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An innovative particle detector onboard the CSES-02 satellite

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The China Seismo-Electromagnetic Satellite (CSES) mission develops through a constellation of satellites, devoted to the study of the near-Earth environment, including electromagnetic fields, ionospheric plasma and particle populations. Each satellite - flying on a quasi-polar Sun-synchronous low-Earth orbit - is a multi-channel space observatory and hosts several instruments onboard.

One of its scientific instruments is the High Energy Particle Detector (HEPD), a sophisticated apparatus designed to identify and measure energy and arrival direction of cosmic particles in the MeV energy window, thus being a perfect detector for Space Weather purposes. This high-precision instrument is composed by several subdetectors: a tracker, a trigger system, a calorimeter made by a tower of plastic scintillators and an array of LYSO crystals and a veto system.

The first High Energy Particle Detector (HEPD-01) has been working since 2018 onboard the CSES-01 satellite.

HEPD-02 - subject of this contribution - presents important improvements with respect to its predecessor: it is the first instrument carrying a CMOS pixel tracker in space, designed to reach a 5 micron resolution; the LYSO crystals are the largest ever used in space; the new trigger system, providing trigger pre-scaling and concurrent trigger configurations, allows to adapt the data acquisition scheme depending on the orbital zone and on the presence of impulsive events. HEPD-02 will be hosted on the second satellite of the CSES mission, scheduled to fly at the beginning of 2024.

In this contribution I will focus on the design choices and the new technologies used for HEPD-02, and mention the test campaign for the instrument space qualification and calibration.

Primary author: Dr DE DONATO, Cinzia (Istituto Nazionale di Fisica Nucleare sezione "Roma Tor Vergata")

Presenter: Dr DE DONATO, Cinzia (Istituto Nazionale di Fisica Nucleare sezione "Roma Tor Vergata")

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