Operational Aspects of Space Weather-Related Missions

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Outline

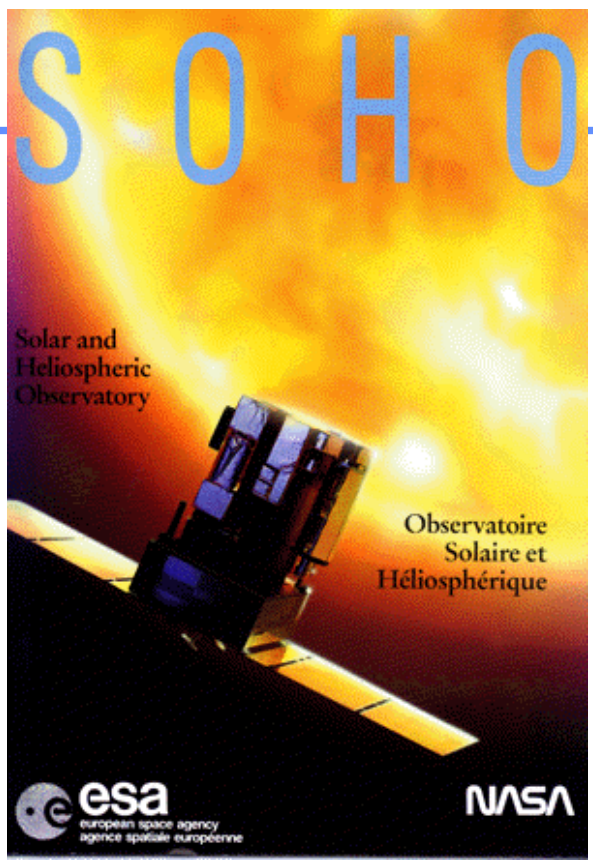
- SOHO: Example of Near-Earth Observatory-class Mission
- Ulysses: Example of Deep Space Monitor-class Mission
- Solar Orbiter: Example of Future Space Weather-related Mission
- Summary

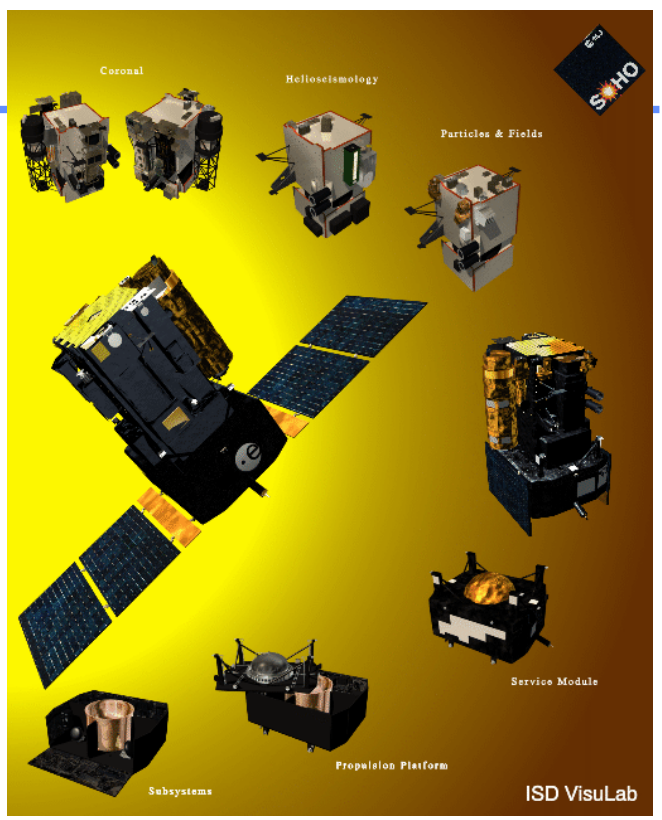
SOHO

The Solar and Heliospheric Observatory (SOHO) is a cooperative mission between ESA and NASA to study the Sun, from its deep core to the outer corona, and solar wind.

