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Quality Factor for the Hadronic Calorimeter in High Luminosity Conditions

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The Tile Calorimeter (TileCal) is the central section of the hadronic calorimeter of ATLAS experiment and has about 10,000 electronic channels. An Optimal Filter (OF) has been used to estimate the energy sampled by the calorimeter and applies a Quality Factor (QF) for signal acceptance. An approach using Matched Filter (MF) has also been pursued.

In order to cope with the luminosity rising foreseen for LHC operation upgrade, different algorithms have been developed. Among them, the Constrained Optimal Filter (COF) is showing good capacity in handling such luminosity rise by using a deconvolution technique, which recovers physics signals from out of time pile up. When pile up noise is low, COF switches to MF estimator for optimal performance.

Currently, the OF measure for signal acceptance is implemented through a chi-square test. At a low-luminosity scenario, such QF measure has been used as a way to describe how the acquired signal is compatible to the pulse shape pattern. However, at high-luminosity conditions, due to pile up, this QF acceptance is no longer possible when OF is employed, and the QF becomes a parameter to indicate whether the reconstructed signal suffers or not from pile up. As COF recovers the original pulse shape, the QF may be used again as signal acceptance index.

In this work, a new QF measure is introduced. It is based on divergence statistics, which measures the similarity of probability density functions. The analysis of QF measures in deconvolved pulses is performed and the chi-square measure is compared to the divergence index. Results are shown for high-luminosity Monte Carlo data.

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