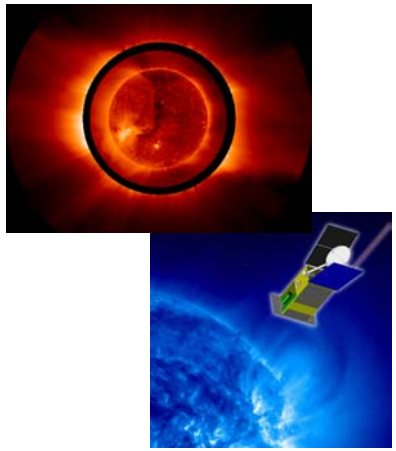

ILWS
Italian SpaceAgency (ASI) Contribution

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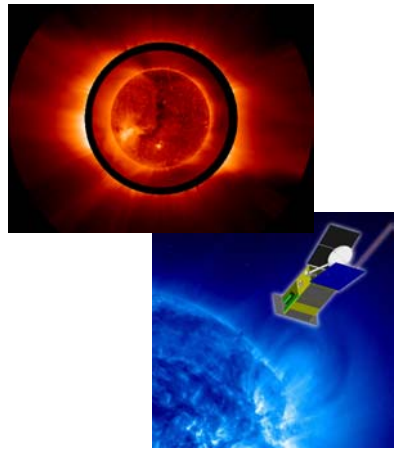


LWS – NASA

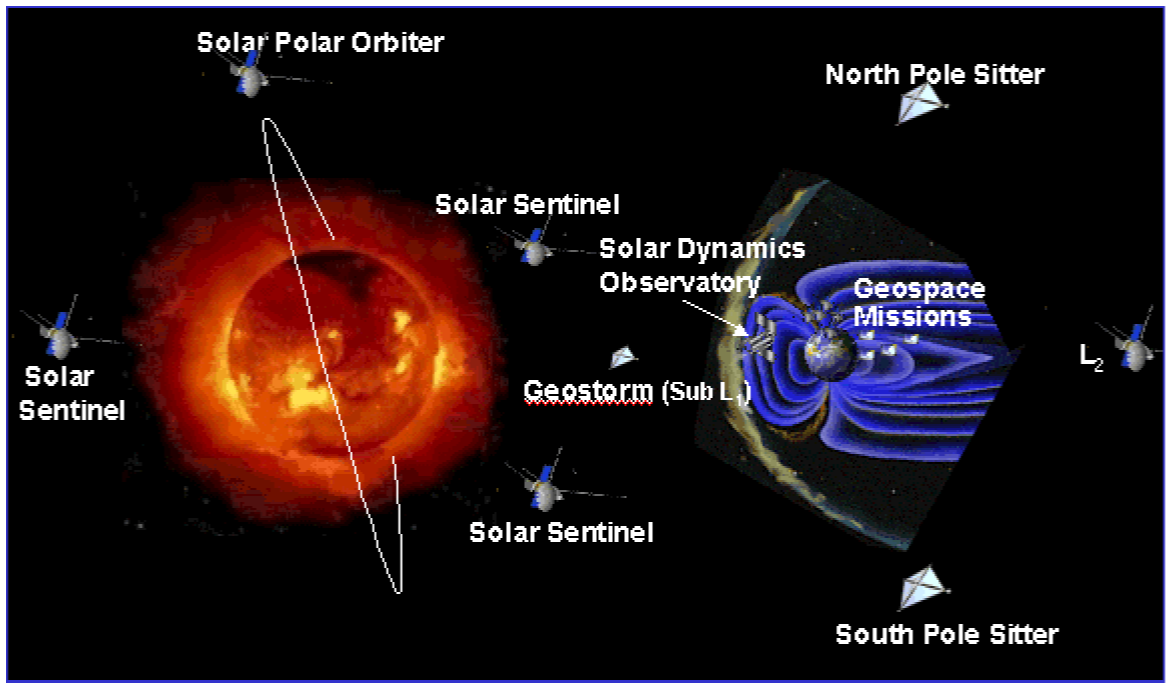
SPECTRE SolarDynamicsObservatory
HERSCHEL