Key Mission Characteristics:

- **Launch: Dec 1995**
- **Lifetime: approved until 2007**
- **Orbit: halo orbit around Sun-Earth L1 Lagrangian point**
- **Sun-pointing, 3-axis stabilized platform**
- **Payload: 12 sets of instruments (remote-sensing and *in-situ*)**
- **Tracking: DSN (3 x 1.6 hrs and 1 x 8 hr pass per day)**
- **Telemetry: 40 kbps (160 kbps for MDI high data rate mode during 8-hr pass)**



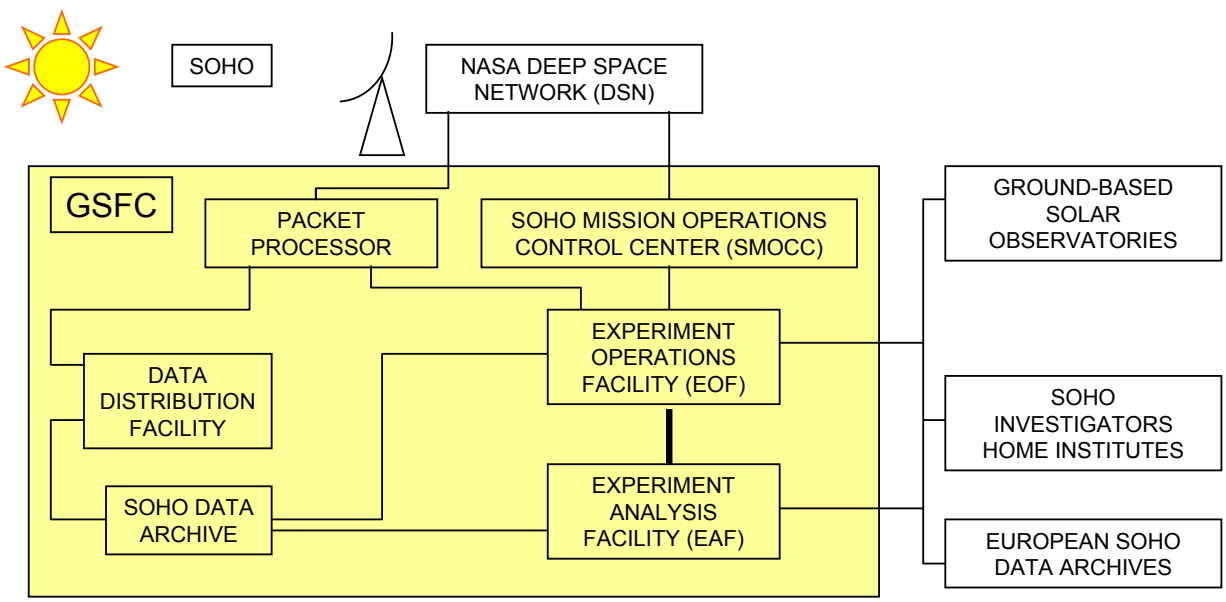


SOHO Operations Concept

❑ Near-Real-Time Operations:

- ➢ Observatory-class Mission
- ➢ Typical Time Delays:
  - ❍ Telemetry receipt by Ground Station => Experimenter (EOF) < 5 sec
  - ❍ Experiment Command from EOF => SOHO < 1 min
- ➢ EOF and EAF connected by 100 Mbps link
- ➢ PI Teams and Flight Ops Team Co-located
- ➢ Rapid Exchange of Complementary Data
  - ❍ Ground-based and other Space Observatories (e.g. TRACE)

