	Spectral Imaging of the Coronal Environment	European-led facility instrument	EUV spectroscopy of the solar disk and near-Sun corona
STIX	Spectrometer/Telescope for Imaging X-rays	S. Krucker	Imaging spectroscopy of solar X-ray emission

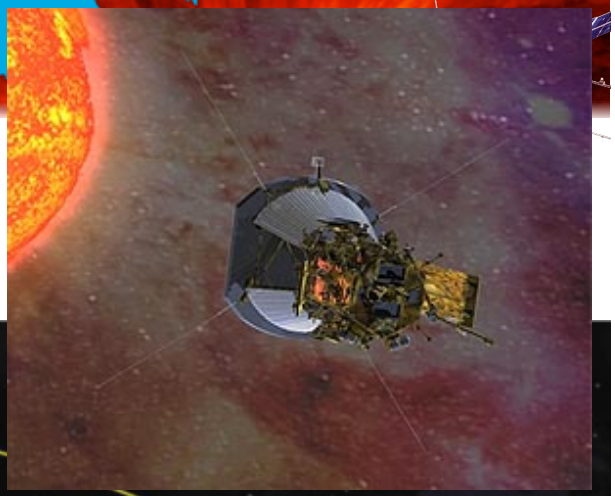
The Spacecraft

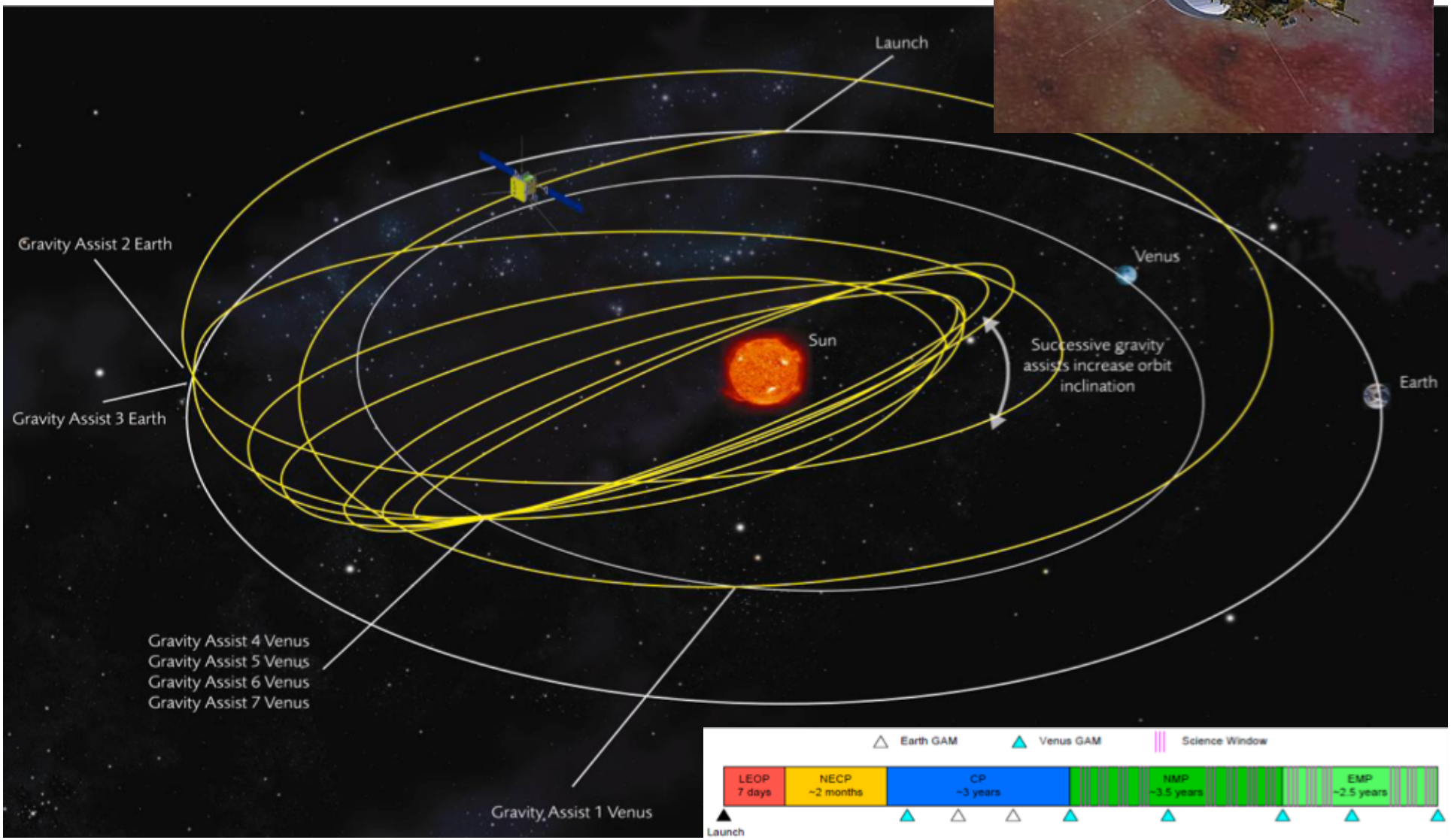


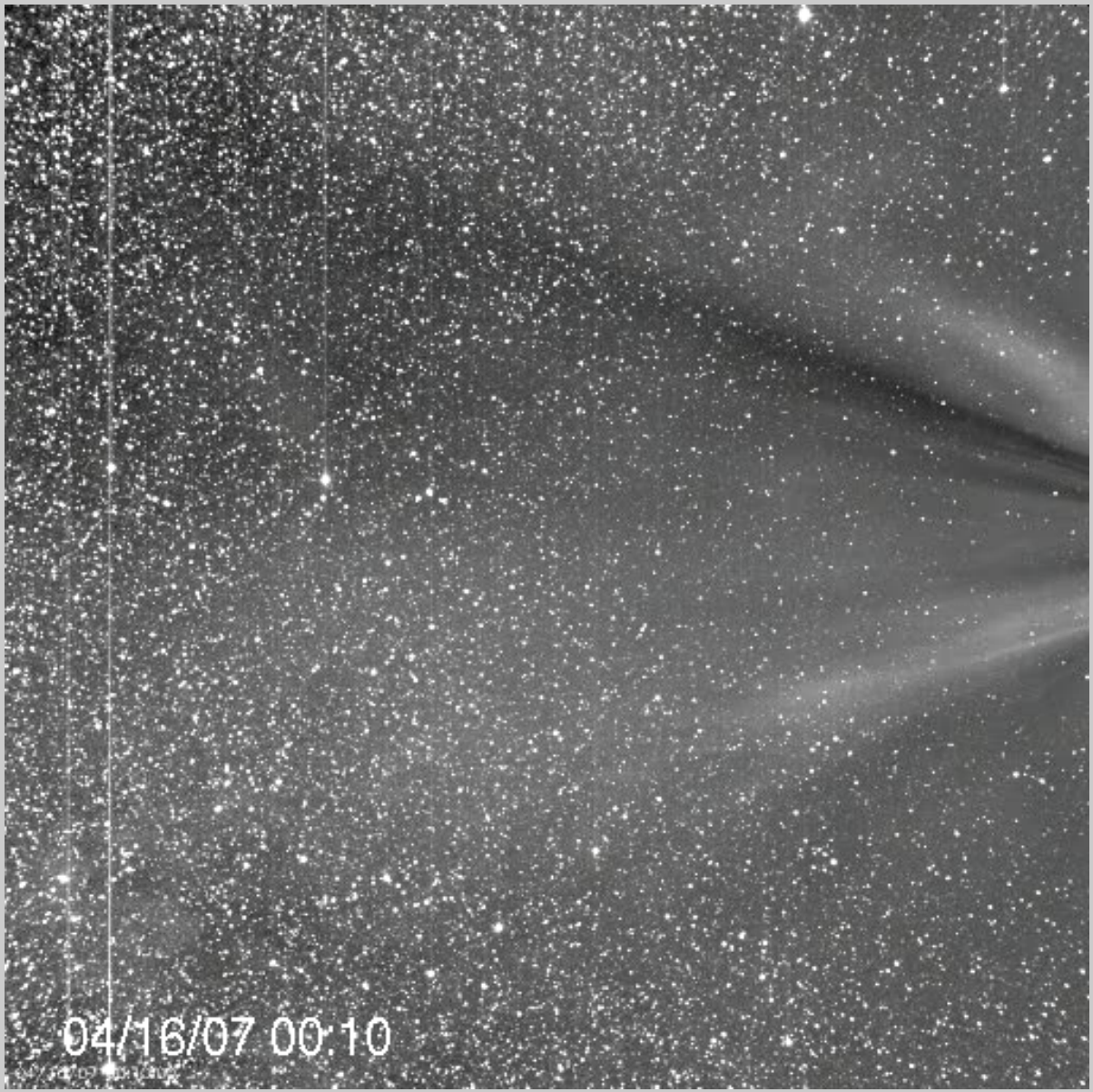
Payload Accommodation



Synergies with Solar Probe Plus



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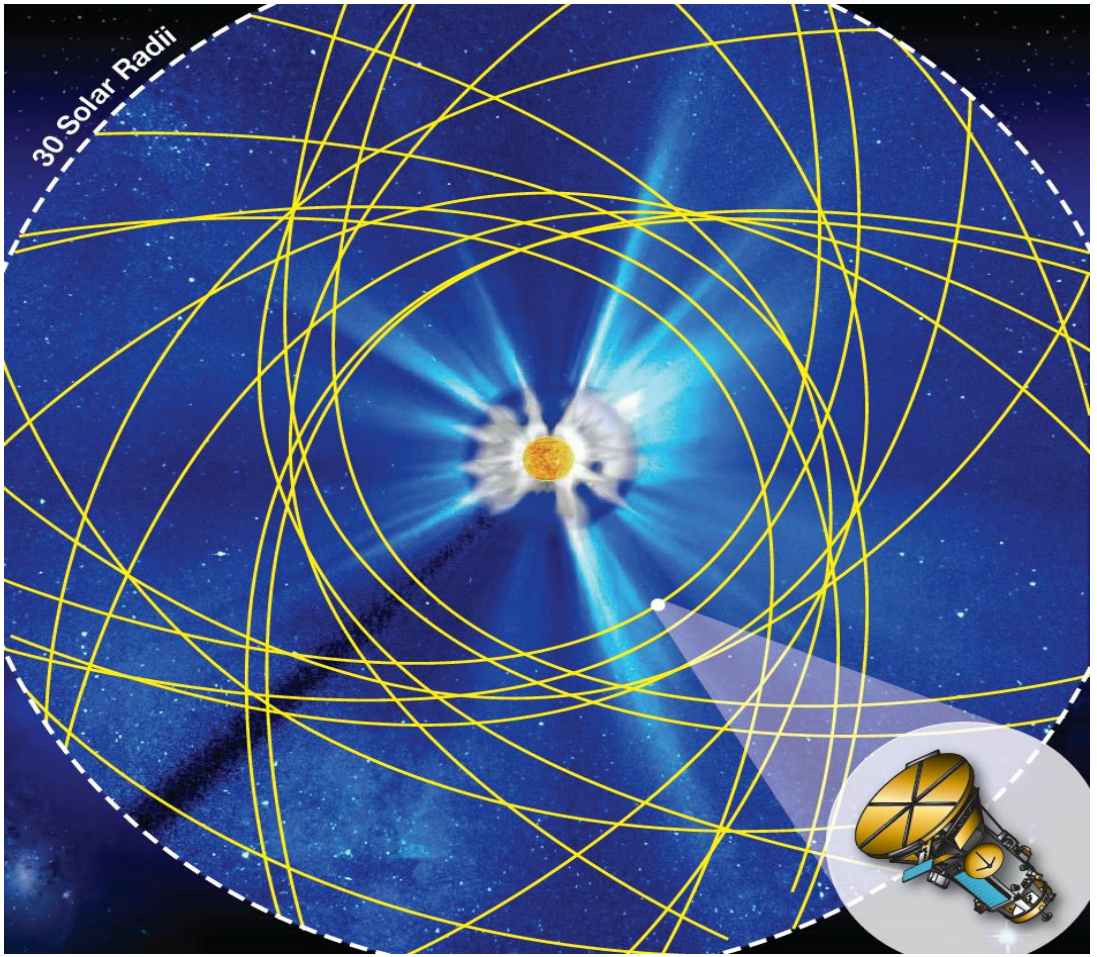
