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CaloCube: a new-concept calorimeter for the detection of high-energy cosmic rays in space

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The direct observation of high-energy cosmic rays, up to the PeV region, will increasingly rely on a highly performing calorimetry apparatus, and the physics performance will be primarily determined by the geometrical acceptance and the energy resolution of the deployed calorimeter. Thus, it is extremely important to optimize its geometrical design, granularity, and absorption depth, with respect to the total mass of the apparatus, which is the most important constraint for a space launch.
Calocube is a homogeneous calorimeter whose basic geometry is cubic and isotropic, so as to detect particles arriving from every direction in space, thus maximizing the acceptance; granularity is obtained by filling the cubic volume with small cubic scintillating crystals. This design forms the basis of a three-year R&D activity which has been approved and financed by INFN.
A comparative study of different scintillating materials have been performed. Optimal values for the size of the crystals and spacing among them have been studied. Different geometries, beyond the cubic one, and the possibility to implement dual readout techniques have been investigated. A prototype, instrumented with CsI(Tl) cubic crystals, has been constructed and tested with particle beams. An overview of the obtained results will be presented and the perspectives for future space experiments will be discussed.

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