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Bonds for detection of very inclined “old” shower due to anti-aliasing filter in the Pierre Auger surface detector data acquisition system

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At large zenith angles the slant atmospheric depth to the ground level is sufficient to absorb the early part of the shower that follows from the standard cascading interactions, both of electromagnetic and hadronic type. Nucleon induced showers are initiated at the top of the atmosphere. For very inclined showe only muons in showers survive. The fronts of deeply penetrating muon showers have only a small longitudinal extension, which leads to short detector signals. “Old”showers generate short traces of very similar shapes at all core distances.

Inclined showers mainly composed of muons, allow a direct measurement of the muon content at ground level and as a consequence, they can be used to study mass composition and to test high-energy hadronic interaction models. The Pierre Auger Observatory is particularly well suited for the detection of inclined showers because the water Cherenkov tanks used for the surface detector act like volume detectors.

The standard data acquisition system quantizing the analog signals in ADCs, according to the “Golden rules”, is equipped with the anti-aliasing filter with the cut-off Nyquist frequency. However, very short pulses, typical for very inclined showers, are significantly suppressed by the anti-aliasing filter and their amplitude may be not enough to generate the 3-fold coincidence trigger.

The paper presents the theoretical analyses of the anti-aliasing Auger filter response as well analyses of measured Auger data. We conclude that for a detection of non-standard rare events maybe it is worth considering non-standard approach and resign with the standard Golden rules.

Minioral

Yes

Description

Anti-alias filter

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