HENON: An Interplanetary CubeSat To Monitor Space Weather Phenomena in an Unexplored Sun-Earth DRO Region

ASI Workshop "L'impegno italiano nel settore dei CubeSat: tecnologie e missioni future" – 2° edizione

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Town, State: Rome, Italy

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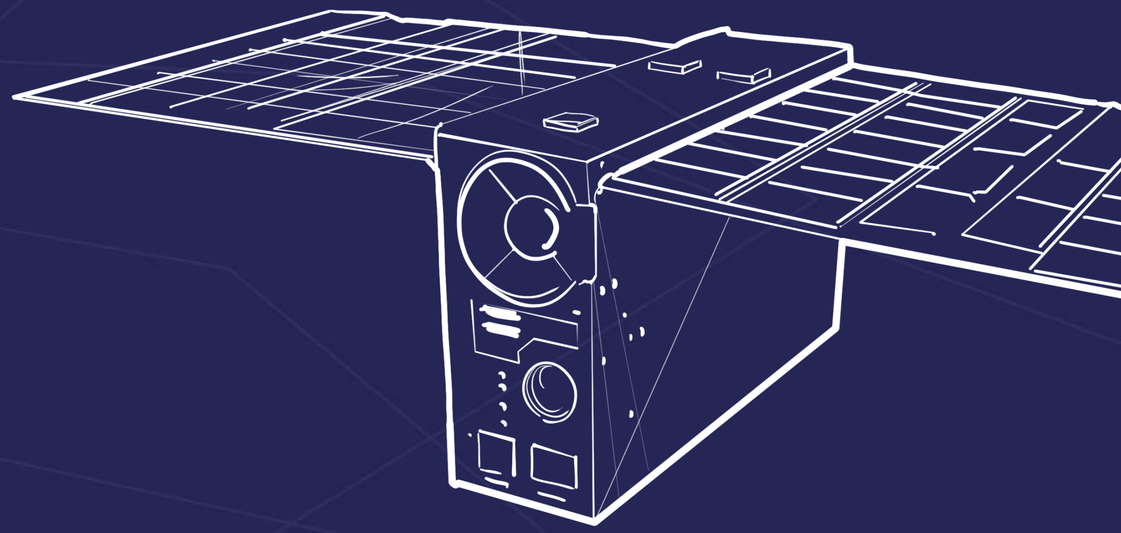
Agenda



1. Project Framework
2. Mission Goals
3. Main Scientific Outcomes
4. ConOps
5. Interplanetary Journey to DRO
6. HENON Platform
7. Program Timeline

HENON

Project Framework

HEliospheric pio**N**eer for s**O**lar and interplanetary threats defe**N**ce

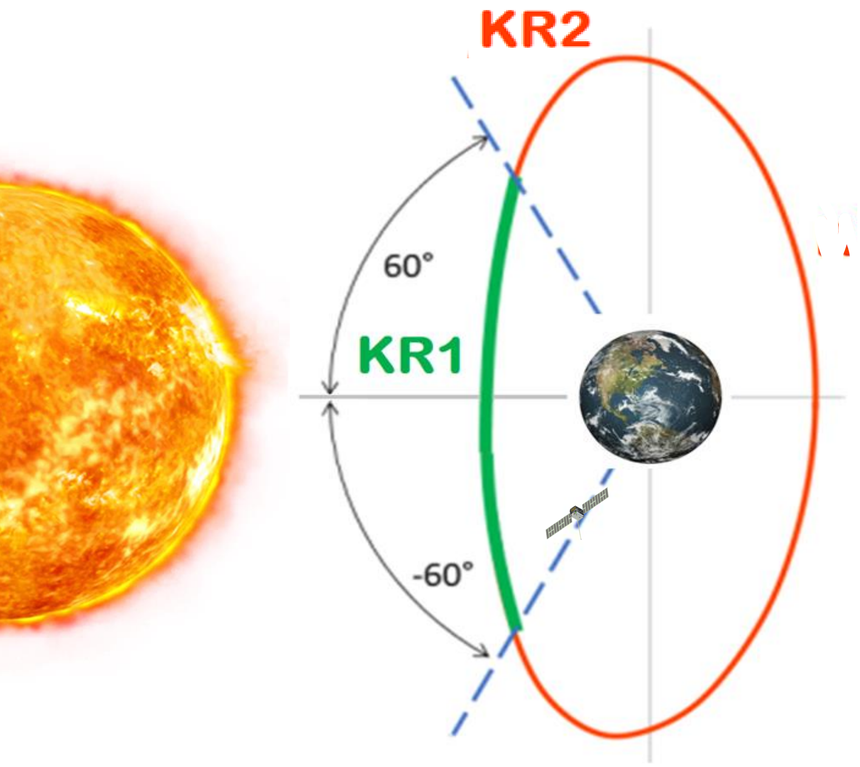
Main Objective: Demonstrate near real-time in-situ monitoring of the space environment to provide near real time alerts with increased warning time.