SOHO Ground System



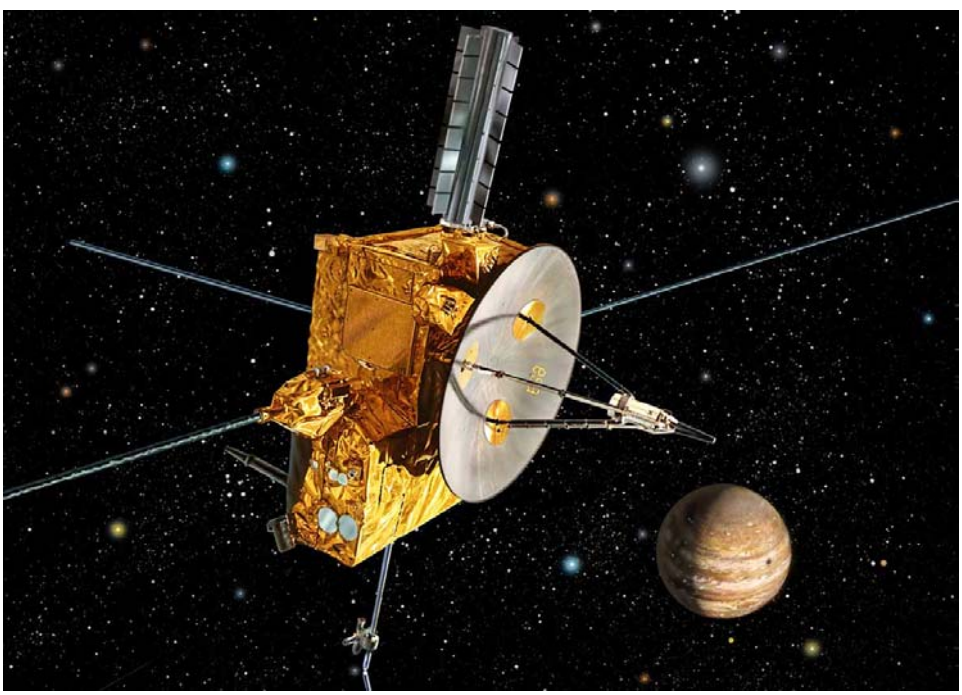
Ulysses

Ulysses is a cooperative mission between ESA and NASA to study the Sun and heliosphere in 3 dimensions.

Key Mission Characteristics:

- **Launch: Oct 1990**
- **Lifetime: approved until Sep 2004**
- **Orbit: heliocentric orbit inclined at 80º to the ecliptic plane**
- **Earth-pointing, spin-stabilized platform (5 rpm)**
- **Payload: 9 sets of instruments (*in-situ* particles and fields; gamma-ray bursts)**
- **Tracking: DSN (1 x 10 hr pass per day)**
- **Telemetry: 0.5 kbps (1 kbps real-time mode)**

Ulysses



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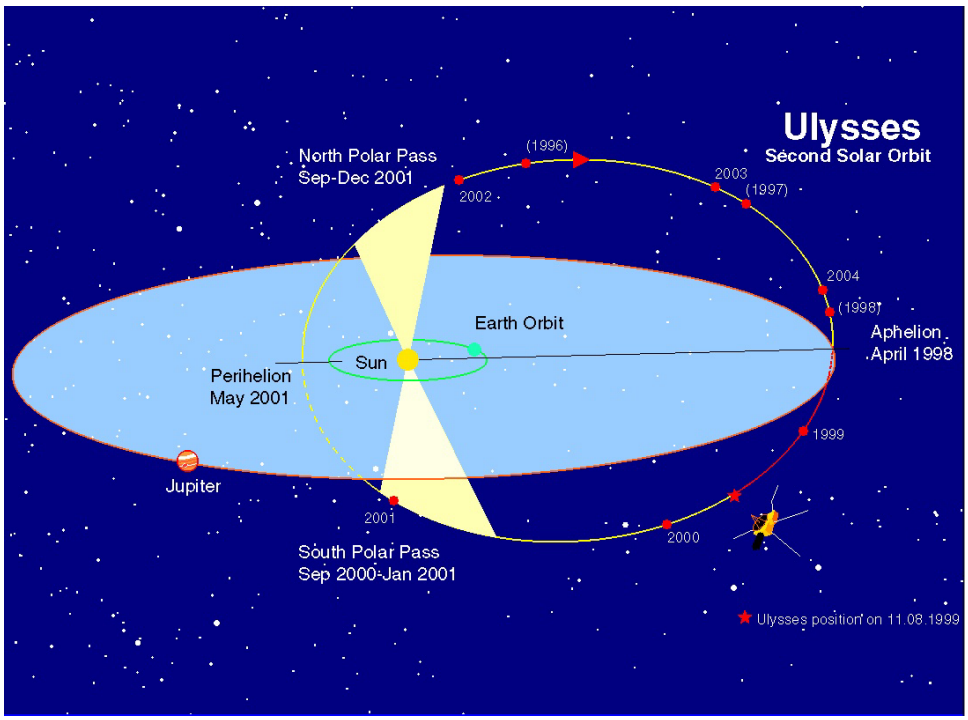
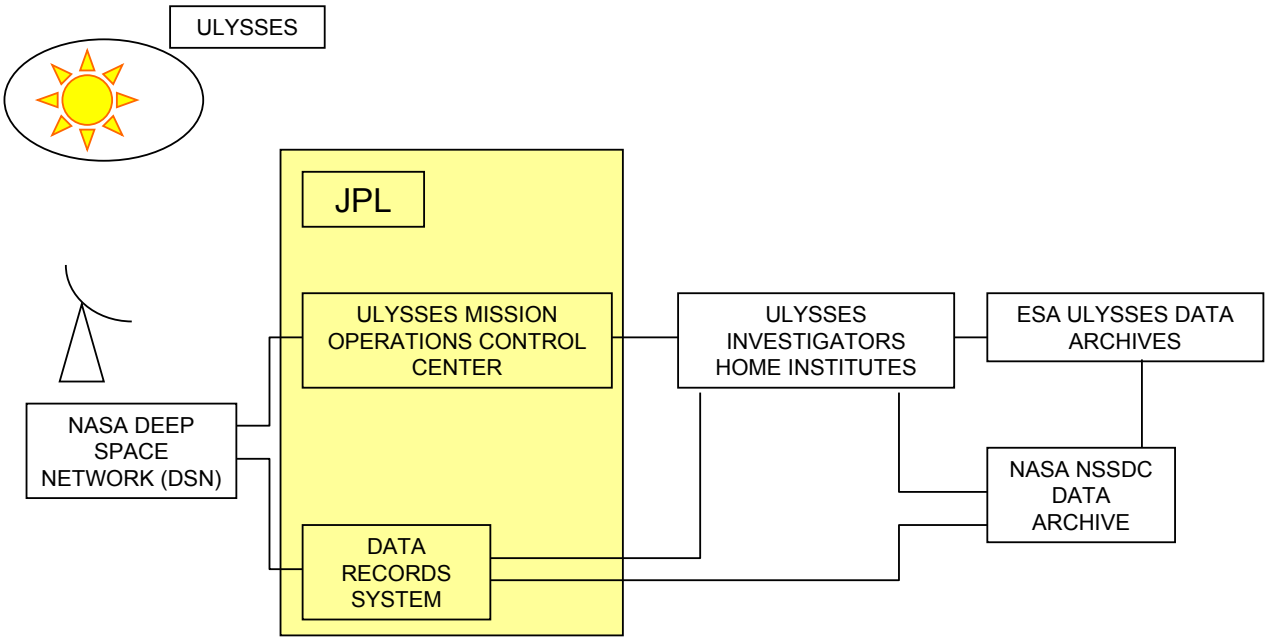
Ulysses



