REPE for HENON: ASRO's Advanced Radiation Monitor for Space Weather Applications

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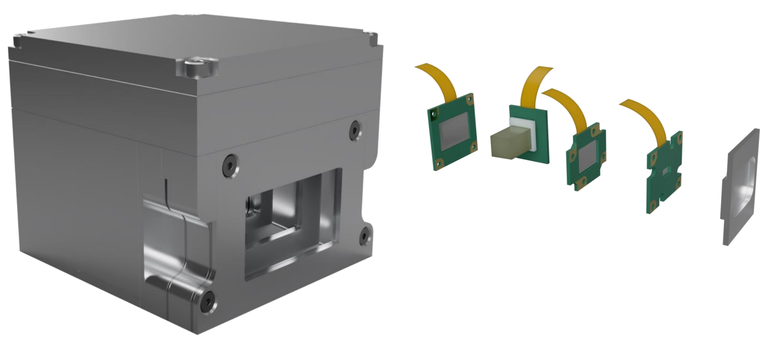
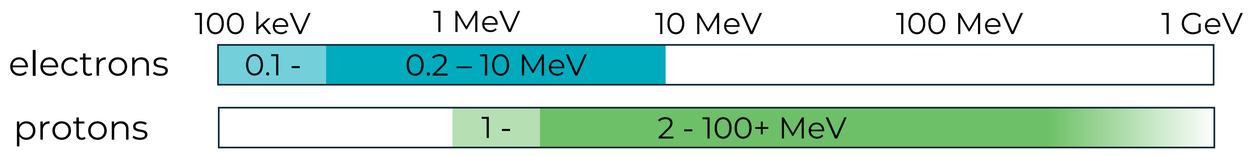
Relativistic Electron and Proton Experiment (REPE)

REPE is a compact energetic particle instrument, initially conceptualised for studying particle fluxes in the Van Allen belts.

The development was originally started for the nanosatellite mission Foresail-2 and later became a collaborative effort between University of Turku and ASRO for future missions.





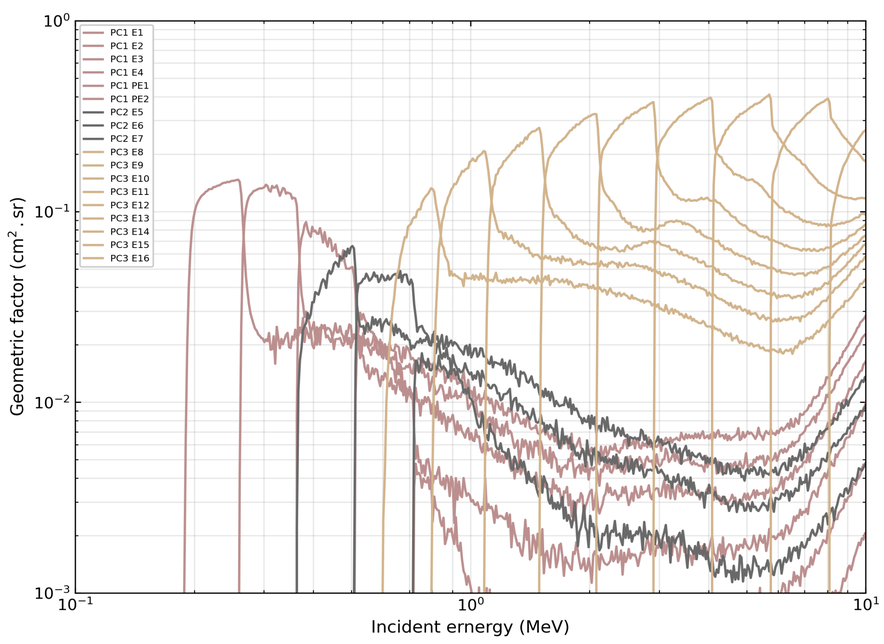
REPE measures electrons and protons using a stack of three silicon detectors and a scintillator with photodiode readout.

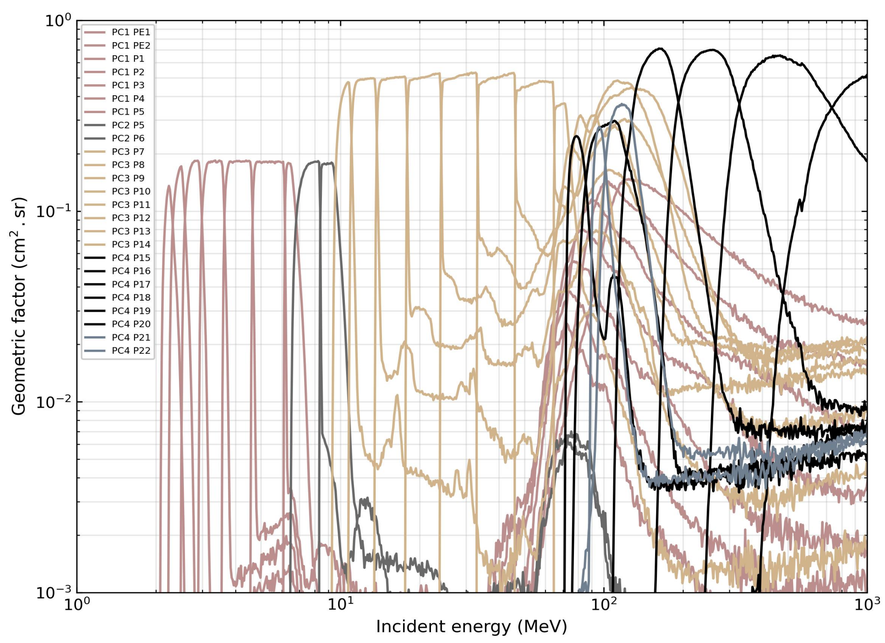
The aperture allows for 8-sector (45° FWHM) anisotropy measurements with spinning satellite, while the geometric factor is high enough for sufficient statistics at low fluxes.