Secondary Objectives:

- Enhance the space weather forecasting models
- Operate an Interplanetary CubeSat in the Sun-Earth DRO

HENON

Main Scientific Outcomes



Key Region 1:

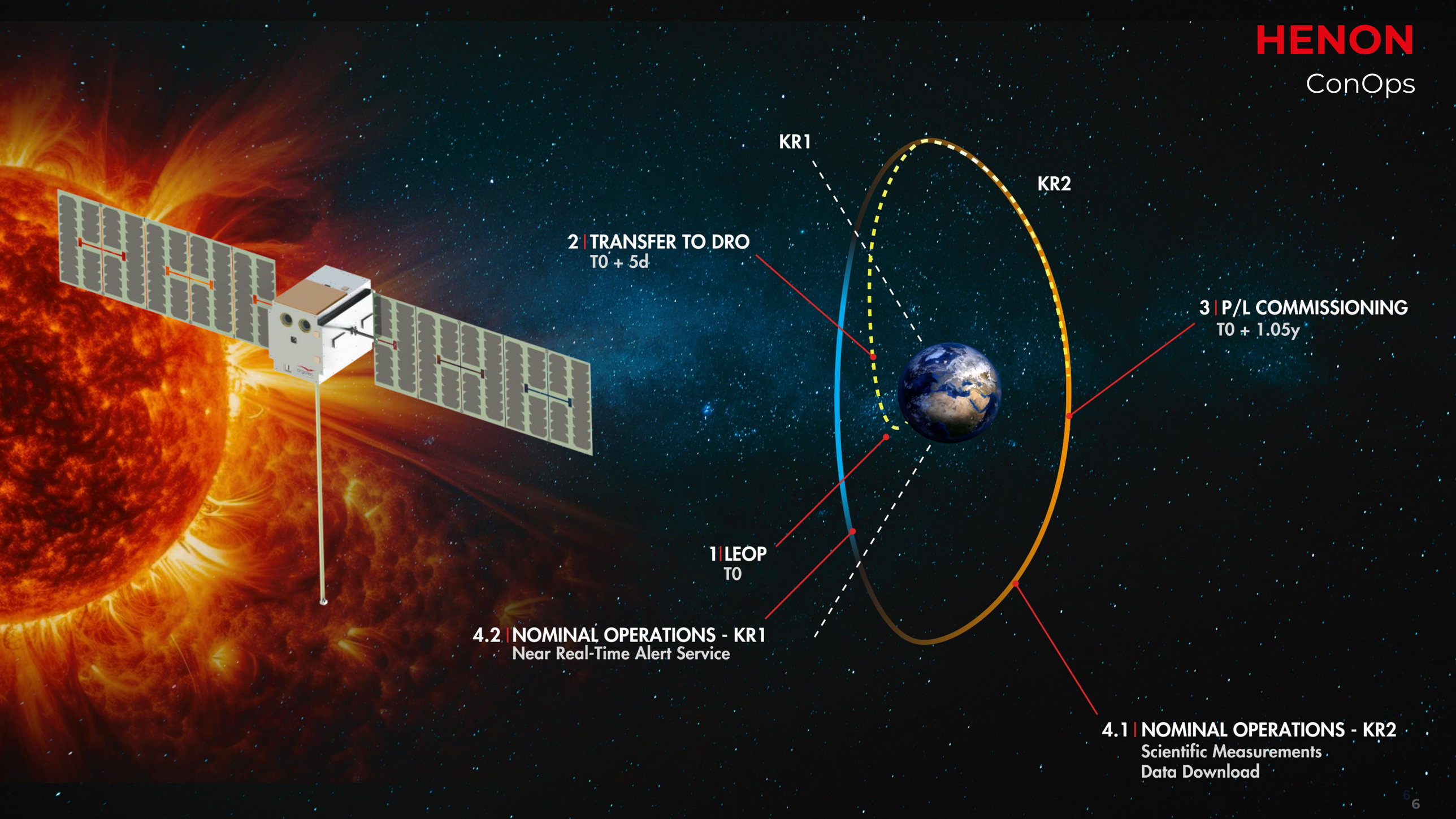
- S/C is in-between Sun and Earth. Generation of **near real-time alerts** for space weather events
- On-board processing of scientific data to detect possibly geo-effective events such as **solar wind perturbations** and generate alerts
- A machine learning algorithm will provide reliable prediction of the >10 MeV **proton flux**
- Innovative on-board algorithm to compute severity indexes of four different events: **SEP, FD, ICME, HSS**

Key Region 2:

- In-situ scientific measurement of space environment to enhance **space weather forecasting models**
- Study fundamental **plasma physical process** and their role in the evolution of the interplanetary perturbations
- Dedicated Spinning Modality for **anisotropy measurements**

