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On the need for unbiasing azimuthal asymmetries in signals measured by surface detector arrays

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A surface detector array samples the lateral distribution of an extensive air-shower (EAS) at the ground, i.e. the density of particles as a function of the distance from the axis of the shower. The azimuthal symmetry of this measured lateral distribution is broken for EAS with a non-zero zenith angle. The resulting asymmetry, caused by atmospheric attenuation and geometrical effects, increases with the inclination of the shower and introduces a bias in the reconstruction of the shower parameters.
Using simulated sets of air-showers, we present a model to correct the azimuthal asymmetry in signals measured by water-Cherenkov detectors and exemplified using the geometry and detector response of the Pierre Auger Observatory. Testing showers initiated by proton and iron primaries using EPOS-LHC and QGSJetII-04 as hadronic models, we developed a fine-tuned model of the amplitude of the asymmetry as a function of the zenith angle, shower size and distance of a detector from the shower axis. The improvements resulting from the application of the correction are quantified in terms of the biases and resolutions in the impact-point and arrival direction.

Keywords

asymmetry, lateral distribution function, energy estimation, models of hadronic interactions, simulation of extensive air showers

Collaboration

other Collaboration

Subcategory

Theoretical Methods

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