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A Reconstruction Method for Extensive Air Shower Arrays Using Monte Carlo Based Templates with a Likelihood Approach

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Traditionally for the extensive air shower arrays, the reconstruction of the gamma-ray induced air showers properties: such as core, energy and the depth of the shower maximum (X_{max}) is done by the model-dependent fit of the observed lateral amplitude distribution. This approach has certain disadvantages owing to the limitations of the fit models and procedures. To ameliorate this, we present the functionality of a Monte Carlo template based likelihood fit method, its usability, and advantages over a model dependent fit method. In contrast to the model dependent fit methods, the shower properties are reconstructed by fitting the observed lateral amplitude distribution of a gamma-ray induced air shower against an expected probability distribution using a likelihood approach. Additionally, the goodness of fit of the method gives us the gamma-hadron rejection power. Finally, one crucial advantage of this method is its easy adaptability for the mixed type particle detector arrays. As an example, we show its working for the High Altitude Water Cherenkov (HAWC) gamma-ray observatory and combined with its upcoming upgrade with a sparse outrigger array.

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