HENON

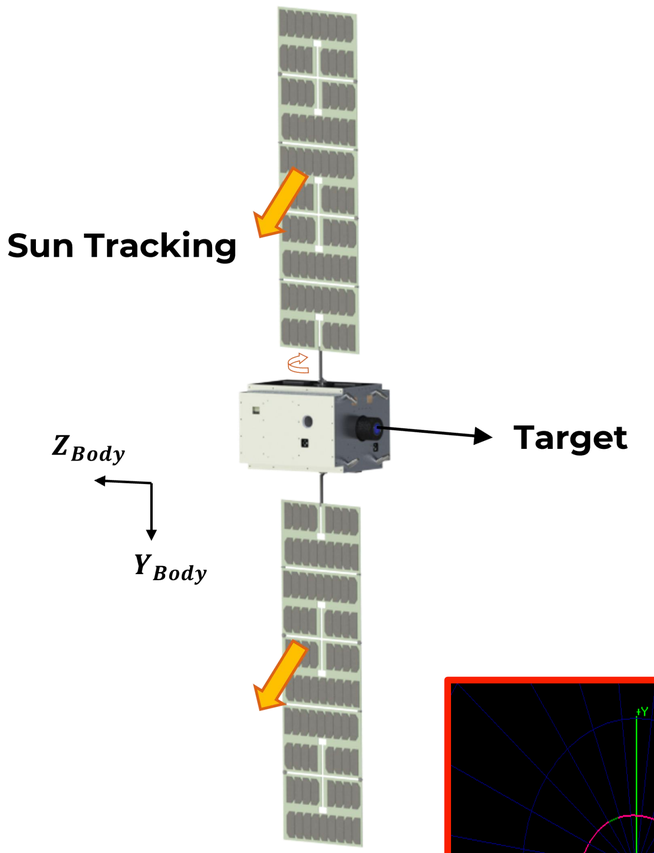
ConOps

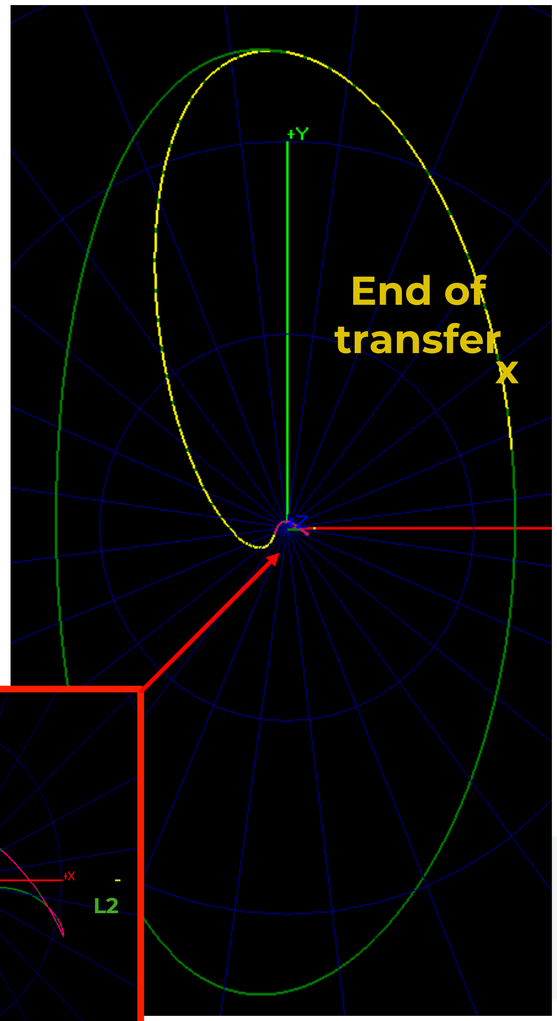


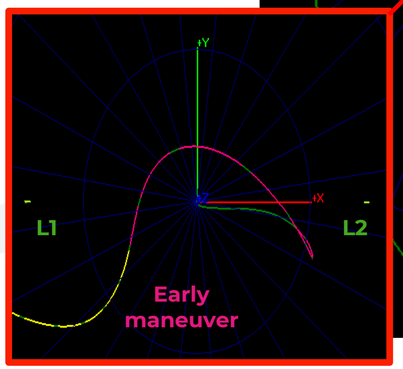
Interplanetary Journey to DRO

HENON Mission Analysis

Main Assumptions and Results	
Initial Conditions	Same IC of JWST 1.5h after lift-off
Time to start thrusting (nominal)	17d
SC total wet mass	29kg
Nominal thrust and Isp	As a function of Max Power available
Maximum electric power	Power vs. Sun-Distance Model
Thruster ON/OFF strategy	6days-ON, 1day-OFF
Transfer Time	**~385 d**
Propellant Consumption	**~1.54 kg**
DRO Min Dist. from Earth	**~12.3 x10⁶ km**
DRO Max Dist. from Earth	**~24.7x10⁶ km**