ESA

Solar Orbiter
Bepi Colombo

Solar Dynamics Observatory Participation

Solar Dynamics Observatory SPECTRE HERSCHEL Program



Solar Dynamics Observatory
NASA Living with a Star program
Cornerstone mission

Primary goals

- Determine how the Sun drives Space Weather and global change
- Understand how and why the Sun varies

High telemetry and nearly constant solar viewing
(geosynchronous orbit to allow continuous contact at high data rate, 160 Mbps)

Launch 2007 – nominal mission 5 years

Solar Heliospheric Activity Research and Prediction Program
SHARPP on the Solar Dynamics Observatory

provides high spatial and temporal resolution observations of the complete solar atmosphere and its coupling to the heliosphere (0.6 arcsec, 10 sec)

to trace the flow of energy and mass from the chromosphere through the corona (0.02-3 MK, up to 20 MK)

provides the 'STEREO third eye'

to reconstruct the 3D structure of Earth directed coronal mass ejections

SHARPP SCIENCE OVERVIEW

SHARPP Investigations

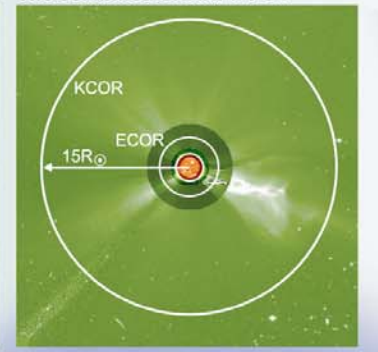
- *How and why does the Sun vary?*
- *How does the Sun drive the solar wind?*
- *What solar mechanisms lead to global change at Earth?*

SHARPP Applications

- *Significantly improve space weather disturbance predictions*
- *Provide a scientific foundation for irradiance variability proxies*
- *Offer modeling and visualization tool to the community*

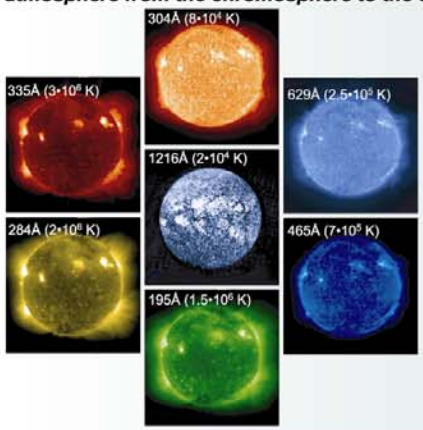
The combined ECOR/AIA FOV

The combined SHARPP FOV

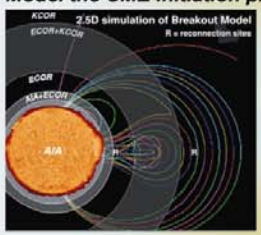


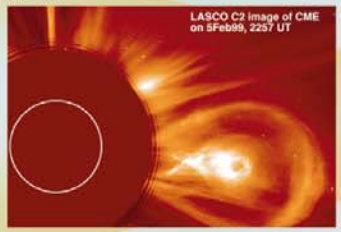
Provide a "third eye" for STEREO

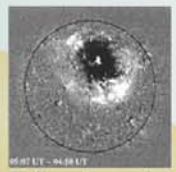
AIA provides complete coverage of the solar atmosphere from the chromosphere to the corona



Model the CME initiation process

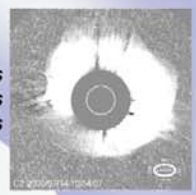




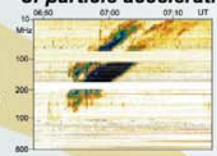


Follow the early evolution of CMEs

Monitor and assess geoeffectiveness of CMEs



Locate and track the sites of particle acceleration



Solar wind variability

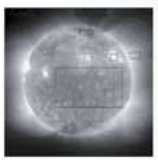
Geomagnetic Storms

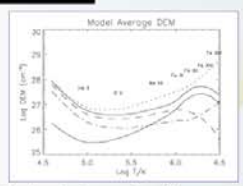
Short-term variability

SEPs

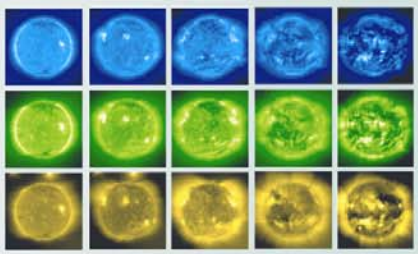
Flare emissions and structure

Coronal heating mechanisms





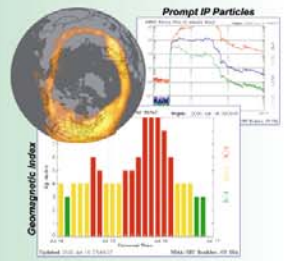
AIA DEM analysis deciphers the thermal structure of the atmosphere



