

ESA Vigil (L5) and D3S missions update

Presented to CGMS-52 Space Weather Coordination Group session,
agenda item CGMS-52-ESA-WP-01

Executive summary of the WP

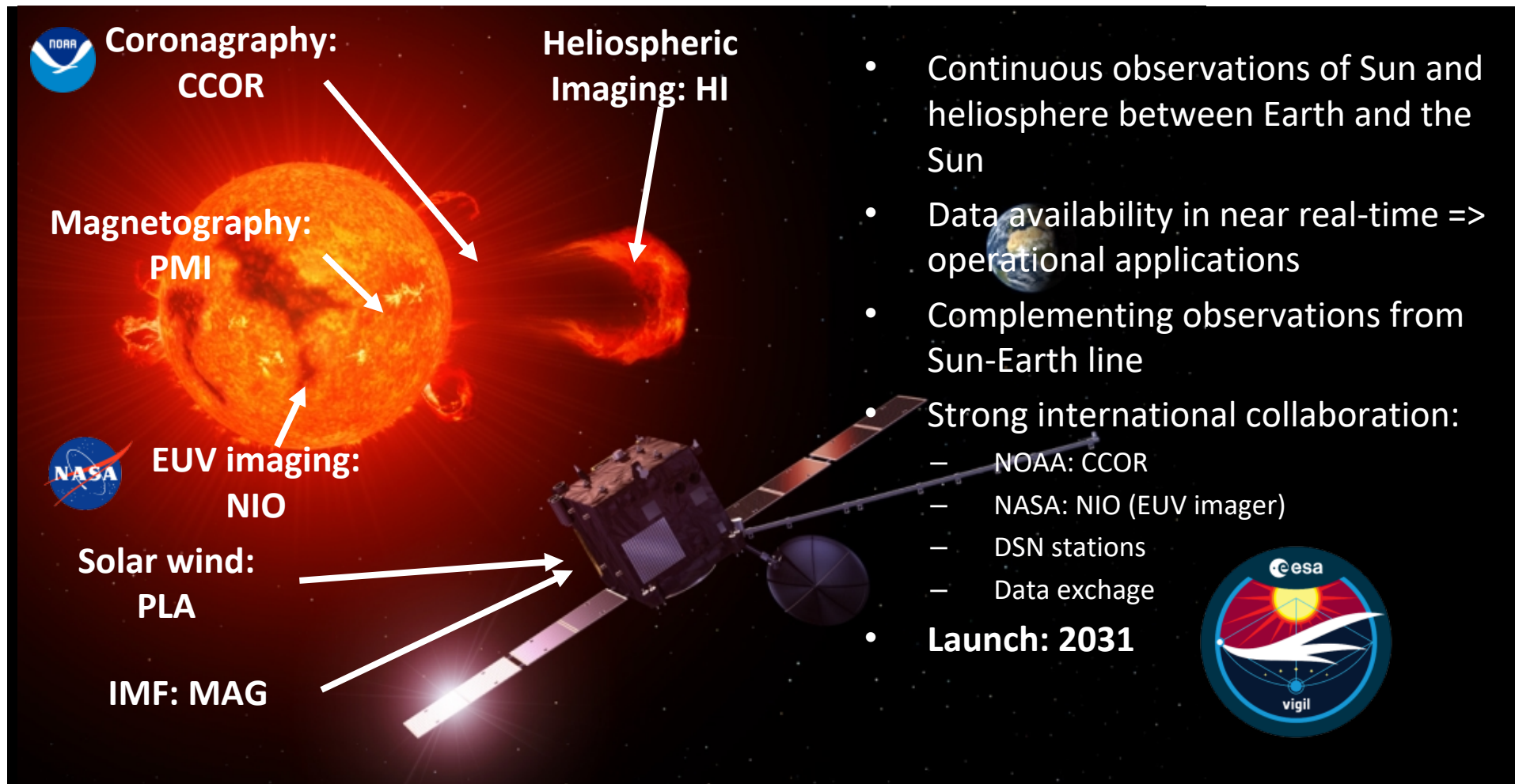
- This presentation provides a summary of the implementation status of the space weather missions in the framework of the ESA Space Safety Programme
- The presentation covers
 - missions in development: Vigil, Aurora, space weather nanosatellites
 - new missions being proposed in the next ESA Ministerial Level Council: SWORD