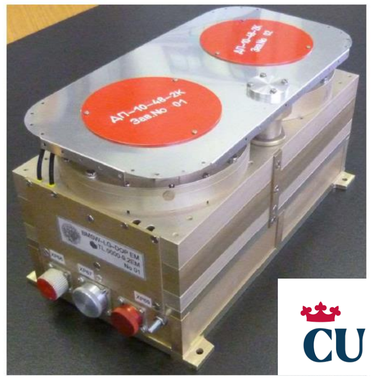


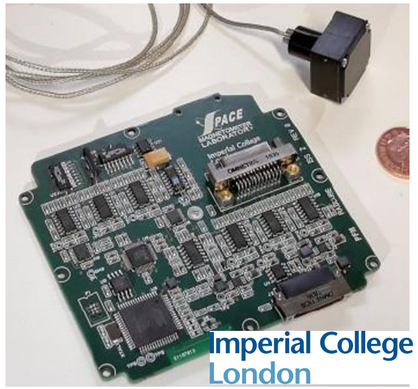
- "Large Flyby" from Earth d~400.000km
- Dist. from Moon > 400.000km (always)
- It takes about 80-90 days

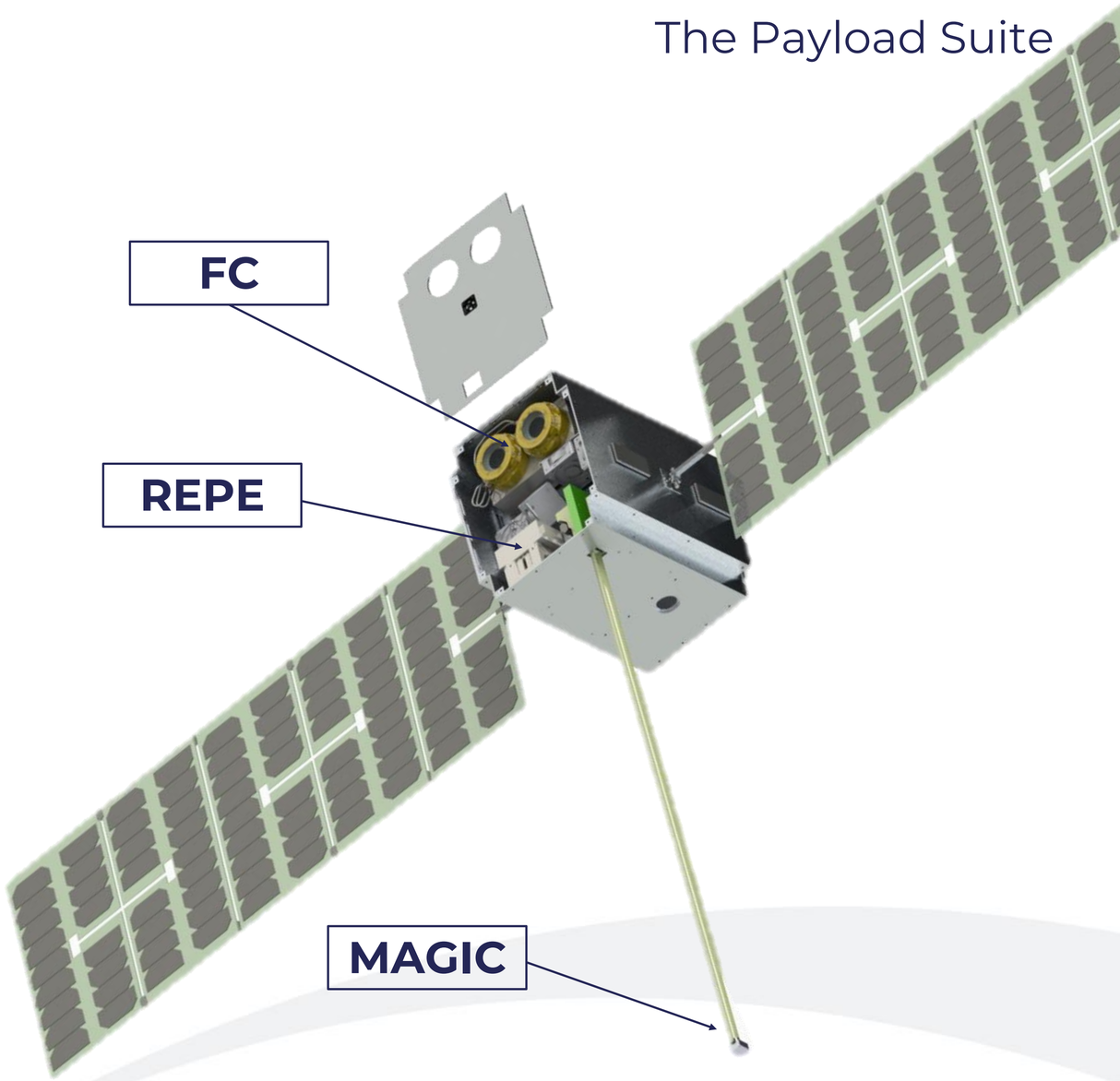
HENON Platform

The Payload Suite

- **Radiation Monitor (REPE)** – ***ASRO/UTU (Turku)***
  Proton and electron fluxes
- **Faraday Cup Analyzer (FC)** – ***CU (Prague)***
  Solar Wind measurements
- **Magnetometer (MAGIC)** – ***ICL (London)***
  Interplanetary Magnetic Field





