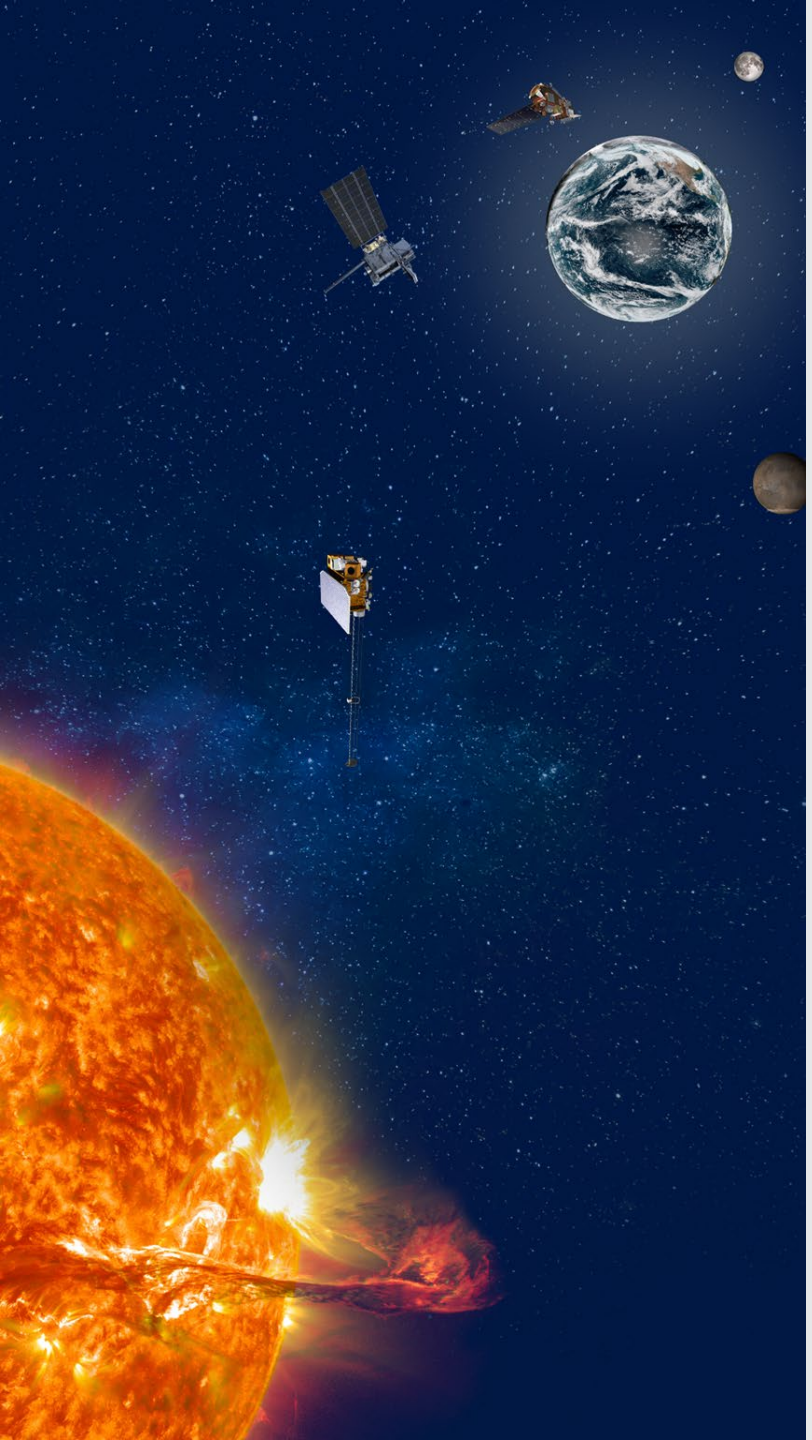
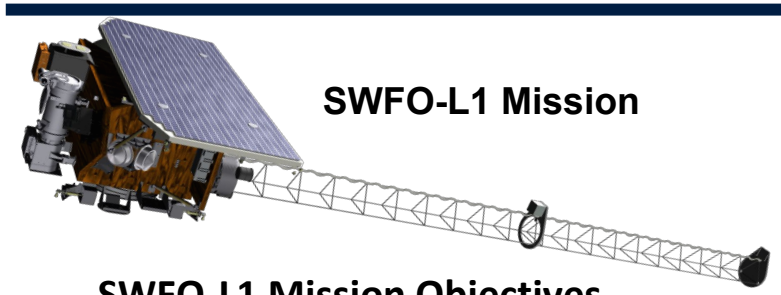


