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New concept of very high energy cosmic ray observation by wide field-of-view telescope

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The chemical composition of the very high energy cosmic rays (VHECRs) is an important piece of information to investigate their origin and acceleration mechanism. Possible change of chemical composition at the knee energy range has been reported by air shower experiments based on sampling of muons or Cherenkov photons. So far low flux of VHECRs along with uncertainties due to indirect detection, has limited the precision of chemical composition measurement. It is thus essential to improve primary mass estimation via measurement of additional parameters of the air showers. In the present work, we propose a new concept of VHECR observation using ultra-wide field-of-view (FOV) refractive imaging atmospheric Cherenkov telescope (IACT). The wide-FOV optics have been designed in the
framework of JEM-EUSO mission for ultra-high energy cosmic ray (UHECR) observation from the International Space Station. The pathfinder experiments testing such optics have been successfully operated on the balloon and on the
ground. The technique of imaging of the Cherenkov light hasbeen used in GeV–TeV energies by IACT arrays using $\gg$ 10-m-scale reflective telescopes.
Above $\sim 10^{15}$~eV, the Cherenkov light from cosmic rays initiated air showers spreads over a few km that can be detected even by meter-scale telescopes. At these energies, Cherenkov images of distant air showers span $\sim 15^{\circ}$ and thus wide FOV otpics is necessary for their detection and
characterization. To evaluate potential performances of this concept, a large number of air showers were generated using CORSIKA packages. In the presentation, we introduce the basic concept of wide-FOV IACT technique for VHECR observation and characterize the performance of the sets for the chemical composition study. In addition, we discuss prospective advantages of EUSO-type
wide-FOV telescopes for VHECR and UHECR physics.

Collaboration

– not specified –

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