AIA calibrated images determine the sources of irradiance through the solar cycle

Long-term irradiance variability

Global Change



Dramatically improve space weather forecasting

SHARPP International Consortium: Funding

United States

SHARPP

K-COR

Guide Telescopes
SHEB
Mission Ops & Data Analysis
Software

Magritte

AIA FPA

Belgium

France

AIA Optics
AIA Multilayer coating

Germany

Doors
Shutters

SPECTRE

Italy

SHARPP Instruments

- **KCOR** Visible Light Coronagraph (NRL)

- **AIA** Atmospheric Imaging Assembly including:

  Magritte - 6 channels HI Ly alpha, HeII, NeVII, FeXII, FeXV, FeXVI (Belgium)

  SPECTRE - OV channel 629 A (Italy)

  Structure
  Optics
  Filters
  Integration, alignement, calibration

other european partners: (France, Germany)

SHARPP Instruments

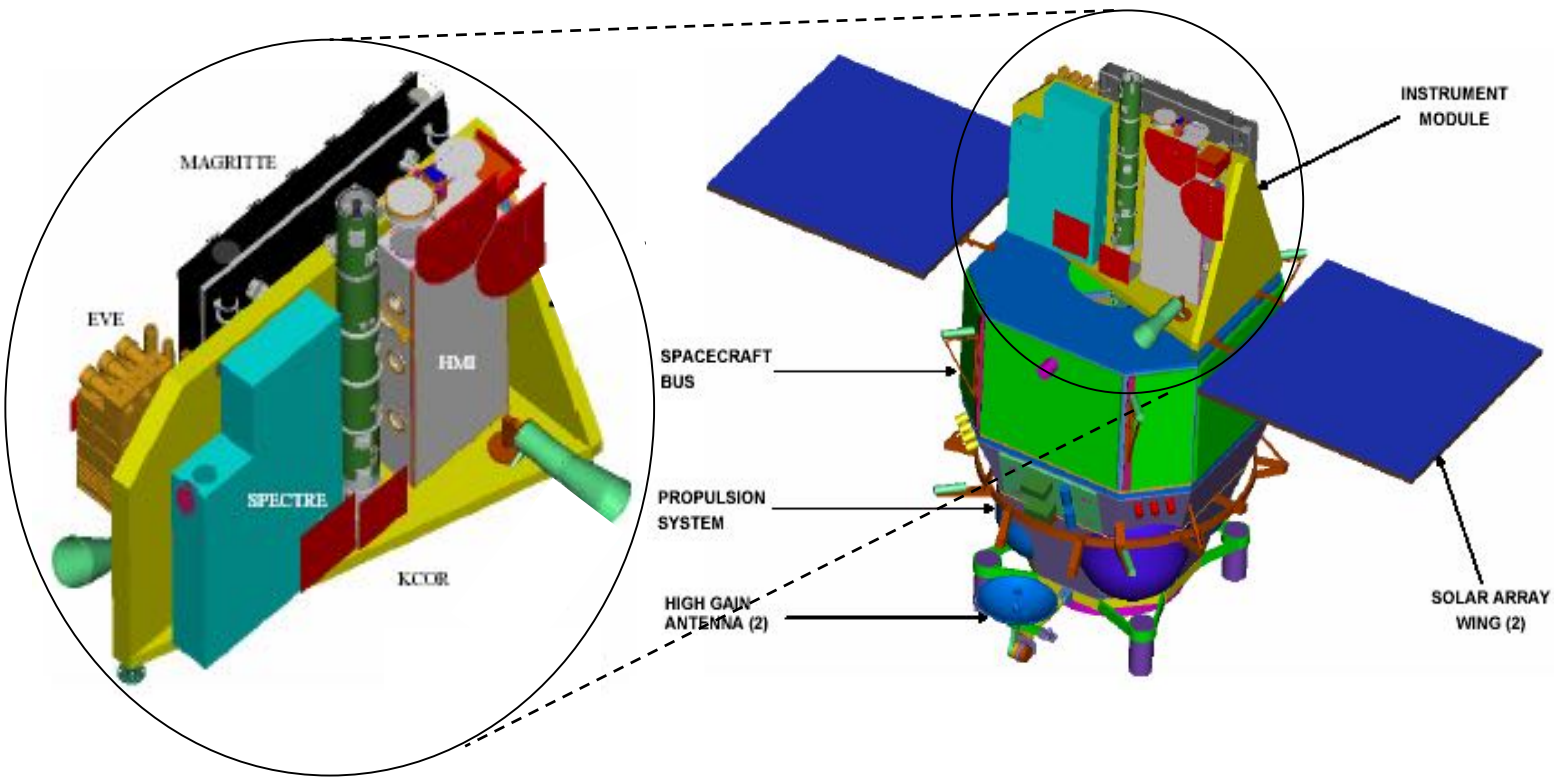
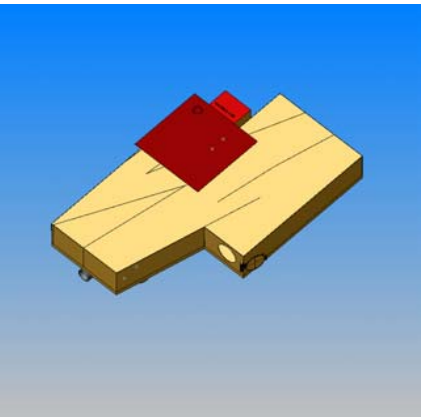
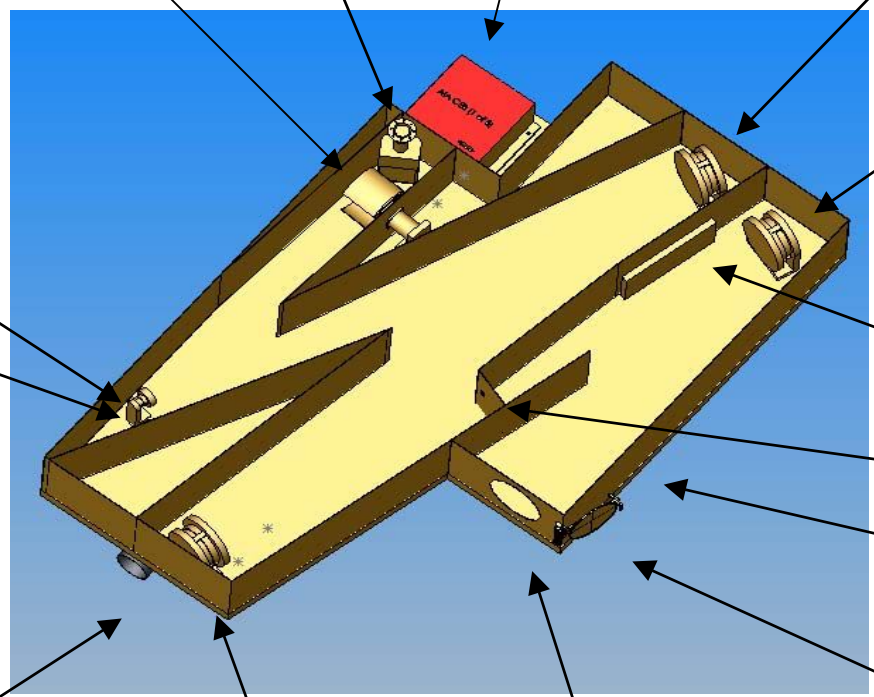


Figure 1. Right: The Solar Dynamics Observatory (SDO) satellite. Left: The Instruments payload aboard SDO includes SPECTRE-SHARPP that represents the Italian contribution to the SDO mission.