Space Weather Follow On (SWFO) Program

Gene Martin, Deputy System Program Director, SWO, NASA
Marco Vargas, SWFO Program Coordinator, SWO, NOAA
Greg Yoblin, SWFO-L1 Deputy Project Manager, SWO, NASA

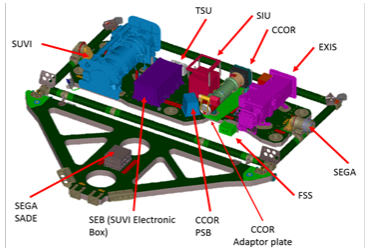
SWFO Program Overview



SWFO-L1 Mission

SWFO Ground System

CCOR + SUVI + EXIS



GOES-U Solar Pointing Platform

SWFO-L1 Mission Objectives

Establish operational capability and continuity of space weather observational requirements. Enable space weather watches, warnings, forecasting and predictions

- Coronal White Light Images for detection of Coronal Mass Ejections (CMEs)
  - Observe CME parameters, shape, density, velocity
  - Produce CME characteristics for input into operational heliospheric propagation code
- In situ solar wind measurements
  - Measure solar wind magnetic field, thermal plasma, and energetic particles

CCOR on GOES-U Mission Objectives

Establish operational capability and continuity of Sun CME imaging observational requirements with multiple platforms; primary operational objectives:

- Observe CME parameters, shape, density and velocity
- Produce CME characteristics for input into operational heliospheric propagation code
- Enable space weather watches, warnings, forecasting and predictions

SWFO-L1 Overview

- Launch: 2025; Orbit: Lagrange Point 1 (L1)
- Rideshare with NASA IMAP; ESPA Grande compatible spacecraft bus
- CCOR; Solar Wind Instruments: MAG, SWiPS, STIS
- Commanding and data through SWFO Ground Segment

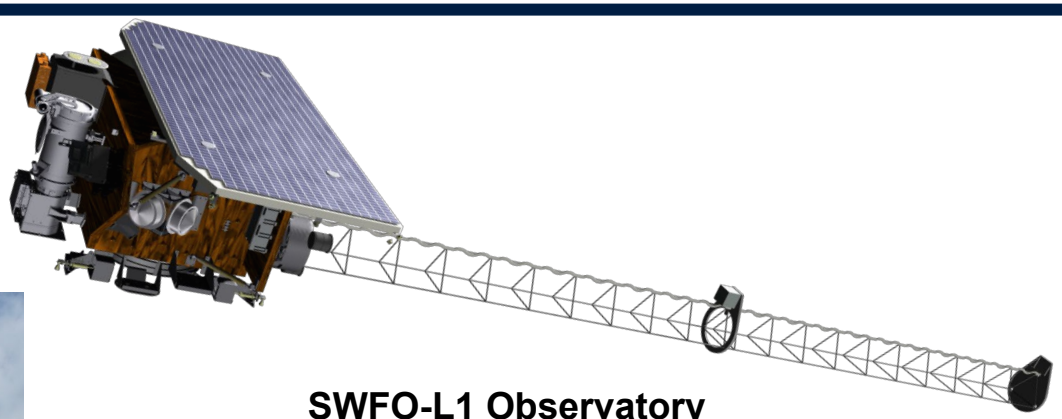
CCOR on GOES-U Overview

- Launch: 2024; Orbit: GEO
- CCOR integrated onto GOES-U Solar Pointing Platform
- Commanding and data through GOES-R Ground System

SWFO Program schedule is a key driver: 2025 SWFO-L1 launch treated as having a “planetary launch window”

- IMAP rideshare
- Continuity of space weather watches and warnings: In-flight assets are well past their design life

