Contribution ID: **732** Type: **Talk**

The MoonRay concept of a high energy cosmic radiation telescope at the Moon

Thursday 17 July 2025 16:20 (15 minutes)

The MoonRay project is carrying out a concept study of a permanent lunar cosmic-ray (CR) and gamma-ray observatory, in view of the implementation of habitats on our satellite. The idea is to build a modular telescope that will be able to overcome the limitations, in available power and weight, of the present generation of CR instruments in Low Earth Orbit, while carrying out high energy gamma-ray observations from a vantage point at the South Pole of the Moon.
An array of fully independent modules (towers), with limited individual size and mass, can provide an acceptance one order of magnitude larger than instruments in flight or planned to be operative within the decade. The modular telescope is designed to be deployed progressively, during a series of lunar missions, while collecting meaningful scientific data at the intermediate stages of its implementation. The operational power will be made available by the facilities maintaining the lunar habitats.
With a geometric factor close to 15 m^2sr and about 8 times larger sensitive area than FERMI-LAT, MoonRay will be able to carry out a very rich observational program over a time span of a few decades with an energy reach of 10 PeV allowing the exploration of the CR "knee"and the observation of the Southern Sky with gamma rays well into the TeV scale.
Each tower is equipped with three instruments. A combined Charge and Time-of-Flight detector (CD-ToF) can identify individual cosmic elements, leveraging on an innovative two-layered array of pixelated Low Gain Avalanche Diode (LGAD) sensors, with sub-ns time resolution. The latter can achieve an unprecedented rejection power against back-scattered radiation from the calorimeter. It is followed by a tracker, providing also photon conversion, and by a thick crystal calorimeter (55 radiation lengths, 3 proton interaction lengths at normal incidence) with an energy resolution of 30-40% (2%) for protons (electrons) and a proton/electron rejection in excess of 10^5.
In this presentation, a time resolution close to 100 ps, obtained with prototypal arrays of 3mm x 3mm LGAD pixels, will be reported from a recent test campaign carried out at CERN with Pb beam fragments.

Collaboration(s)

Author: MARROCCHESI, Pier Simone (University of Siena and INFN Pisa)

Presenter: MARROCCHESI, Pier Simone (University of Siena and INFN Pisa)

Session Classification: CRD

Track Classification: Cosmic-Ray Direct & Acceleration