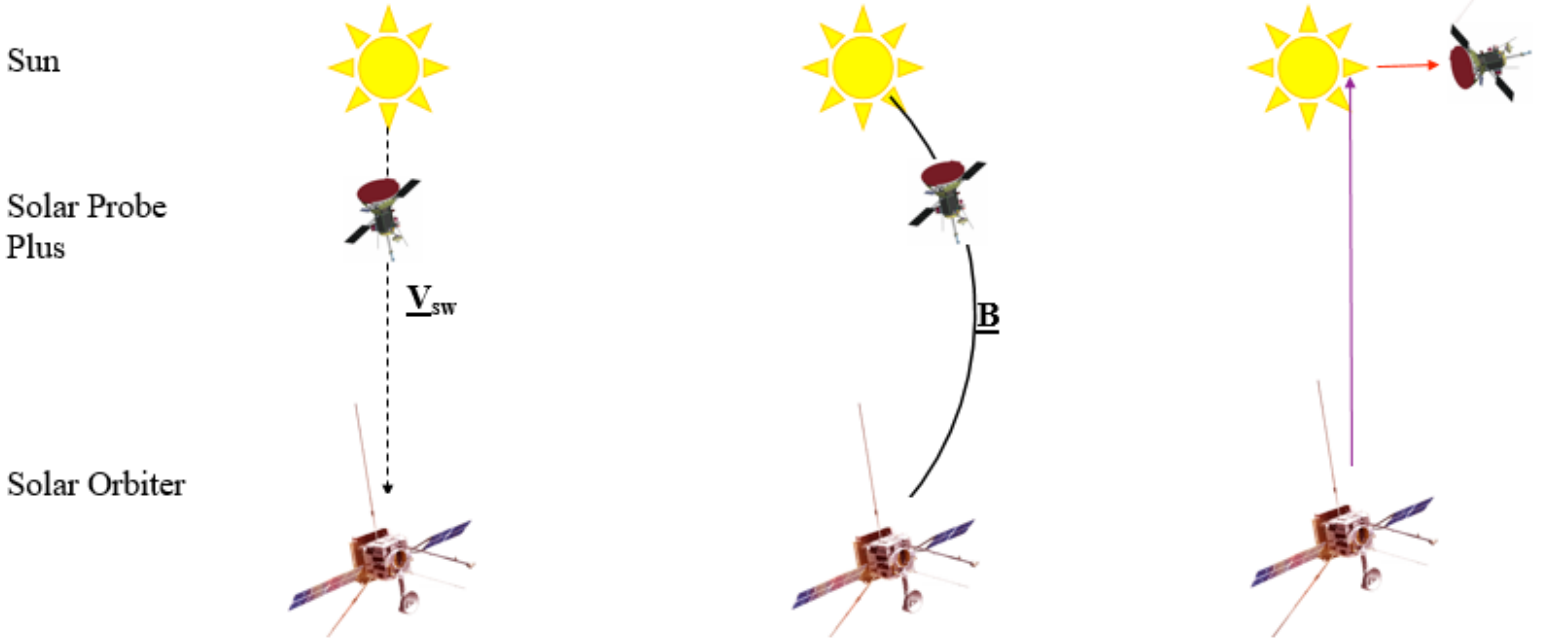
Synergy between Solar Orbiter and other Observatories



Joint Observations Solar Orbiter - Solar Probe Plus

Example of alignments/quadratures:



Radial alignments:

SO and SPP observe the same SW plasma

IMF alignments:

SO and SPP connect to the same IMF footpoint

Quadratures:

SO remote-sensing and SPP in-situ @ ≥9.5 Rs

A joint WG has been established to maximize the opportunities provided by the contemporaneous presence of both missions in the inner heliosphere.