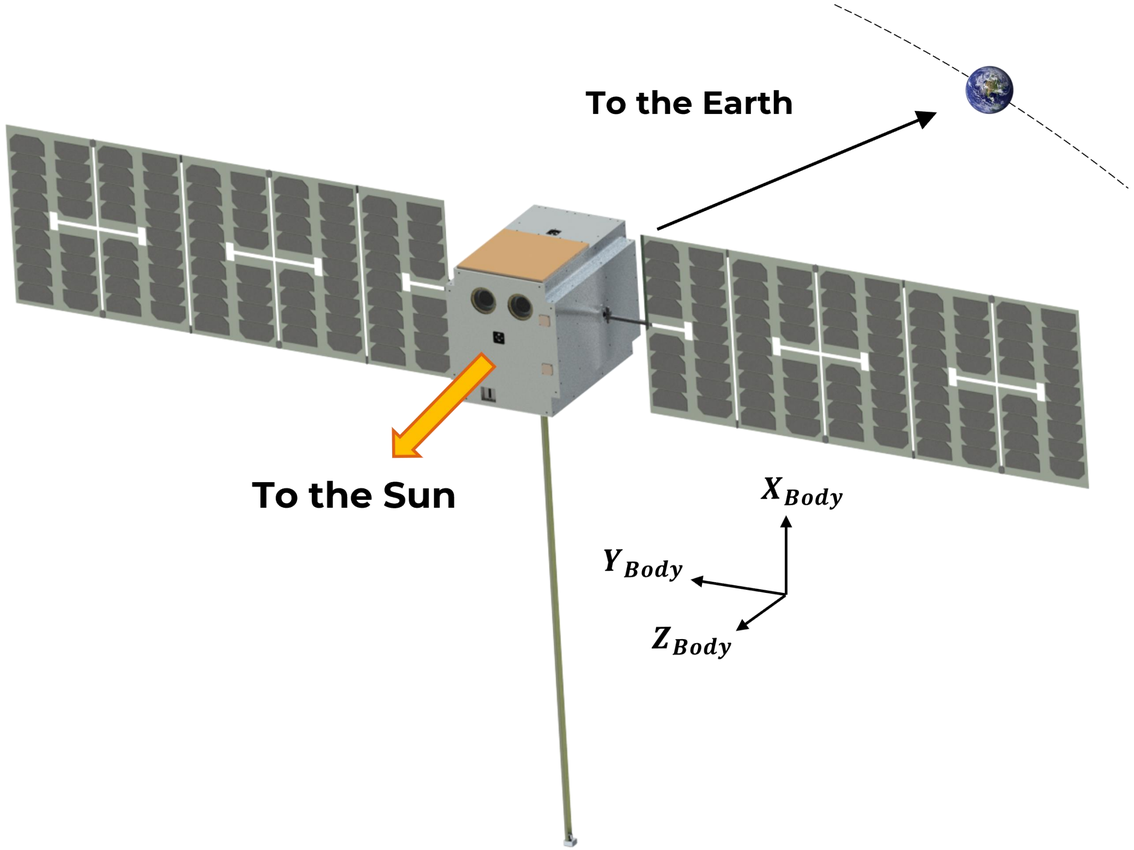


HENON Platform

Scientific Modes

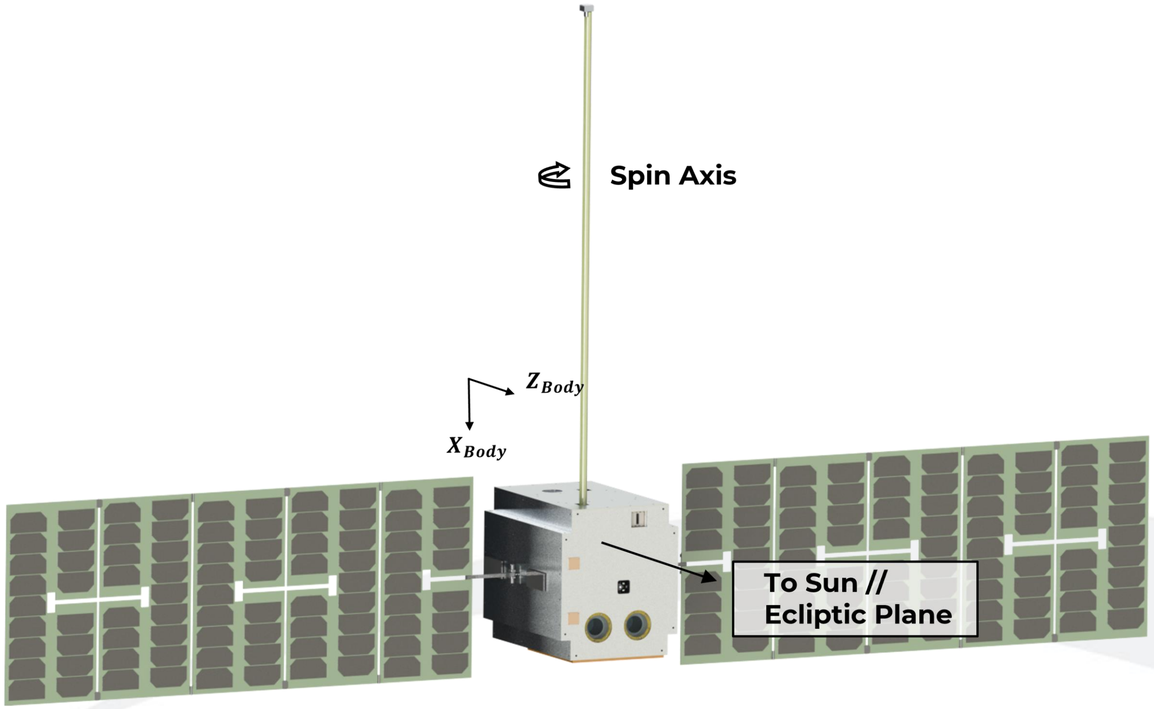
• Science Mode

Typical Configuration for scientific acquisition



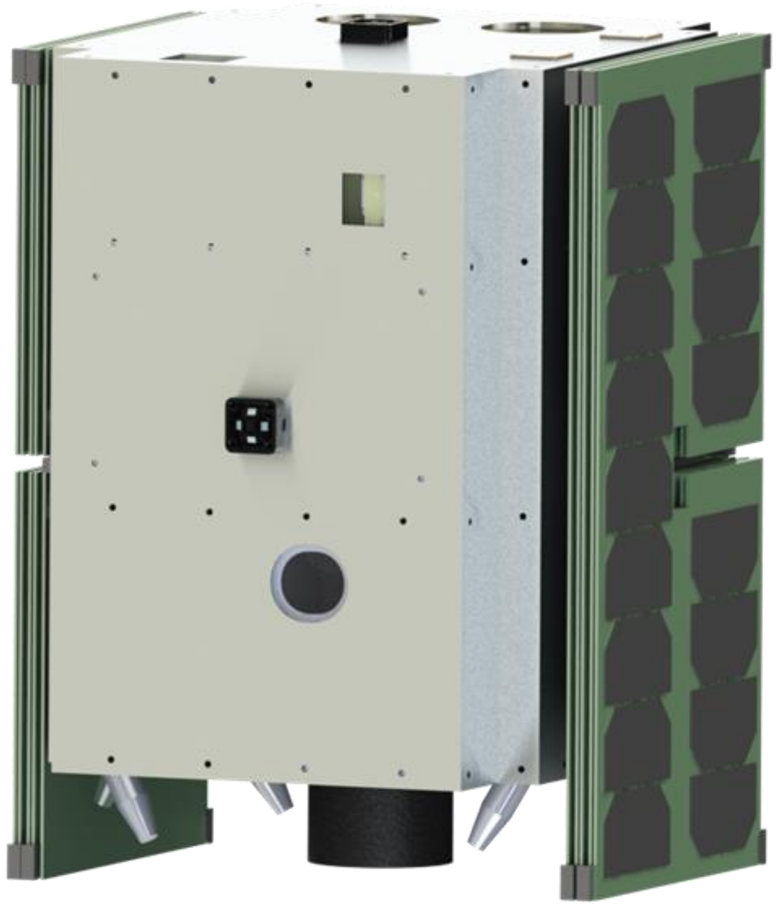
• Spinning Mode

Mode for enabling anisotropy measurement in KR2



HENON Platform

