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Photon Reconstruction and Identification with the ATLAS Detector

The understanding of the reconstruction of photons will be one of the key issues at the start-up of data-taking with the ATLAS experiment at the LHC in 2009. Large statistics of photons produced in association with jets are expected over a wide range of ET, from 20 GeV to several hundred GeV. These will be used as an important in situ calibration tool for the jet energy scale.

The energy measurement of unconverted photons is based on the electromagnetic calorimetry over the full relevant energy range (10 GeV to a few TeV). The electromagnetic calorimeter cluster algorithm starting from electronically calibrated calorimeter cells will be described. Local position and energy variations are corrected for. A refined calibration procedure, developed and validated over years of test-beam data-taking and analysis, strives to identify all sources of energy losses upstream of the calorimeter and outside the cluster and corrects for them one by one (using Monte-Carlo). Unconverted photons require a specific calibration depending on the conversion radius to reach the optimal linearity and resolution.

The construction tolerances and the calibration system ensure that the calorimeter response is locally uniform to ˜ 0.5%.
Z to ee events, using the precisely known Z-boson mass as a constraint, will be used for in-situ calibration to achieve the desired global constant term of 0.7%. To achieve this the material in front of the calorimeter will have to be mapped out precisely using other methods, one of which involves low-energy photon conversions.

The photon reconstruction is based on a calorimeter-seeded algorithm which classifies as photons those candidates which have no matching prompt track. These are subdivided into unconverted photon candidates without any matching conversion candidate and converted photon candidates, which contain one or more matching conversion candidates.
The reconstruction of converted photons will be described and the expected efficiency versus conversion radius will be presented. Converted photons can provide further discrimination against the residual background from hadronic jets which consists mostly of isolated pi0's.

The photon identification is based almost exclusively on the shower shapes in the calorimeter. The goal is to achieve the required rejection of $10^3 - 10^4$ against QCD jets in the moderate pT region of 20 to 100 GeV, which is the relevant one for Higgs to gamma-gamma searches. The photon identification methods and their performance will be discussed. While the baseline identification will rely initially on simple cut-based analyses, powerful multivariate techniques, such as LogLikelihood and the H-matrix, have also been explored and the gain expected from them has been quantified.

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