Vigil mission objectives vs. observations (endorsed by MAG)

	Objective	Observations	
A	<ul style="list-style-type: none"> Improved assessment of CME motion and density, in the corona and heliosphere, in combination with L1 observations Observations necessary to improve solar activity onset detection and identification 	Coronagraphy Heliospheric imaging Magnetography EUV imaging ¹⁾	Highest priority
B	<ul style="list-style-type: none"> Measure vector components of the IMF Determine the characteristics of solar wind features rotating towards Earth 	Plasma spectrometry Magnetometry EUV imaging ¹⁾	2 nd priority
C	<ul style="list-style-type: none"> Enable assessment of developing solar activity, through the monitoring of active region development up to 4 or 5 days beyond the East limb 	Magnetography EUV imaging ¹⁾	Highest priority

¹⁾ Strongly supports objectives in C, contributes to A and B. Not mandatory for 1st priority objectives

Vigil mission moving towards Phase B2/C/D



Coronagraphy: CCOR

Heliospheric Imaging: HI


Magnetography: PMI

EUV imaging: NIO

Solar wind: PLA

IMF: MAG

- Continuous observations of Sun and heliosphere between Earth and the Sun
- Data availability in near real-time => operational applications
- Complementing observations from Sun-Earth line
- Strong international collaboration:
 - NOAA: CCOR
 - NASA: NIO (EUV imager)
 - DSN stations
 - Data exchange
- **Launch: 2031**



Vigil mission status

- Phase B2/C/D started in April 2024 for spacecraft and most European instruments
- Contract for PMI signed in March 2024
- Co-operation with NOAA and NASA
 - NOAA will provide CCOR-3 instrument for coronagraphy
 - NASA Announcement of Opportunity for EUV instrument released in 2023
=> instrument selection at final phase
- Vigil Level 1 data NRT processing will be done in ESA SWE Payload Data Centre
- Level 1 products for operational applications (Priority 1 data) will be provided in NRT through ESA SWE Data Hub
- In addition Vigil supports collection of science data (Priority 2 data):
 - Instruments operated at higher cadence or resolution
 - Additional data collected onboard and transmitted when space data link capacity available
=> Priority 2 provided without timeliness commitment
- Launch target: 2031

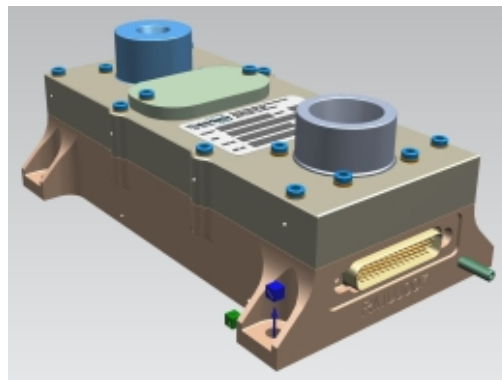
Data from hosted payload missions

Instrument	Hosting flight	Orbit	Launch Date	Mission Lifetime	NRT data available
SOSMAG	GEO-Kompsat-2A	GEO (128° East)	2018	10 years	Yes
NGRM	EDRS-C	GEO (31° East)	2019	10 years	Yes
NGRM	Sentinel-6	LEO (1336 km, i = 66°)	2020	7 years	Yes
NGRM	MTG-I1	GEO (0°)	2022	8.5 years	2024
ICARE-NG	HOTBIRD 13F	GEO (13° East)	2022	10 years	2024
ICARE-NG	HOTBIRD 13G	GEO (13° East)	2022	10 years	2024
NGRM	MTG-S1	GEO (0°)	2024	8.5 years	TBD
NGRM	Metop-SG A1	LEO (~830 km, SSO)	2024	7 years	TBD
NGRM	Metop-SG B1	LEO (~830 km, SSO)	2025	7 years	TBD
NGRM	MTG-I2	GEO (0°)	2025	8.5 years	TBD
MiniRMU	Lunar Pathfinder	Lunar (elliptical)	2025	8 years	TBD
ERSA	Lunar Gateway	Lunar (NRHO)	2025	5+ years	TBD

