

CUBIC CALORIMETER FOR STUDY OF HIGH ENERGY COSMIC RAYS

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An hadronic calorimeter for the detection of high energy cosmic rays, optimized for a space experiment, is described in this paper. Making use of the fact that cosmic rays are isotropic and that the available aperture for experiments in near Earth orbit is more than 2π , our calorimeter is sensitive to all directions of arriving cosmic rays. This calorimeter has the shape of a cube and is made of consecutive alternating rows of logs. Each log has a plastic scintillator core with an outer shell made of high-Z material. This approach provides an increase of the geometrical factor by a factor of 2-3 with respect to the more conventional “flat” calorimeter where area is traded for depth.

We found that a face-to-face calorimeter thickness of $\sim 300\text{g/cm}^2$ is sufficient to provide energy resolution of 35-40%, independent of the density. To maximize the geometrical factor for a given available mass, we use low density material. Event selection is based on the measured particle path in the calorimeter after the first interaction. Our design leads to a calorimeter of “variable depth”. This approach leaves for the analysis the choice of trading collecting power against energy resolution.

For the ACCESS mission, the calorimeter is allocated approximately 3,000kg. For this mass, the geometrical factor of such calorimeter could be up to $5\text{ m}^2\text{sr}$, compared to less than $2\text{ m}^2\text{sr}$ for a “flat” calorimeter of the same mass. The ACCESS mission has a goal of extending the range of measured cosmic ray protons up to at least 10^{15}eV . This cubic calorimeter can extend the geometrical factor beyond the current baseline mission to provide improved statistical precision.