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Combining Hough Transform and Optimal Filtering for Efficient Cosmic Ray Detection with a Hadronic Calorimeter

The hadronic calorimeter of ATLAS, TileCal, provides a large amount of readout channels (about 10,000). Therefore, track detection may be performed by TileCal when cosmic muons cross the detector. The muon track detection has extensively been used in the TileCal commissioning phase, for both energy and timing calibrations, and it will also be important for background noise removal during nominal LHC operation.
This work presents a cosmic ray detection algorithm based on TileCal information. The algorithm employs the Hough Transform to map the data from activated calorimeter cells into a parameter (straight-line track) space, in which detection is effectively performed. Due to intrinsic low signal-to-noise ratio for cosmic ray detection with TileCal, a preprocessing algorithm based on a matched filter operating over TileCal time sampled signals is implemented to improve detection efficiency. Experimental data shows that the proposed method possesses extensive efficiency superiority over straight-line fitting produced by least-square methods.

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