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CaloCube and "Tracker In Calorimeter" projects for the direct measurement of high energy charged astro-particles and gamma rays.

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Measurements of high energy cosmic rays in the "knee" region (about 10^15 eV) are currently available only with ground detectors: new observations of cosmic particles up to this energies with direct measurements are one of the main goals of the next generation space experiments. To achieve those aim, a large acceptance, good energy resolution and particle identification are needed. CaloCube is the design of a space borne calorimeter which is capable to accepts particles coming from any direction, increasing the acceptance with respect to traditional telescopes. A good performance for both hadronic and electromagnetic showers is achieved with a 3-D sampling capability: the basic picture of CaloCube is a cubic homogeneous calorimeter which consists of cubic scintillating crystals. MC simulations, concerning different materials and geometrical configurations, and several beam test with different versions of the CaloCube prototype have been employed to optimize both the detector design and the data analysis method. Taking advantage of the CaloCube project, the space experiment HERD ("High Energy Cosmic Radiation Detection") will include a large acceptance cubic calorimeter with cubic LYSO crystals. It will be installed on-board of the Chinese space station around 2025.
Beside the charged particle observations, high energy gamma rays provide direct information about the galactic cosmic ray sources. A new project named "Tracker In Calorimeter"(TIC) was approved by INFN in 2017 with the main purpose of the optimization of the calorimeter design for the reconstruction of the gamma ray direction, without the requirement of additional not homogeneous pre-shower detector. A TIC prototype was recently assembled and tested at the PS-CERN accelerator.

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