The chosen configuration enables adaptability to different energy ranges. The collimator can be modified according to the mission needs. REPE is well-suited for scientific missions in LEO, high Earth orbits and beyond.

Instrument performance

- 1.2 kg
- <1 U
  95 × 90 × 97 mm³
- 8 V (6 - 12..28 V)
  2.4 W
- RS422/485, LVDS
  > 2 MB/day
- HENON FM
  Q1/2026
- Science and GTO missions, LEO fleets

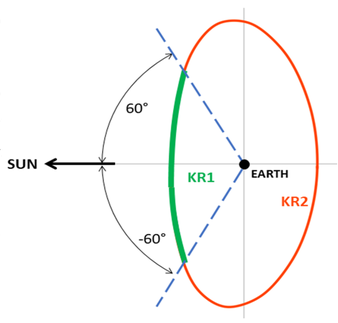




REPE response functions for electrons (left) and protons (right) simulated in Geant4 Monte Carlo environment. The curves show individual channel responses.

HENON mission

REPE will fly on the HEliospheric pioNeer for sOlar and interplanetary threats defeNce (HENON) mission to the previously unexplored Distant Retrograde Orbit. In DRO, it will remain upstream of the Earth, further than L1, for extended periods of time, making it possible to provide Space Weather alerts with significantly increased warning times. Furthermore, the mission will provide demonstration of reliable use of CubeSat technologies in deep space.
The platform is a 12-U cubesat from Argotec (IT), and in addition to REPE, the payload includes a magnetoresistive magnetometer (MAGIC) from Imperial College (UK) for magnetic field measurements and a Faraday cup (FCA) from Charles University (CZ) for solar wind measurements.



Key Region 1:
- Near real-time alerts for space weather events
- Detect geo-effective events and generate alerts
- Prediction of >10 MeV proton flux by a machine-learning algorithm

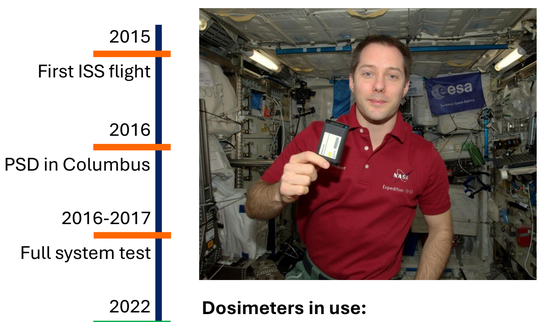
Key Region 2:
- Scientific measurement of space environment
- Study fundamental plasma physical process
- Anisotropy measurements with spinning satellite

ESA-PAD: Dosimeters for Human Spaceflight

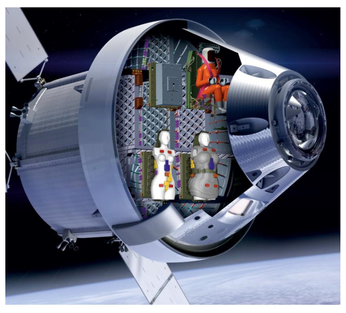
ASRO has been developing active dosimeters together with German Aerospace Center (DLR) since the mid 2010s. ASRO is currently acting as the prime contractor for the ESA Personal Active Dosimeter (ESA-PAD) project, whose aim is to deliver personalised dosimeters to European astronauts flying aboard the ISS, and Orion and later the lunar Gateway from Artemis III onwards.

Dimensions: 93 × 58 × 17 mm³
Mass: 120 g
Four sensors:
- I: Thin and Thick silicon diodes
- II: INSTADOSE©
- III: RadFET

Time resolution: 300 s
Battery capacity: 1100 mAh Li-ion
Operational time: 10.5 days



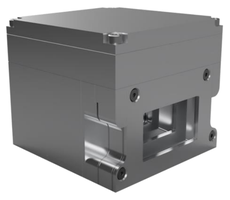
Dosimeters in use:
Astronaut Thomas Pesquet holding an EAD Mobile Unit aboard the ISS during his TechDemo personal dosimeter study in 2016-2017. Figure © ESA



Part of Artemis 1:
Five MUs were mounted to the walls to help validate the Orion spacecraft for future crewed exploration and inform future human spaceflight mission design. Figure from Nature vol. 634, pages 48-52 (2024)

SWM: ASRO's Space Weather Monitors

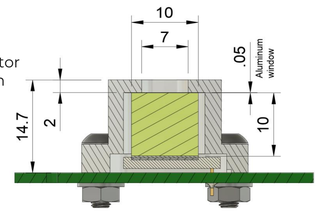
REPE – Relativistic Electron and Proton Experiment



Compact energetic particle instrument that detects electrons and protons over broad energy range

MIRA – Miniaturised Instrument for Radiation Analysis

Single-board radiation monitor with detector unit based on one scintillator photodiode combination



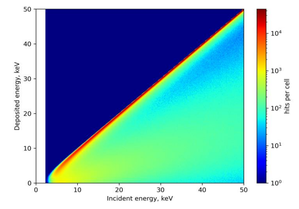
ASRO's radiation monitors

REPE
FELIX
MIRA
LEEVI

Solar X-ray spectrometer for measuring and characterising solar flares

FELIX – Flare Examination and Lookout in X-ray

Extension of REPE capabilities for Auroral electrons (3.5 – 50 keV)



LEEVI – Low Energy Electron Vigilance Instrument

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