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Study of air shower reconstruction with asymmetric lateral distribution function for TAx4 SD

TAx4 is an extension of the detection area for ultra-high-energy cosmic ray observations in the Telescope Array experiment. In the TAx4 surface detector analysis, a lateral distribution function (LDF) is used to describe particle density as a function of distance from the air shower axis. The current TAx4 analysis assumes a symmetric LDF around the shower axis; however, this assumption may not be ideal for inclined air showers. Due to differences in the path lengths of air shower particles traveling through the atmosphere, the particle density at ground level may be asymmetric between the upstream and downstream regions of the shower axis. This asymmetry can affect the accuracy of primary particle energy estimation. In this study, we develop a functional model to account for air shower asymmetry, aiming to improve the precision of energy determination in the TAx4 surface detector analysis.

Collaboration(s)

Author: SAKAMOTO, Ryunosuke (Osaka Electro-Communication University)

Presenter: SAKAMOTO, Ryunosuke (Osaka Electro-Communication University)

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