Lunar hosted payload missions

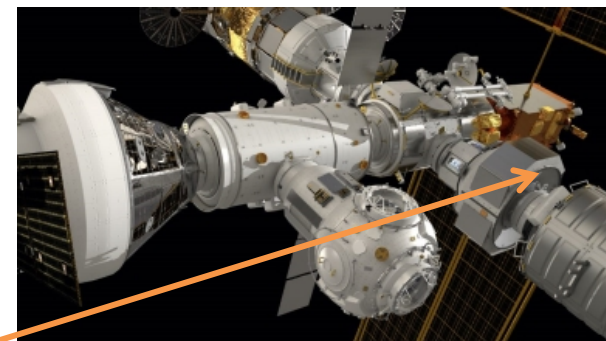
MiniRMU on Lunar Pathfinder

- Monitoring of high energy electrons and protons from orbit around the Moon
- Instrument based on NGRM
=> same data characteristics
- Instrument ready for delivery for integration
- Launch in 2025



ERSA on Lunar Gateway

- Radiation monitoring instrument package: NGRM, SREM, ICARE-NG, 2 x EAD, 2 x MediPix, 2 x magnetometers
- Complementary with NASA solar physics HERMES payload
- All instruments ready, package integration in progress
- Planned launch end 2025



Space Weather Nanosat Mission

Mission objectives:

- Data on space environment and effects in LEO
- Demonstrate “new space” and commercialisation approach with mission/data-as-a-service
 - => Industry responsible for implementation, mission operation & Level 1 data processing
 - => ESA an anchor customer

Baseline measurements:

- High energy Proton and Electron flux
- Solar X-ray spectrum
- 3D electron density in the ionosphere
- Ionospheric Radio Occultation

Status:

- Phase A/B/C/D/E1 to be started in Q2 2024

Launch: 2026

Note: Second, complementary nanosat mission in preparation => launch 2027



Aurora

Mission objectives:

- 24/7 monitoring of day/night side Aurora for operational applications
- Radiation and magnetic field monitoring

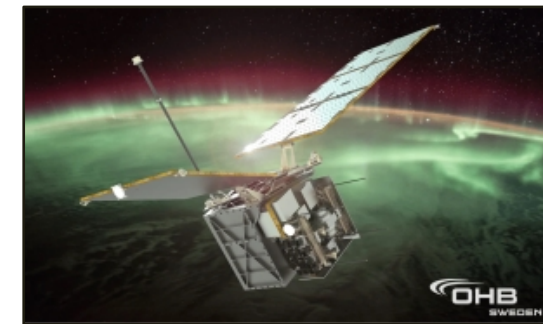
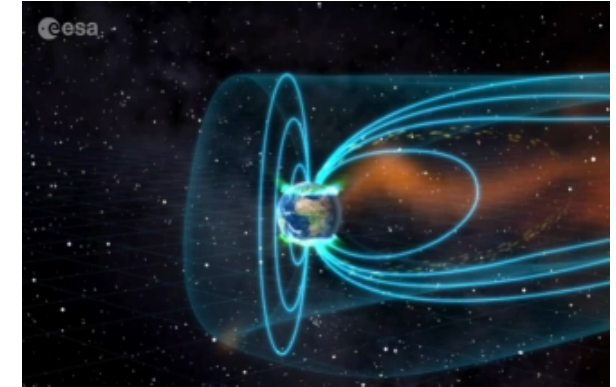
Orbit: 7000 km, polar

