

Reconstruction of Nearly-Horizontal Muons in the HAWC Observatory

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The volcanoes surrounding the HAWC observatory provide varying material depths from open sky to over 15 km of rock for nearly-horizontal muon trajectories. The measurement of the rate of muons as a function of arrival direction near the horizon thereby provides a means to measure the muon flux as a function of material depth. A Hough transform algorithm is used to identify nearly-horizontal muons traversing the HAWC observatory by finding a line in the 3d point cloud of PMT hits ($x_{\{i\}}$, $y_{\{i\}}$, and $ct_{\{i\}}$). The arrival direction of the muon can be estimated from this line. Background Extensive Air Shower (EAS) fragments are identified by the presence of a lateral extension of PMT hits in a plane normal to the muon candidate trajectory. A geometry-based simulation has been developed to improve and estimate arrival direction reconstruction resolution and effective area. A description of the reconstruction techniques and estimates of detector resolution, backgrounds, and effective area as a function of arrival direction, will be provided.

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