Muons as a tool for background rejection in imaging atmospheric Cherenkov telescope arrays

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The presence of muons in air-showers initiated by cosmic ray protons and nuclei is well established as a powerful tool to separate such showers from those initiated by gamma-rays. However, so far this approach has been fully exploited only for ground level particle detecting arrays.

We explore the potential for muon detection with imaging atmospheric Cherenkov telescopes (IACTs) as a tool for background rejection by characterizing the number of muons that are detectable by a large Cherenkov telescope in proton- and gamma-initiated showers of different energies.

We implement an analytical model of the Cherenkov light from individual muons to allow rapid simulation of a large number of showers in a hybrid mode. Because of this, we are able to explore the muon-poor shower regime, which constitutes the irreducible background of the muon-tagging approach.

We find that, for IACT arrays with at least one large (>20 m) telescope, efficient muon identification can lead to background rejection powers of up to 10^{-5} above tens of TeVs while maintaining a relatively high gamma-ray efficiency.