Ulysses Operations Concept

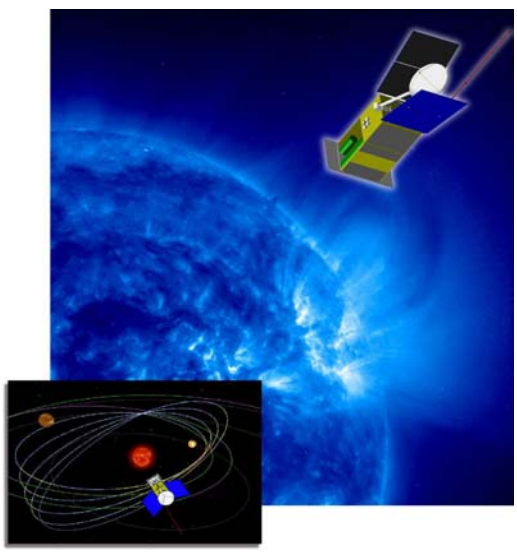
- **Non-Real-Time Operations:**
  - Monitoring-class Mission
  - No Ulysses EOF / EAF (Formal interface between PI Teams and Flight Ops Team is via e-mail and/or dedicated fax number)
  - Spacecraft Operations Team (ESA personnel) located at JPL
  - Typical Time Delays:
    - One-Way Light Time (OWLT) up to 52 min
    - Telemetry receipt by Ground Station => Experimenter
      - Quick-look data < 30 min
      - Final Experiment Data Record < 18 days
  - Experiment Commanding via SOT (3-week lead time)

