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Large-area high-altitude sampling calorimetry for cosmic rays: current potential and sensitivity

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Understanding the energy spectrum and the mass composition in the range 10 TeV - 10 PeV is crucial to establish a robust model of galactic cosmic rays. To do that, precise measurements are needed, with systematic uncertainties sufficiently low to discriminate among models. In this regard, the issues of the energy and the mass of the knee are scientific cases of particular importance. Contrary to what commonly thought today, experiments are still far to give compatible results, with differences larger than quoted uncertainties, related to detector features (high background, inefficiency) and analysis methods (selections, unfolding). Here we provide results based on the detailed simulation of a simple yet efficient experimental layout, using 1 radiation length of lead followed by 20 radiation lengths of soil, with increasing thickness to ensure sensitivity all over the energy range. Particular emphasis will be put on the sensitive layers of the device, made of Resistive Plate Chambers, never used for large-scale calorimetry up to now. The analog readout, based on a logarithmic amplifier, toghether with excellent time resolution (few hundreds ps), will allow to detect hadrons interacting within $\sim 100\mathrm{g/cm}^2$ from the detector surface, measuring single hadrons in the calorimeter as well as newborn showers with secondaries distinctively distributed in time and space. The approach entirely relies on well tested key-features of recent high-altitude extensive air shower detectors, which guarantee its feasibility. This contribution is intended to show that large-area high-altitude sampling calorimetry, suitably implemented, provides better sensitivity than any alternative approach attempted to date.

Collaboration

– not specified –

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