SPECTRE
Spectroheliograph for the Transition Region





CEB

Shutter

CCD-FPA

Second Wadsworth Grating

Wadsworth-Cassegrain Secondary Mirror

IMC Actuators

Zero Order Rejection Mirror

Field Stop

GFRP Structure, Optical Bench 3 x Kinematic Mounts

Door

Guide Telescope

Collimating Paraboloid

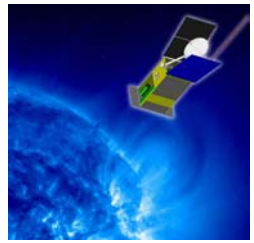
Entrance Aperture

The HERSCHEL Program
Helium Resonant Scattering in the Corona - Heliosphere

The HERSCHEL program consists of a 3-year effort to build and launch on a sounding rocket the two complementary instruments for coronal and disk observations:

- **investigate the solar wind acceleration from a range of solar source structures**
- **obtain the first measurements of the coronal helium abundance**
- **establish proof-of-principle for the Ultraviolet Coronagraph, which is in the ESA Solar Orbiter Mission baseline**

The HERSCHEL Program



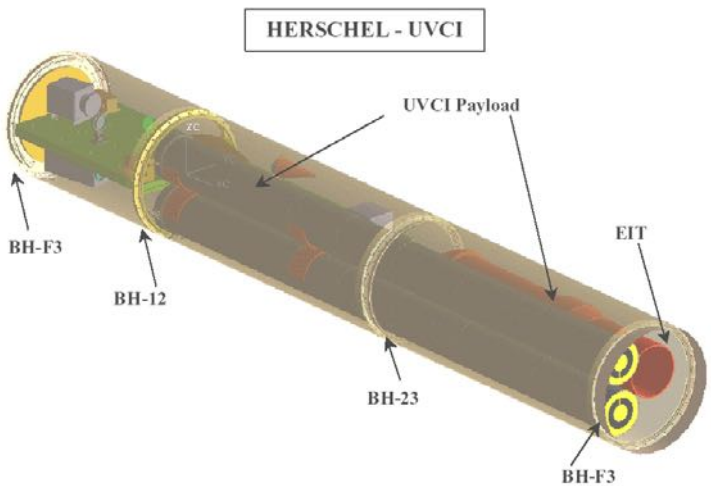
- **UVCI** Ultraviolet and Visible-light Coronagraphic Imager (Italy)

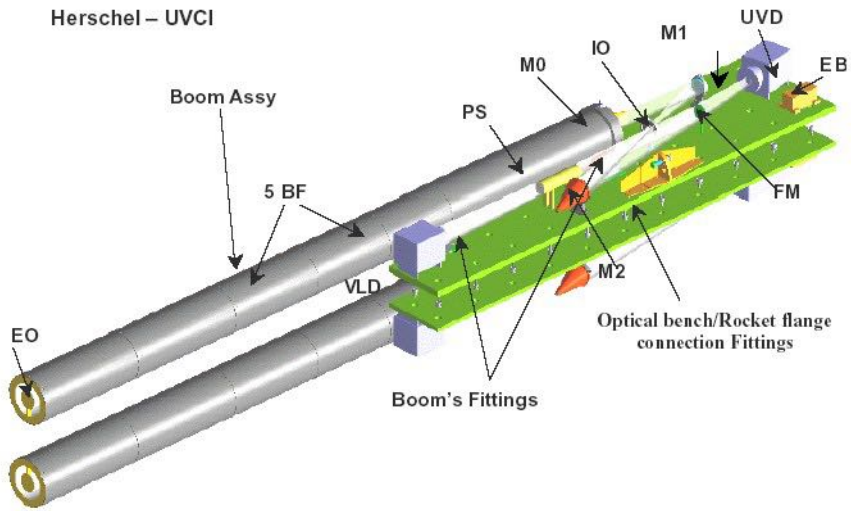
  UV (H, He) and visible-light observations of the solar corona

  same optical path for both the visible and ultraviolet

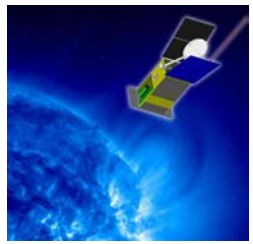
- **EIT** Extreme Ultraviolet Imaging Telescope (NRL, US)