Key Features

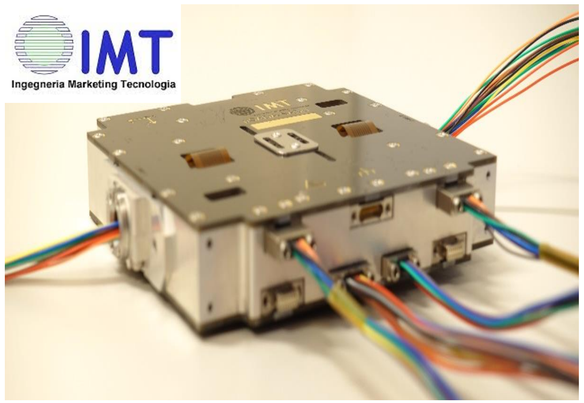


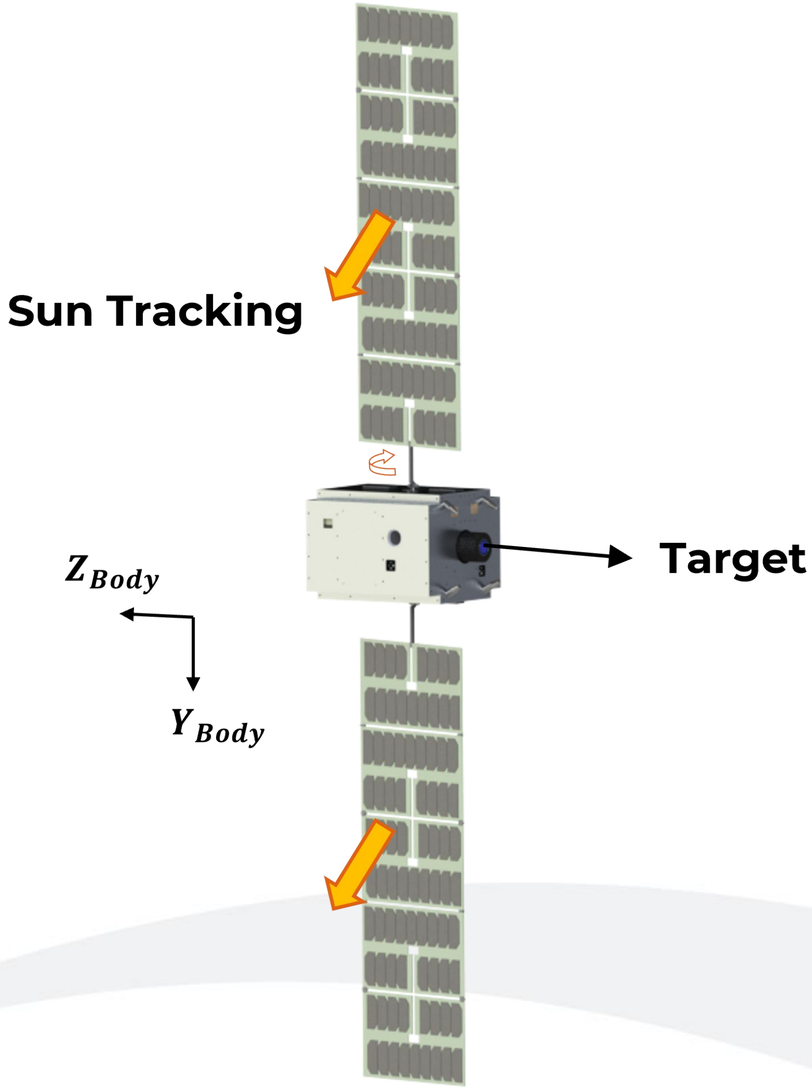
- 29 kg
- 12 U XL
- X-Band up to 512 kb/s
- Electric Propulsion +
  Cold Gas RCS – Xenon >75kNs
- 216W BOL (AM0)
  198W EOL (AM0)
- < 0.1 deg (3-axis)
- > 2.5 years

HENON Platform

Electrical Power Subystem

