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## The Small Particle Recognition Kit for Low Energies (SPaRKLE) Onboard Space Rider: A Multi-Purpose Miniaturized Laboratory for Low-Energy Charged Particles and Gamma-Ray Physics

SPaRKLE (Small Particle Recognition Kit for Low Energies) is a compact detector designed for  $\gamma$ -ray and low-energy charged particle physics in Low Earth Orbit. The project is carried out by an interdisciplinary team of students from the University of Trento and has been selected for the ESA Academy Experiments Programme 2023–2024. SPaRKLE is currently in Phase C (Detailed Definition). Upon successful completion of its development stages, the SPaRKLE payload will be installed on the ESA Space Rider, the first European reusable uncrewed orbiting laboratory, for a mission lasting about two months. During this period, it will measure charged particle fluxes (electrons and protons) and investigate transient phenomena such as Gamma-Ray Bursts (GRBs) and Terrestrial Gamma-ray Flashes (TGFs).

Housed within a CubeSat unit, SPaRKLE features a Cerium-doped Gadolinium Aluminium Gallium Garnet (GAGG) scintillator calorimeter, silicon detectors, and plastic scintillator anti-coincidence detectors. This layout enables event-based particle identification as well as the detection of X-ray and  $\gamma$ -ray photons.

In this contribution, we provide an overview of the project and discuss its scientific, technological, and educational objectives. We also present the performance assessment of the instrument via Geant4 Monte Carlo simulations and show preliminary experimental characterization of the detectors.

## **Collaboration(s)**

SPaRKLE Team

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