  He observations on the solar disk





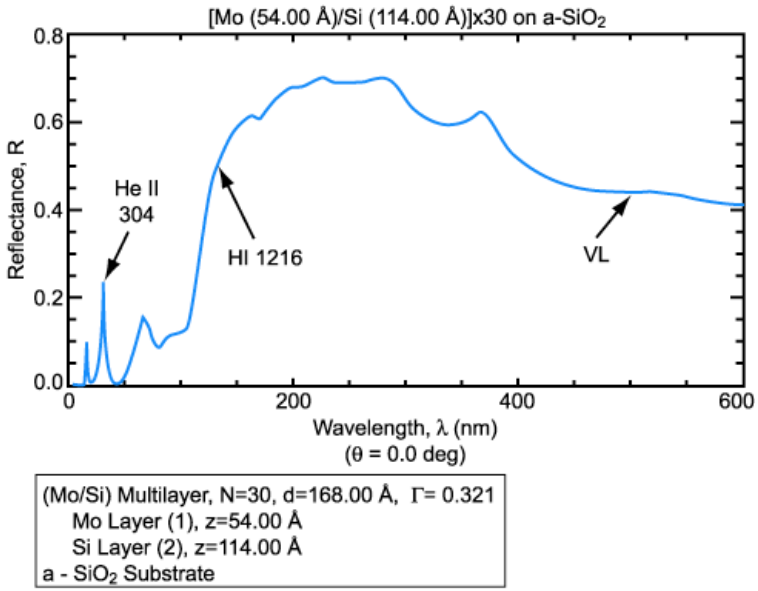
HERSCHEL: a program to test the coronagraph concept for the Solar Orbiter