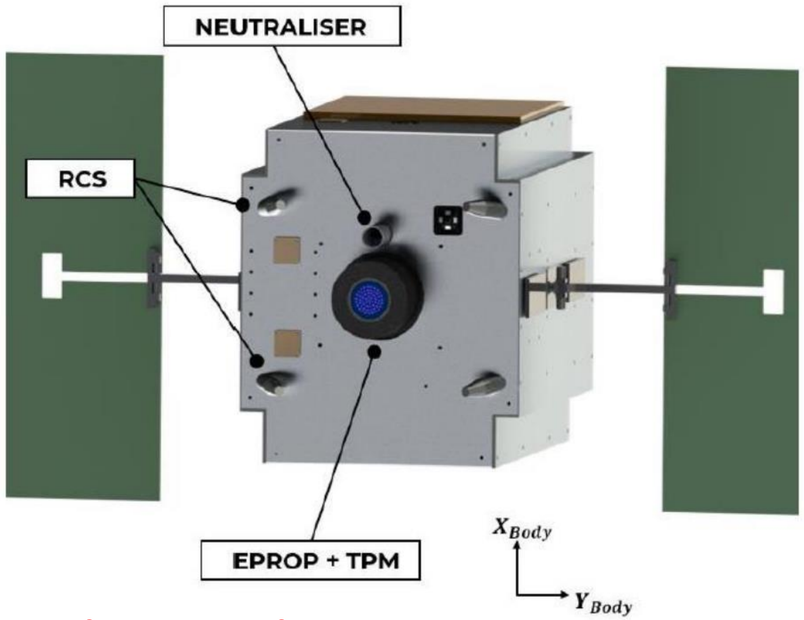
Property	Value
Solar Panels Power Generation	Up to 216 W
Energy Storage	124 Wh
Mechanisms	Solar Array Drive Unit (SADU)
PCDU Radiation Tolerance	30 krad, SEE Tolerant
Power Management	Up to 250 W
Available power interfaces	10 x 28V, 4 x 12V, 4 x 5 V
Panels pointing accuracy	$\pm 0.3^{\circ}$