SWFO Program Elements

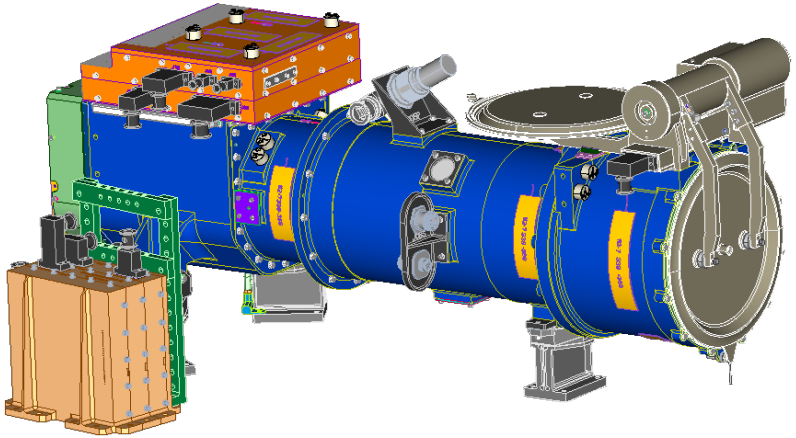


SWFO-L1 Observatory

SWFO Ground Segment Project

- SWFO Antenna Network (SAN)
- Command and Control (C2)
- Product Generation and Distribution (PGD)

GOES-U CCOR
2024
Geosynchronous



NOAA/NASA Partnership for the SWFO Program

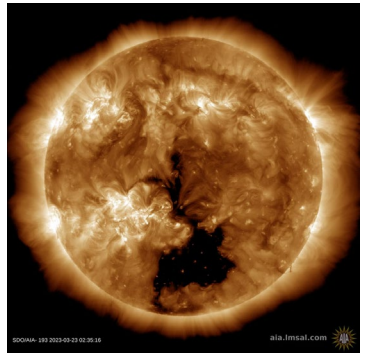
- NOAA Responsibilities:
  - Overall mission and programmatic responsibility
  - Procurement of the Ground Segment

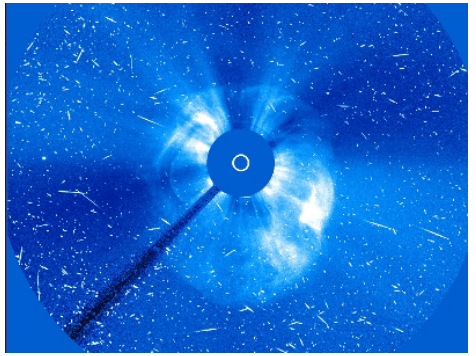
- NASA Responsibilities:
  - Development and procurement of the Flight Segment
  - Systems Engineering Lead
  - Safety and Mission Assurance Lead

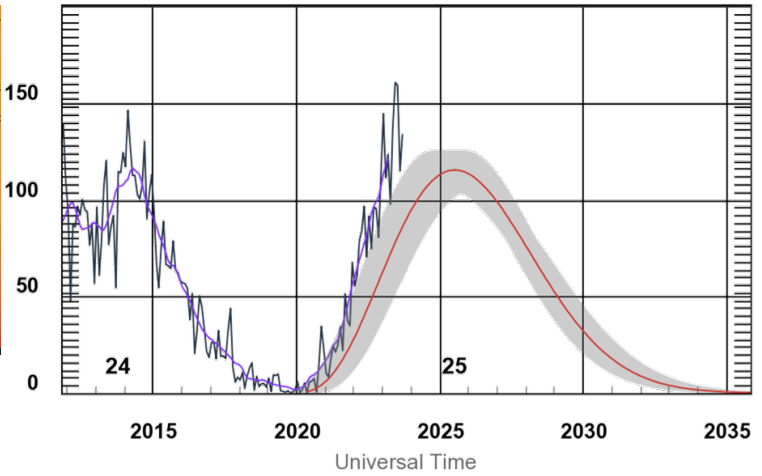
- Governed by the NOAA-NASA Programs and Projects Management Control Plan (MCP) and SWFO Program Plan
  - Managed as a single-project program as defined in NASA Procedural Requirement (NPR) 7120.5E

User Needs: Operations and Research

- Space weather can pose threats to the regular operations of technologies in space and on the ground. Importantly, it can threaten the health and safety of astronauts, and airline crews and passengers. It can also degrade the performance of satellite, navigation, and telecommunication systems among others.
- In addition to the need for timely and continuous operational information to be provided to the National Weather Service, other government branches, and their end-users, there is a need for accurate information for research and development (R&D) including the advancement of predictive, data-driven space environment models.
- Space weather, based primarily on solar activity, has characteristic recurrence patterns. Currently we are in Solar Cycle (SC) 25 which began in December 2019 with a smooth sunspot number of 1.8, and is expected to continue until after 2030 with a predicted maximum in the summer of 2025.