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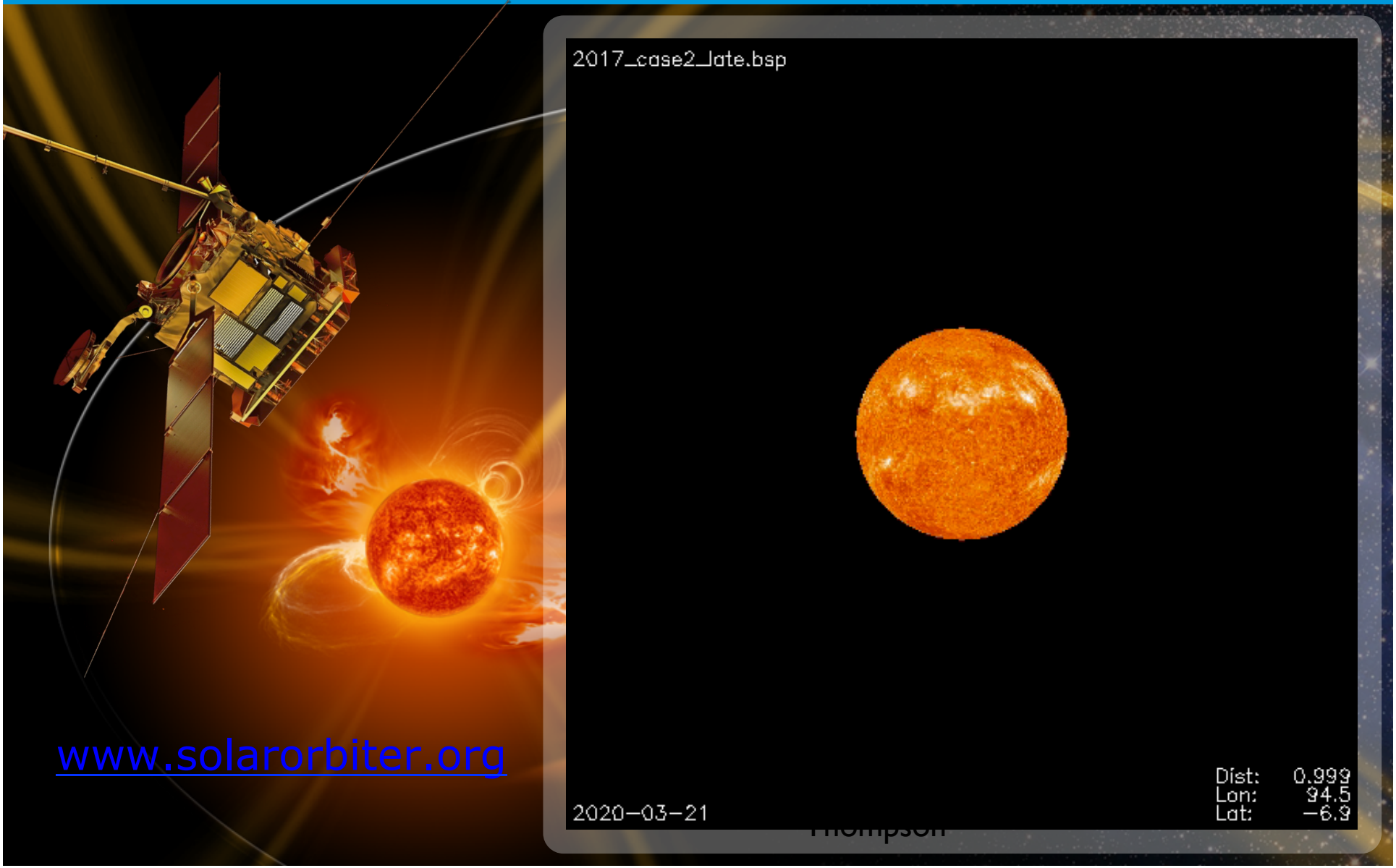
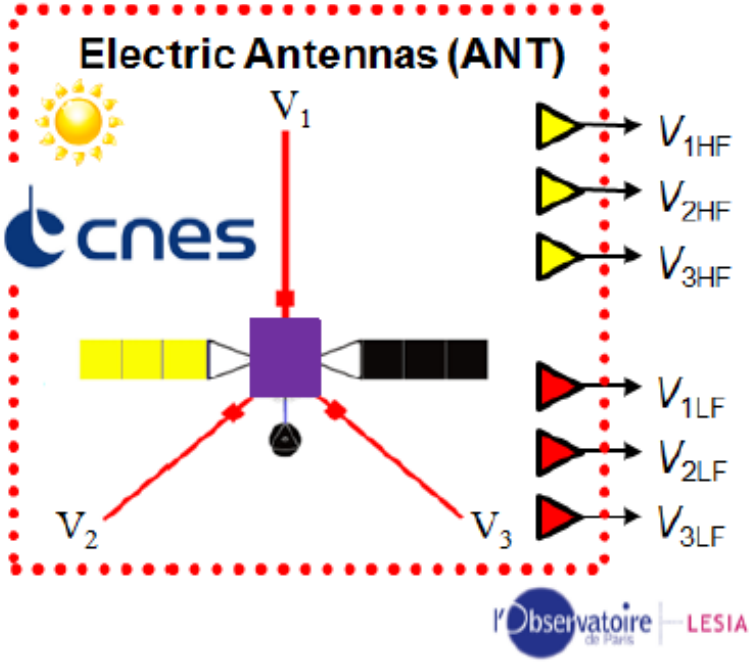
