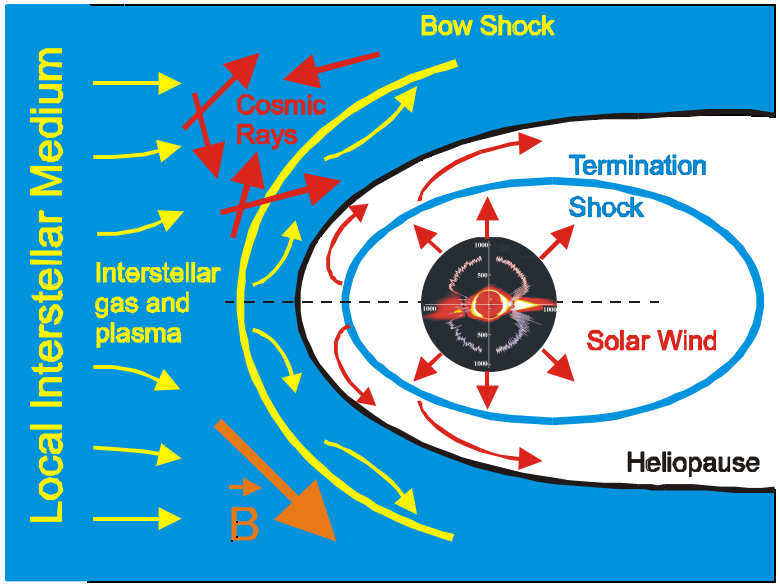
Heliosphere Extreme Ultraviolet Imager (HEUVI)



Fundamental Question

- How does the Sun and Galaxy interact?
- What is the structure of the global heliosphere?
- What are the effects of the changing Sun on the solar wind and the global heliosphere?

Importance of the Question

- Understanding the changing Sun and its effects on the solar system and the interaction with the surrounding galactic medium
- Definition and optimization of future missions to explore the surrounding galactic medium in-situ, e.g., *Interstellar Probe*

Science Objectives

- Establish the detailed three-dimensional structure of the region of the solar plasma interaction with the galactic environment, including the distance to the heliopause, its shape, stability, and effects of the reversal of the solar magnetic field
- Determine whether the bow shock exists and its strength
- Establish the ionization state of helium in the local interstellar medium and determine the asymmetry of the interstellar magnetic field
- Determine how exactly the global flow pattern of the solar wind changes through the 11-year solar cycle

Mission Description

- Orbit beyond the geocorona and magnetosphere

Measurement Strategy

- *Remote sensing*: image the heliopause, the boundary that separates the solar and galactic plasmas, and the global flow pattern of the solar wind plasma
  - ➢ All-sky maps in the 30.3-30.5 nm spectral range with the 0.005-nm resolution

Technology Requirements

- Low-noise diffuse radiation extreme ultraviolet (EUV) spectrometer (at 30.4 nm) with 1 milli-Rayleigh sensitivity and 0.005-nm (0.05-Å) spectral resolution
- Instrumentation concept formulated; feasibility demonstration required

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Heliosphere Extreme Ultraviolet Imager (HEUVI) is a mission 1) to comprehensively explore the interaction of the heliosphere with the local galactic environment, with the focus on the heliopause (the boundary that separates the solar and galactic plasmas) and the region beyond, and 2) to reveal how exactly the global flow pattern of the solar wind changes through the 11-year solar cycle.

The HEUVI mission will remotely study the essentially three-dimensional (3D) global heliosphere. HEUVI is complementary to 1) the well-defined concept of heliosphere imaging in energetic neutral atoms (focused on the termination shock and the heliospheric sheath), and 2) the extended *Voyager* and future *Interstellar Probe* missions (in-situ "ground truth" measurements of the interaction region in selected directions).

The principal scientific objectives of HEUVI are (1) to establish the detailed 3D structure of the region of the solar plasma interaction with the galactic environment, including the distance to the heliopause, its shape, stability, and possible effects of the solar magnetic field reversal; (2) to determine whether the bow shock exists and its strength; (3) to establish the ionization state of helium in the local interstellar medium and determine the asymmetry of the interstellar magnetic field; (5) to determine how exactly the solar wind global pattern changes during the 11-year solar cycle.

The EUV signatures at 30.4 nm that will be probed from 1 AU are 1) the solar line radiation reflected by galactic plasmas beyond the heliopause and by pickup ions in the solar wind and 2) characteristic emissions of the solar wind plasma.

HEUVI specific measurement objectives are to obtain full-sky maps at 30.4 nm with high spectral resolution and high sensitivity. Such maps will image the heliopause, establish the ionization state of interstellar helium, and reveal the properties of the plasma flow around the heliopause and the asymmetry of the interstellar magnetic field. HEUVI will obtain every week the global flow pattern (1-15 AU) of the solar wind plasma in all directions in the heliosphere, including in the regions over the sun's poles and on the other side of the sun.

The HEUVI payload consists of a low-noise diffuse radiation EUV spectrometer with 1 milli-Rayleigh sensitivity and 0.005-nm (0.05-Å) spectral resolution. HEUVI will map the glow of galactic plasmas flowing around the heliopause and the solar wind (Doppler-shifted) emissions at 30.4 nm.

The scientific results of the HEUVI mission will have a major impact on understanding of an interaction of a (typical for its class) star with its galactic environment. HEUVI will obtain, for the first time, the detailed 3D global structure of the heliopause and the region beyond. The ionization state of helium and the asymmetry of the magnetic field will advance understanding of the nature of the local interstellar cloud. HEUVI will reveal how exactly the solar wind global flow pattern changes during the solar cycle.

HEUVI will be launched into an orbit beyond the geocorona and magnetosphere. The effects of the changing Sun on the interaction with the interstellar medium and transformation of the global solar wind flow pattern will be explored during the five-year nominal mission over one half of the solar cycle.

Technology development. The HEUVI mission requires instrumentation significantly better than the current state of the art. The concept of the enabling instrumentation has been formulated. The feasibility demonstration is need.