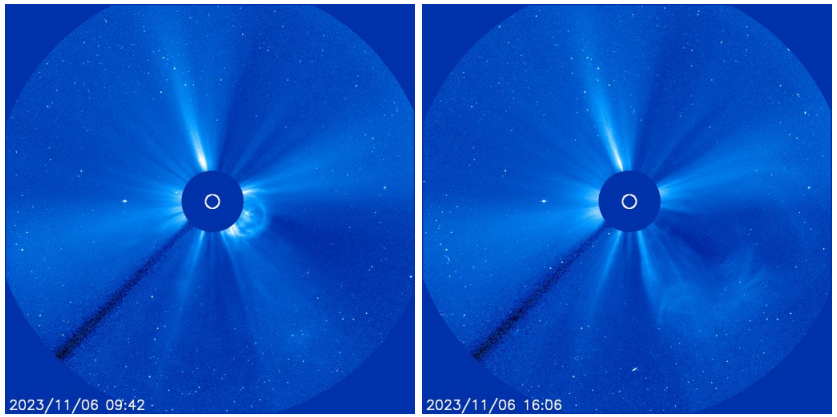




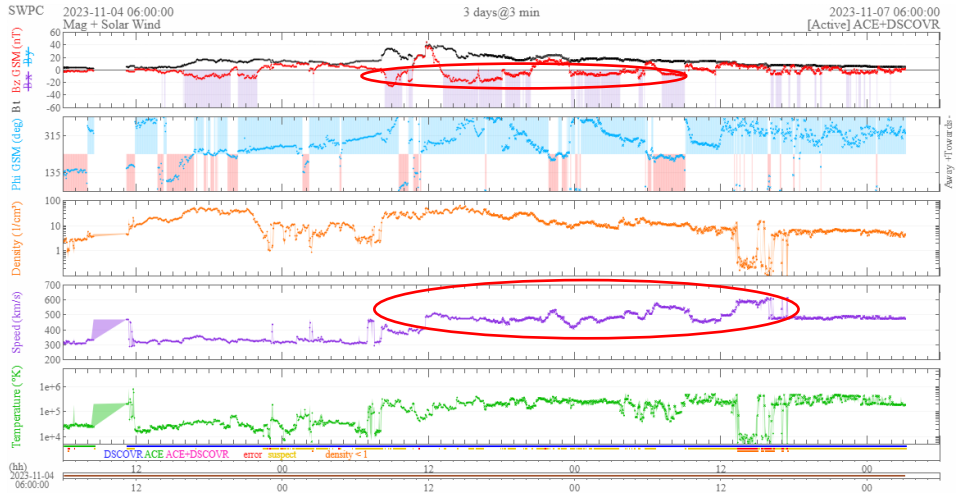
Product Design and Availability

- The SWFO Program will need to deliver high-level products to its users in addition to making the original data available. These topics are generally covered in specialized presentations on products, but a summary is provided here.
- Requirements cover the provision of science measurements as well as housekeeping and ancillary data. There are lower-level requirements for metadata to facilitate searches and comparisons.
- The program will use the SWFO Science Center (SSC) to make data available to retrospective users. The SSC has significant legacy with lessons learned from NOAA data portals (DSCOVR, GOES-R, terrestrial weather) and NASA space science data centers. The SSC is part of a broader NOAA upgrade in archive and access (A&A) functionalities for agency satellite data.
- The SWFO observations are planned to be organized in an archive which is comprehensive and has a required availability with as few gaps due to maintenance routines or severe SpWx conditions as possible.
- In addition, the SWFO Ground Segment's integrated processing and distribution functions will include retransmission and playback capabilities and a short-term archive to support the SWPC operational pipelines as well as other groups within the Program.