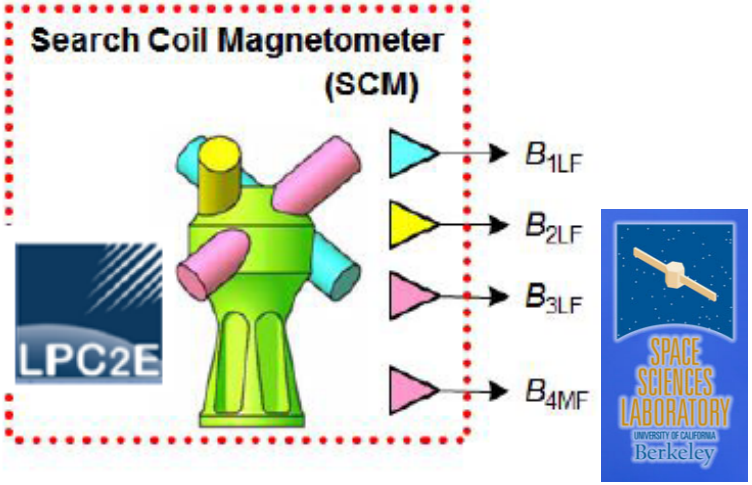
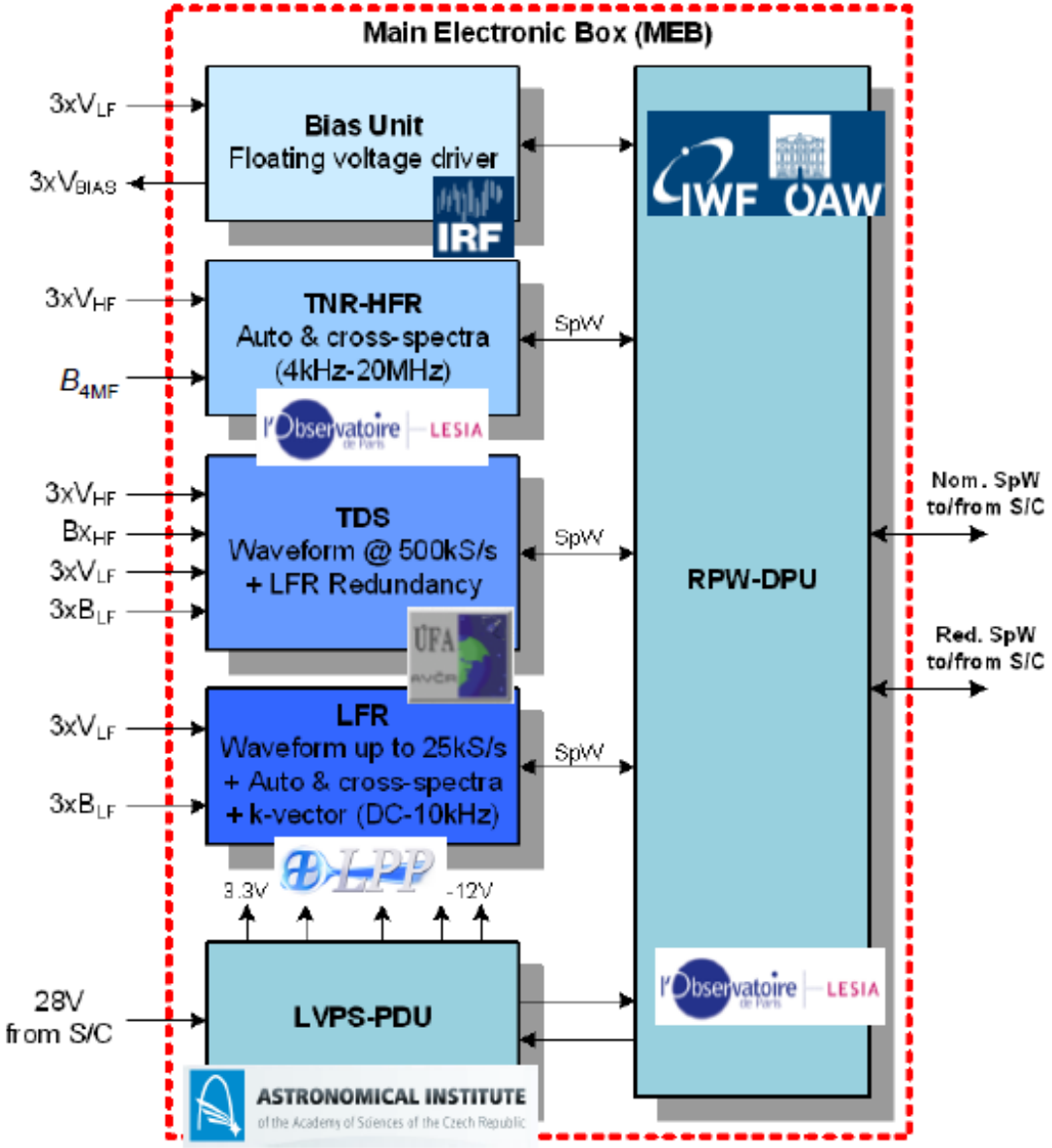