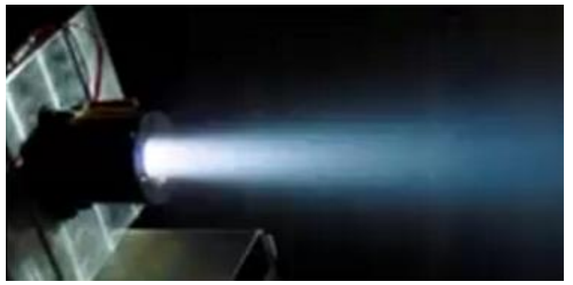




HENON Platform

Propulsion Subsystem





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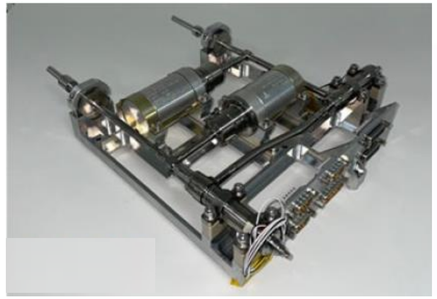
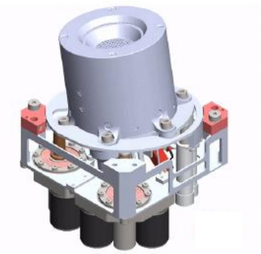
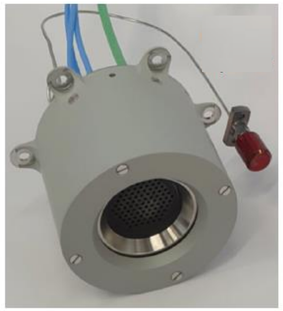






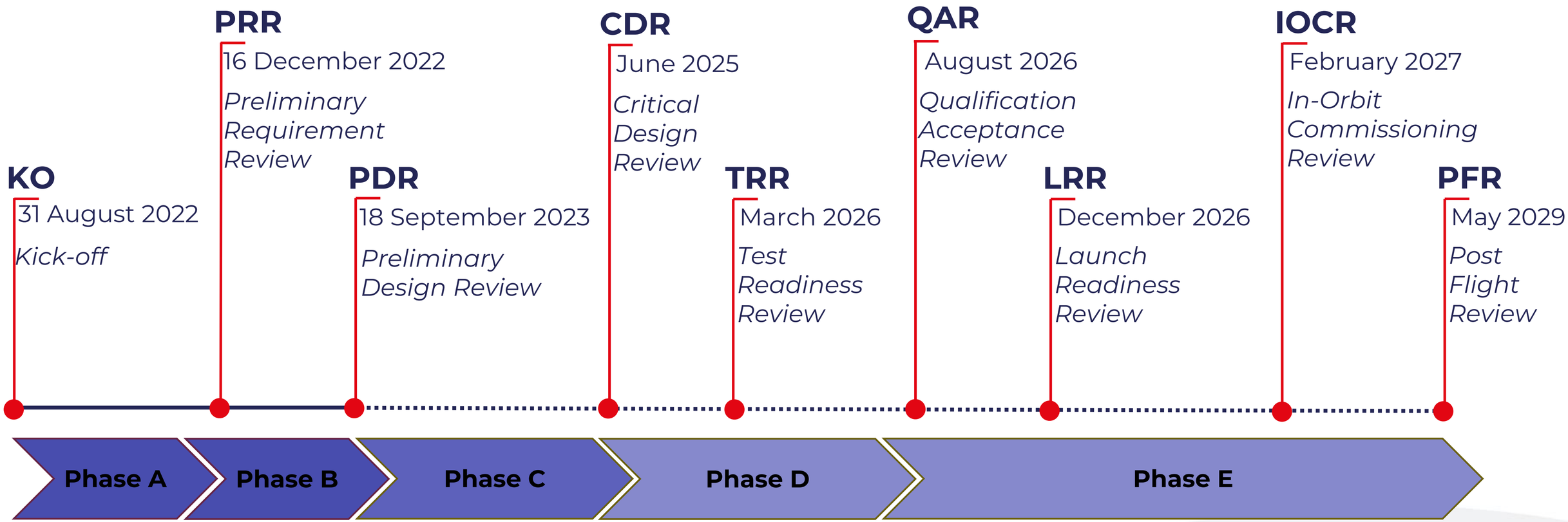
Propulsion Suite

- High-performance Ion-effect electric thruster based on Xenon
- Integrated cold-gas system
- TPM to manage parasitic torques
- Designed for deep-space application
- Key technology for enabling 385 days interplanetary transfer
- Total of 3 years mission lifetime in deep space

Property	Value
Total Impulse	> 90 kNs
Specific Impulse	Up to 3600 sec.
EP Thrust Level	Up to 2.2.mN
RCS	Integrated- - Xenon Based
RCS Thrusters	4x, 10 mN, 30 sec.

Program Timeline

Roadmap



Current status: Phase C1 on-going

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Thank you

Headquarters

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