CME Imagery: November 6, 2023

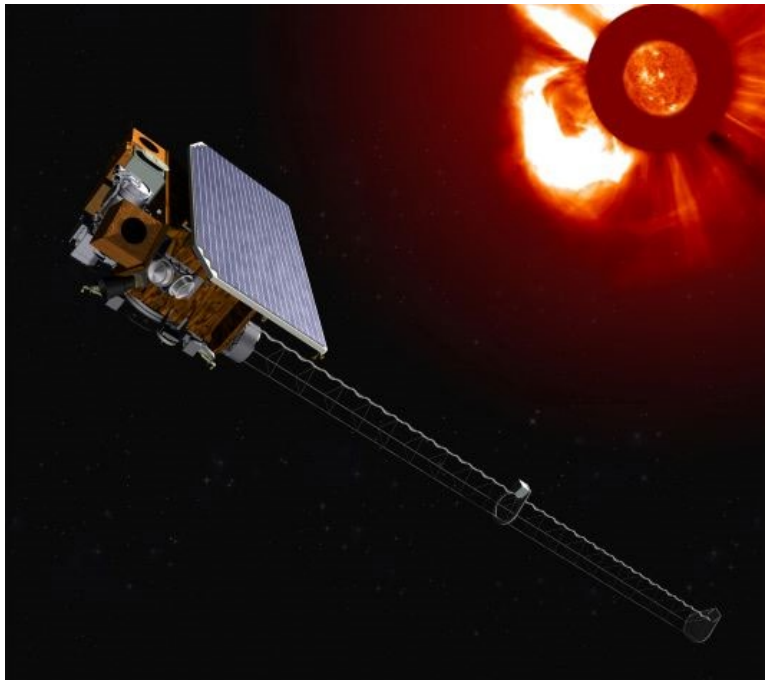


Real-time Solar Wind: November 3-6, 2023



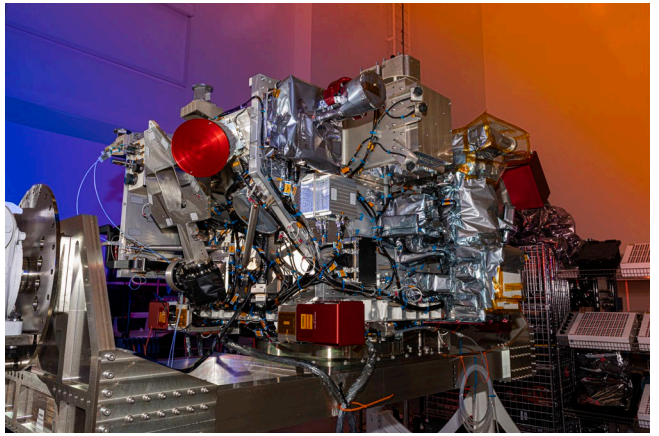
SWFO-L1 Mission Overview

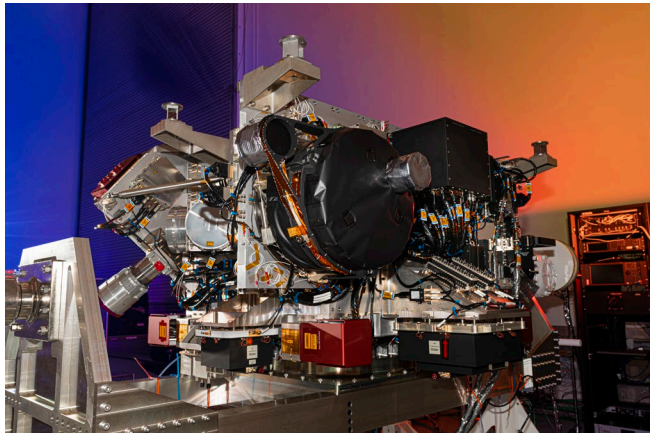
Science Description		Partners & Contractors
• Provide real-time space weather data to NOAA's Space Weather Prediction Center (SWPC) • Measure in-situ solar wind thermal plasma and magnetic field "up-stream" of the Earth • Observe the Sun's corona to detect Coronal Mass Ejections (CMEs) • Help NOAA provide watches and warnings for space weather events that can disrupt the electrical power		**Partners:** • NOAA • KSC Launch Services Program **Prime Contractors:** • Spacecraft (BAE Systems) • SpaceX (Launch Services)
Project Description	**Key Information**	**Instruments**
• Solar observatory at Lagrange Point 1 • Managed by GSFC for the SWFO Program	**Mission Phase:** D **Launch Date:** Apr 2025 **Class:** C **Mission Life:** 5 years **Launch Vehicle:** Falcon 9 Rideshare **Program Office:** SWFO **Technical Authority:** Goddard	• Solar Wind Plasma Sensor (SWiPS): SwRI • Magnetometer (MAG): SwRI/UNH • SupraThermal Ion Sensor (STIS): SSL UC Berkeley • Compact Coronagraph (CCOR): Provided by NOAA/NRL