Ulysses Ground System



Solar Orbiter

A High-resolution Mission to the Sun and Inner Heliosphere



Solar Orbiter

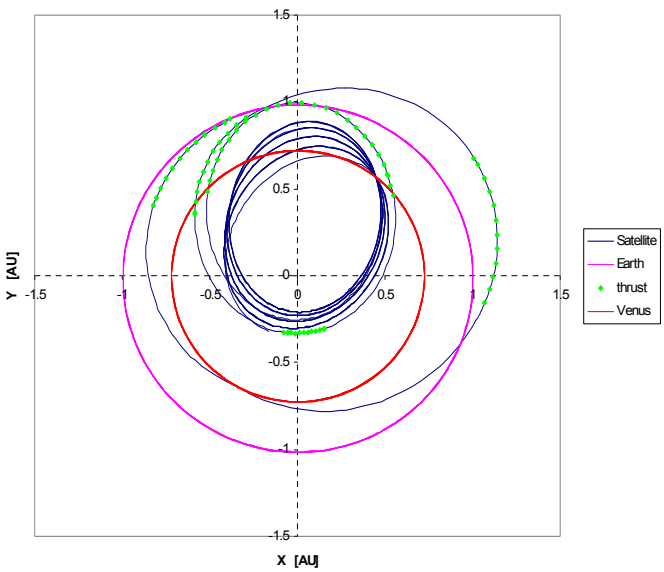
Solar Orbiter is a future ESA mission to study the near-Sun environment, using a combination of in-situ and remote-sensing observations. Solar Orbiter will also image the polar regions for the first time.

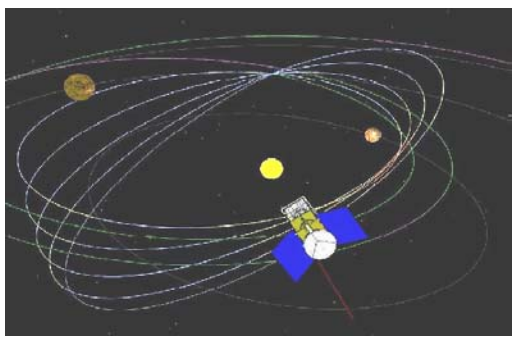
Key Mission Characteristics:

- **Launch: 2011/2012**
- **Orbit: heliocentric with heliosynchronous phase (perihelion 0.21 AU) and high-inclination phase (up to 38º latitude)**
- **Sun-pointing, 3-axis stabilized platform**
- **Solar Electric Propulsion**
- **Payload: remote-sensing and *in-situ* instrument packages**
- **Operations: highly autonomous (esp. during perihelion passes)**

Novel Orbital Design

- **Projected trajectory**



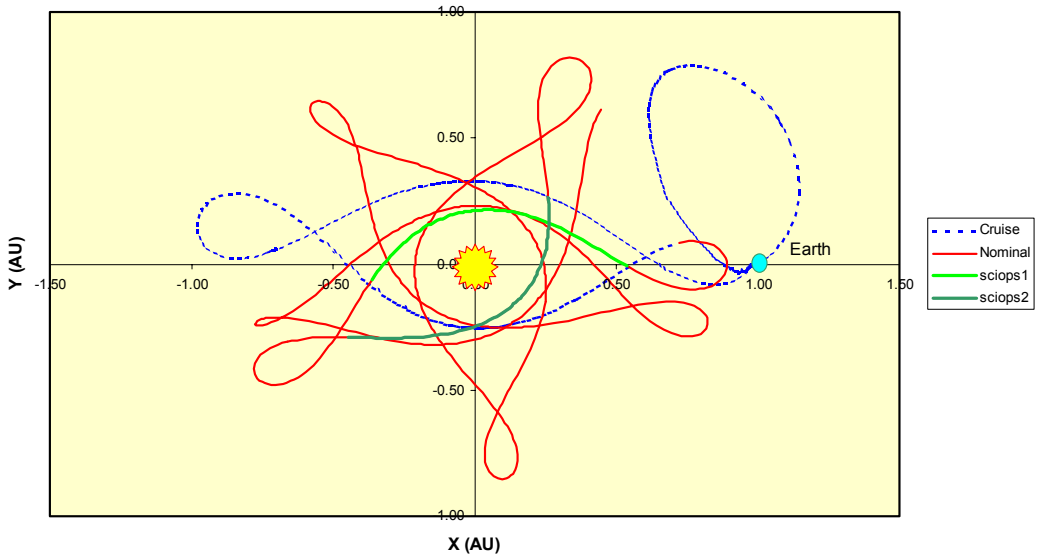


- closer to the Sun

- out of the ecliptic

Fixed Sun-Earth View

Solar Orbiter trajectory in fixed Sun-Earth coords.



Nominal Mission