Payload:

- Wide Field Auroral Imager (WFAI)
 - Auroral Optical Spectral Imager (AOSI)
 - Auroral UV Imager (AUI)
- Radiation Monitor & Magnetometer

Mission implementation:

- Aurora-D: single satellite concept demonstration
 - => Phase B2/C/D started
 - => Launch targeted in **2027**
- Aurora-C: 4 satellite constellation: **2030** (TBC)



SWORD (Space Weather Orbital Radiation Detector)

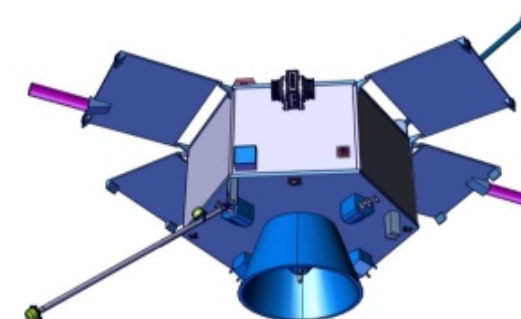
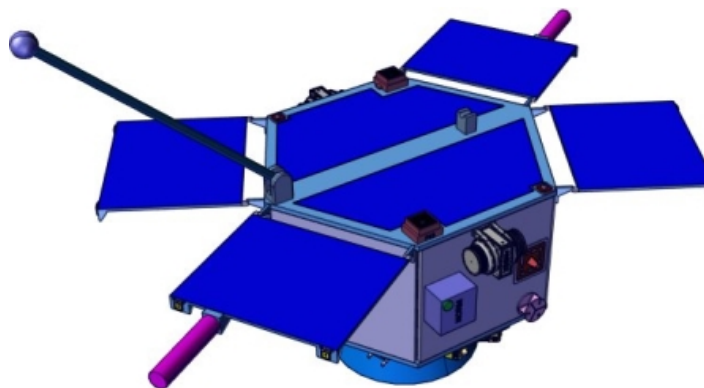
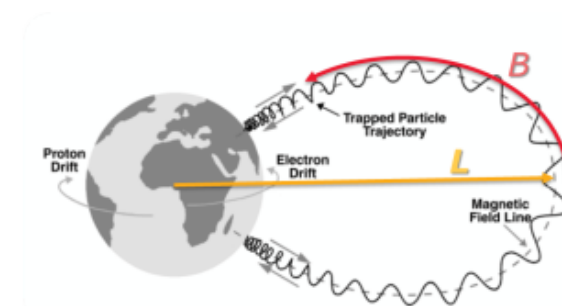
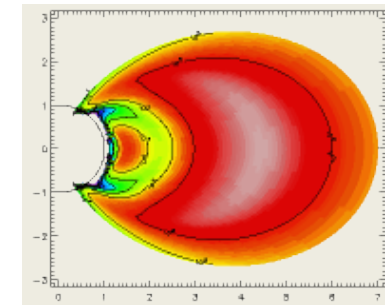
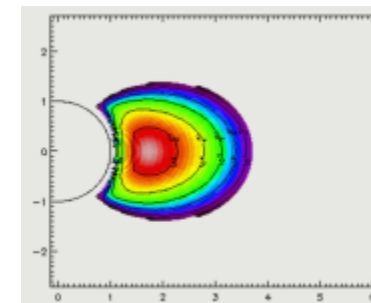


Mission objectives:

- Comprehensive monitoring of the trapped electrons, protons and plasma environment from GTO
- Cross-section of inner and outer belt at least every 5 hours (constellation of two satellites)
- Spinning satellite for determination of pitch angle distribution allowing extrapolation to all Earth orbits
- Latency of <60 minutes, goal of 5 minutes

Status:

- ESA CDF study for mission concepts: 2023
- Pre-Phase A study with industry: to be started in 2024
- Proposal for funding in ESA CM25



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