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Online Time and Energy Resolved Flux Measurements of sub-MeV Charged Particles with the Zirè Low Energy Module (LEM) on the NUSES Space Mission

Observing and monitoring low-energy charged particles—from sub-MeV up to tens of MeVs—has become increasingly important for several reasons, impacting various fields of science. These range from radiation protection and the study of magnetosphere–lithosphere interactions to investigations of space weather and the interplay between the heliospheric environment and the magnetosphere. To address this wide array of scientific objectives, the Low Energy Module onboard the NUSES space mission has been developed.

NUSES is a planned space mission designed to test innovative approaches for studying low-energy cosmic rays, gamma rays, astrophysical neutrinos, space weather phenomena, and models of magnetosphere–ionosphere–lithosphere coupling. The NUSES satellite carries two payloads: Terzina and Zir\'e. Zir\'e, which measures protons and electrons up to a few hundred MeV, incorporates the Low Energy Module (LEM), a compact particle spectrometer mounted directly on the satellite's external top panel. The LEM is dedicated to measuring fluxes of low-energy electrons (0.1–7 MeV) and protons (3–50 MeV) in the Low Earth Orbit environment. Its compact dimensions and limited acceptance enable event-based particle identification even in high-radiation regions such as the South Atlantic Anomaly and the inner Van Allen belt, where electron fluxes can reach approximately 10^6 cm^{-2} s^{-1} sr^{-1}. The innovative features of the LEM include its extremely compact design—fitting within a $10\times10\times10$ cm^3 volume—and its active collimation technique, which effectively mitigates the challenges of multiple scattering (that typically prevent the use of standard tracking techniques) at low energies.

In this contribution, we present the geometry and detection concept of the Flight Model detector, its expected scientific performance, the data products that will be available in orbit, and the experimental results from the beam test campaign.

Collaboration(s)

On behalf of the NUSES Collaboration

Author: SCHLEDEWITZ, David (University of Trento)

Co-authors: NOZZOLI, Francesco (Universita degli Studi di Trento and INFN-TIFPA (IT)); NICOLAIDIS, Riccardo (Universita degli Studi di Trento and INFN (IT))

Presenter: SCHLEDEWITZ, David (University of Trento)

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