U.S. NAVAL RESEARCH LABORATORY

The NFI Instrument for PUNCH

Narrow Field Imager for the Polarimeter of Unify the Corona and Heliosphere

AT A GLANCE

What is it?

NFI will image the transition of the Sun's atmosphere to the solar wind to understand how the Sun generates the space plasma environment. NFI will be combined with the other PUNCH imagers to generate a 90º FOV center on the Sun. PUNCH is schedule to launch in April 2025.

How does it work?

The Narrow Field Imager (NFI) is a compact, externally occulted coronagraph. The external occulter blocks direct sunlight from entering the main optical aperture, which views the corona and starfield around the Sun using a compound lens system. Polarization is resolved using a polarizing filter wheel and the image is digitized using a CCD camera with a 2K x 2K active detector area.

What will it accomplish?

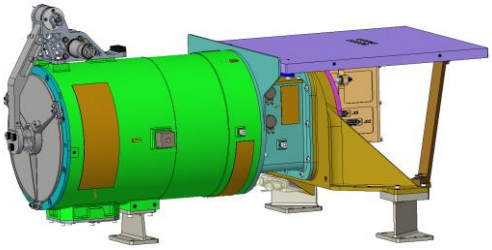
NFI, as part of the PUNCH combined FOV, will help close a 60-year gap in measurement and understanding of the transition of the solar corona to the solar system environment. This transition is critical in understanding how the Sun generates the near-Earth space environment and drives solar weather.

R&D Sponsors NASA

Point of Contact

Dr. Robin Colaninno, PI

Naval Research Laboratory
Space Science Division, Code 7682
robin.colaninno@nrl.navy.mil



(Left pane) The Narrow Field Imager (NFI) is a white-light compact imager designed to observe the solar corona from 6.0 to 32 $R_\odot$ as part of the PUNCH mission. PUNCH is a constellation of four suitcase-sized satellites that will orbit the Earth, studying how the Sun's corona connects with the interplanetary medium, to better understand how coronal structures infuse the solar wind with mass and energy. NFI will be hosted on one of the spacecraft. The other three spacecraft will have Wide-Field Imagers (WFIs) provided by Southwest Research Insitute (SwRI). Each of the four spacecraft will fly in a distributed formation spread around the globe, operating in sync to produce polarized images of the inner solar system every few minutes.

Objectives

Determine the cross-scale physical processes that unify the solar corona with the rest of the solar system environment (the heliosphere).

- Understand how coronal structures become the ambient solar wind.
- Understand the dynamic evolution of structures (such as CMEs) in the solar wind.

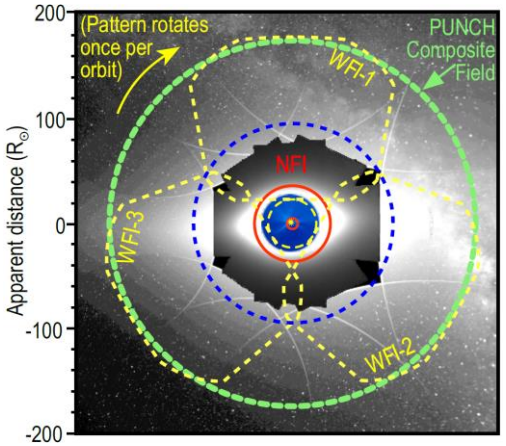
Approach

NFI conducts a regular observing program of

- global, polarized observations of the from the outermost solar atmosphere to the inner heliosphere.

Payoffs

Understanding the solar wind represents a scientific challenge to developing accurate predictions of the geo-effectiveness of space weather events, ranging from small-scale fluctuations to large-scale features such as coronal mass ejections (CMEs) and corotating interaction regions (CIRs). Although the source of these structures is the Sun, evolution and interactions occur en route to Earth. Much of this evolution occurs in the poorly imaged region between solar corona and heliosphere. NFI will image an 8º FOV (red circle) around the Sun.



Three WFIs acquire data in a trefoil on the sky (yellow). As the spacecraft orbit, the trefoil rotates on the sky and builds up the full circular PUNCH FOV (green). The two instruments are designed to be integrated into the full PUNCH composite FOV.