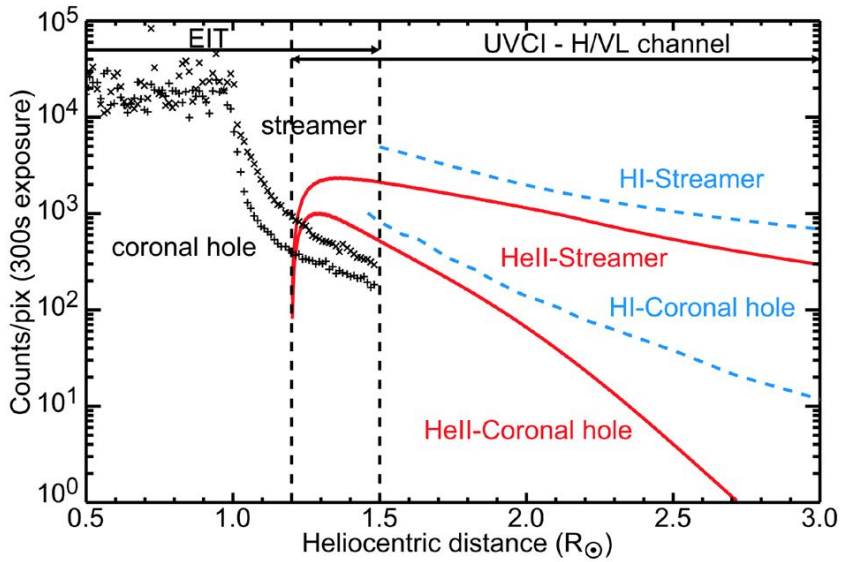


UVCI: VL, HI, HeII coronal imager

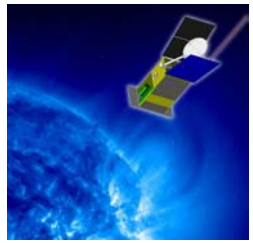
same optical path

- **H, He abundance,**
- **H, He outflow velocity**





The Future: Solar Orbiter
the solar and heliospheric ESA mission

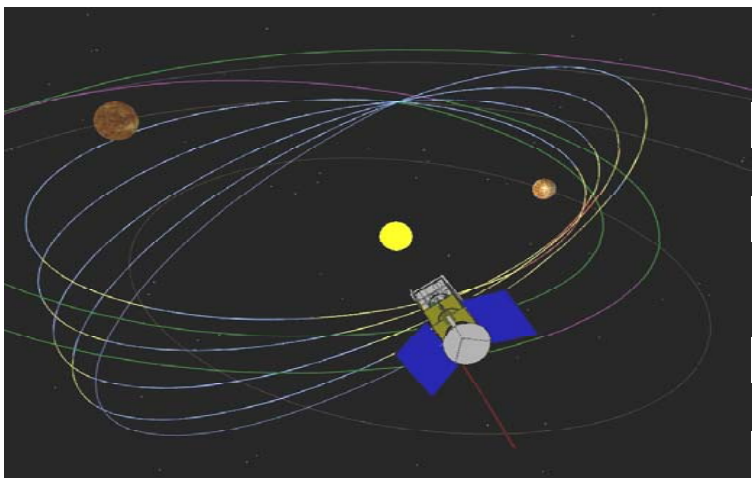


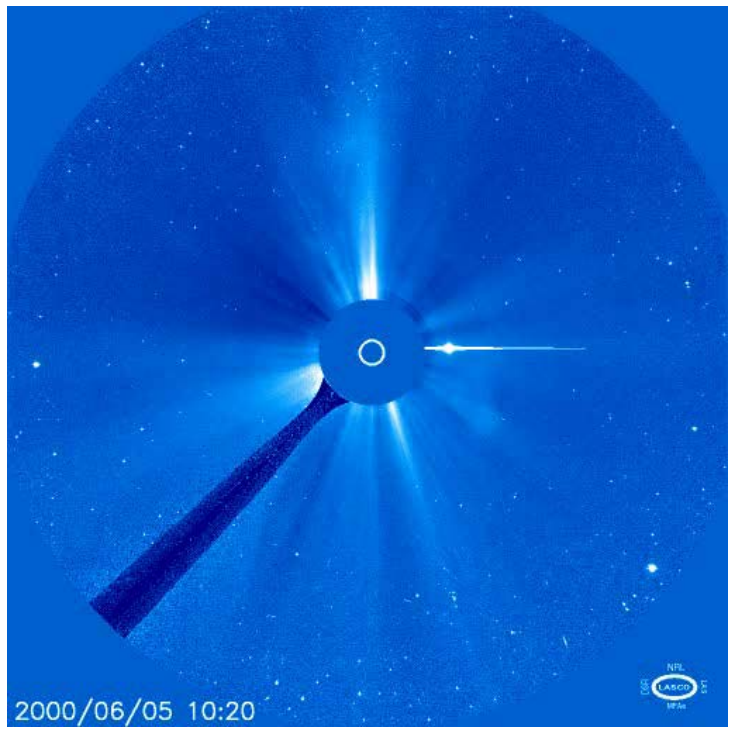
explore unknown territory near the Sun (perihelion 45 Rs, 0.2 AU)

deliver the first images of the solar poles

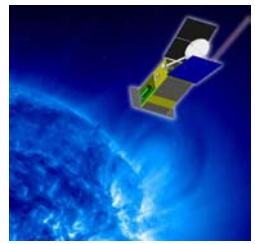
provide unprecedented high-resolution observations of the Sun (> 35 km)

correlate in-situ & remote-sensing measurements during co-rotation





Solar Orbiter instruments



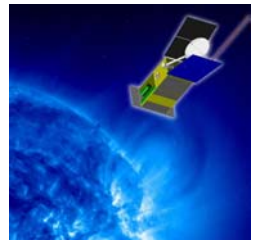
Instrument	Mass kg	Power W	kb/s	
Visible Light Imager & Magnetograph (VIM)	26	25	20	✓
Extreme UV Spectrometer (EUS)	22	25	17	✓
Extreme UV Imager (EUI)	36	20	20	
UV & Visible Light Coronagraph (UVC)	17	25	5	✓
Radiometer (RAD)	4	6.5	0.5	

Remote sensing

In situ

	Instrument	Mass kg	Power W	kb/s
✓	Solar Wind Plasma Analyser (SWA)	6	5	5
	Radio & Plasma Waves Analyser (RPW)	10	7.5	5
	Coronal Radio Sounding (CRS)	0.2	3	0
	Magnetometer (MAG)	1	1	0.2
	Energetic Particle Detector (EPD)	4	3	1.8
✓	Dust Detector (DUD)	1	1	0.05
✓	Neutral Particle Detector (NPD)	1	2	0.3
	Neutron Detector (NED)	2	1	0.15

Other Potential ContributionsPrograms



TRIANA L1 for Earth Observations (ASI -NASA)
Proba II
Bepi Colombo
Ground networks
Theory and modelling