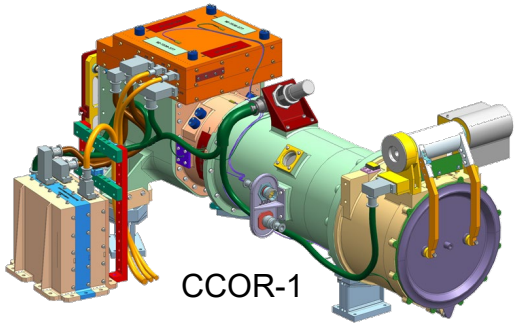
SWFO-L1 Background

- Per NPR 7120.5E, SWFO-L1 is classified as:
  - Category 2
  - SWFO-L1 Project is managed under the SWFO Single Project Program
- Per NPR 8705.4 SWFO-L1 has a Mission Risk Classification of Class C
- SWFO-L1 is a rideshare on the Interstellar Mapping and Acceleration Probe (IMAP) Mission
  - Carruthers is the other rideshare on the IMAP mission
  - IMAP/SWFO-L1/Carruthers are being launched on a SpaceX Falcon 9 from the Eastern Range at Cape Canaveral, Florida

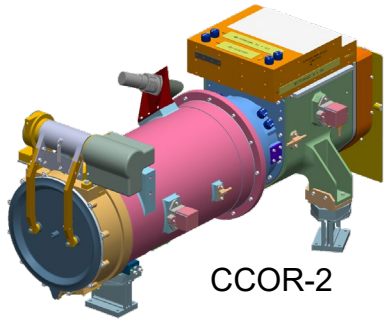




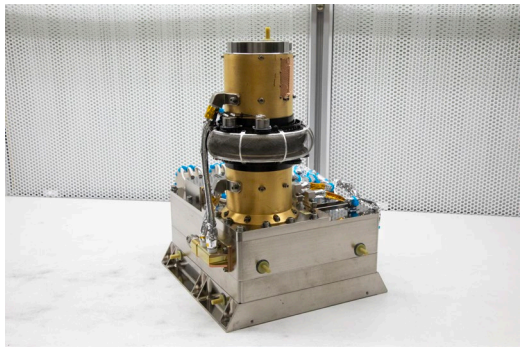
SWFO Instruments


CCOR-1

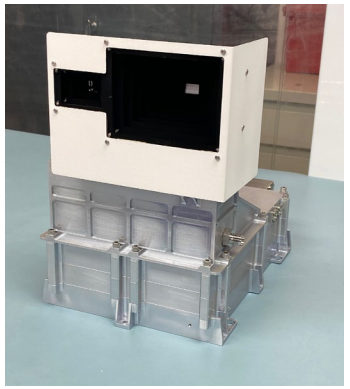
Compact Coronagraphs (CCORs): Developed by Naval Research Lab (NRL), the telescope will be used to observe the solar corona and detect coronal mass ejections (CMEs) and other structures. CCOR-1 will fly on the GOES-U satellite and a nearly identical CCOR-2 on SWFO-L1.


CCOR-2

Solar Wind Plasma Sensor (SWiPS): Built by Southwest Research Institute (SwRI), it will measure properties of the solar wind flowing past SWFO-L1, such as density, velocity, and temperature.



Suprathermal Ion Sensor (STIS): Developed by University of California, Berkeley, it will collect fast ions in the solar wind.



Magnetometer (MAG): Developed by the University of New Hampshire and SwRI, it will measure the magnetic field carried by the solar wind.