www.solarorbiter.org

RPW


Electric Antennas (ANT)
V1
V2
V3
V1HF
V2HF
V3HF
V1LF
V2LF
V3LF
cnes
l'Observatoire de Paris
LESIA


Search Coil Magnetometer
(SCM)
B1LF
B2LF
B3LF
B4MF
LPC2E
SPACE SCIENCES LABORATORY
UNIVERSITY OF CALIFORNIA
Berkeley


Main Electronic Box (MEB)
3xVLF
3xVBIAS
Bias Unit
Floating voltage driver
IRF
3xVHF
B4MF
TNR-HFR
Auto & cross-spectra
(4kHz-20MHz)
l'Observatoire de Paris
LESIA
3xVHF
BxHF
3xVLF
3xBLF
TDS
Waveform @ 500kS/s
+ LFR Redundancy
ÚFA
3xVLF
3xBLF
LFR
Waveform up to 25kS/s
+ Auto & cross-spectra
+ k-vector (DC-10kHz)
LPP
3.3V
-12V
28V
from S/C
LVPS-PDU
ASTRONOMICAL INSTITUTE
of the Academy of Sciences of the Czech Republic
SpW
SpW
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IWF OAW
RPW-DPU
l'Observatoire de Paris
LESIA
Nom. SpW
to/from S/C
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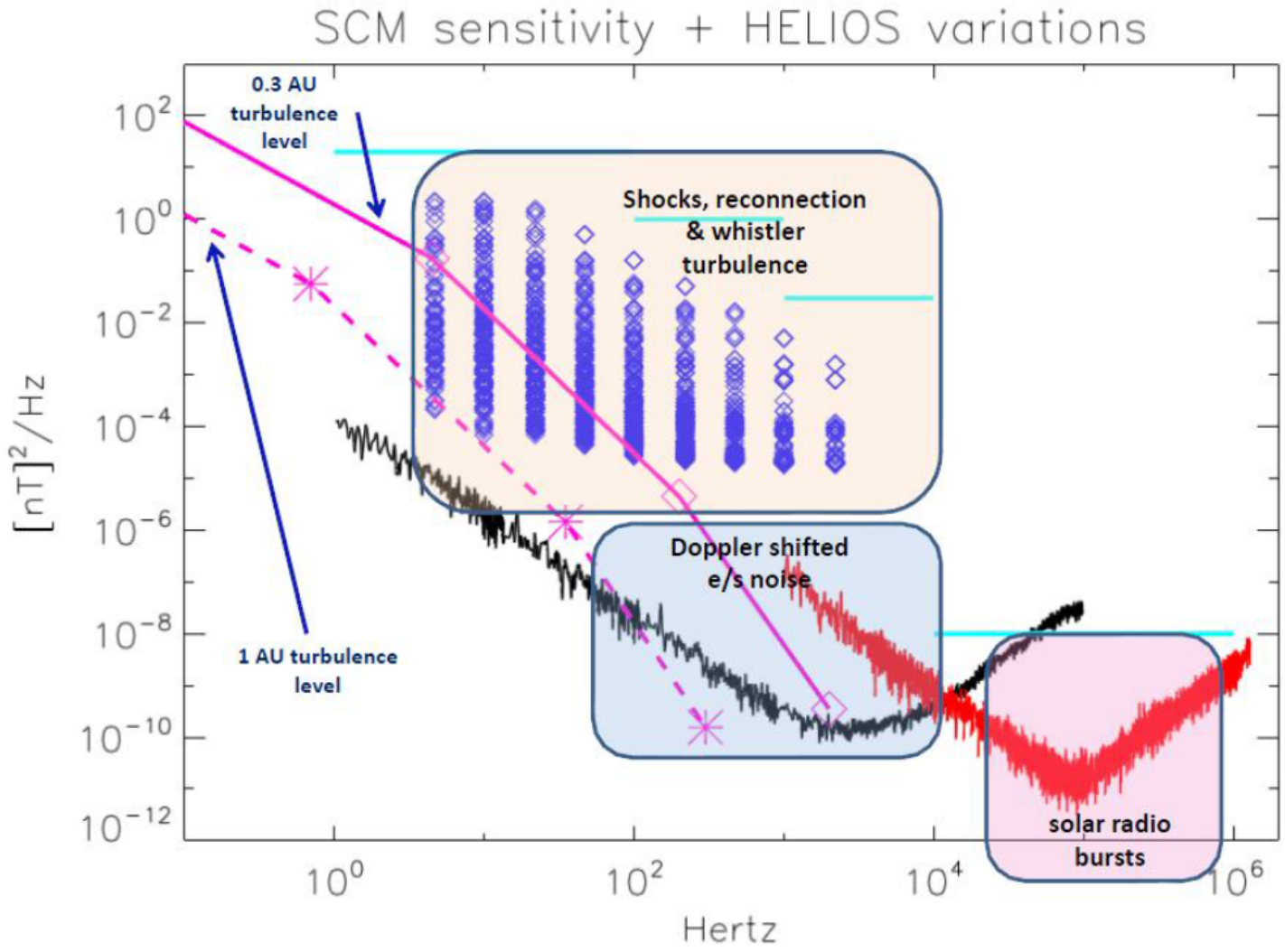
SCM sensitivity + HELIOS variations
0.3 AU turbulence level
Shocks, reconnection & whistler turbulence
Doppler shifted e/s noise
1 AU turbulence level
solar radio bursts
10^2
10^0
10^{-2}
10^{-4}
10^{-6}
10^{-8}
10^{-10}
10^{-12}
$[nT]^2/Hz$
10^0
10^2
10^4
10^6
Hertz