**INTRODUCTION TO e/γ IN ATLAS**

In order to acquire the full physics potential of the LHC, the ATLAS electromagnetic calorimeter must be able to identify photons and electrons at energies in the wide range of 5 GeV to 5 TeV. The reconstruction of an electromagnetic object begins in the calorimeter, and the inner detector information determines whether the object is a photon - either converted or unconverted - or an electron. The photon identification method presented here is a cut-based method, which is one of several methods developed in ATLAS. 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 in 2009. Large statistics of photons produced in association with jets are expected, which will be used as an important in situ calibration tool for the jet energy scale.

**PHOTON/JET DISCRIMINATION**

The main source of high \( p_T \) isolated photons at the LHC comes from QCD processes, with di-jet events as the dominant background. The separation between the photons and the fake photons resulting from the jets, is based on their characteristic features. In the electromagnetic calorimeter, photons are narrow objects, well contained in the electromagnetic calorimeter, while fakes exhibits a broader profile and can deposit a substantial fraction of their energy in the hadronic calorimeter. Hadronic leakage as well as longitudinal and transverse shower shape variables can therefore be used to efficiently reject jets. At this stage of the identification process, the converted and unconverted photons are treated equally. A few of the selection variables for signal and background before cuts are displayed below (|\( \eta \)| < 0.7 and 20 < \( E_T \) < 30 GeV):

- **Hadronic leakage**: ratio of transverse energy in the first layer of hadronic calorimeter to the transverse energy of the cluster.
- **Energy difference between the 2nd maximum and the minimum reconstructed energy between 1st and 2nd maximum in the strips**.

**TRACK ISOLATION**

After the calorimeter cuts are applied, the contamination of the signal from charged hadrons is significantly reduced. The remaining background is dominated by low track multiplicity jets containing high \( p_T \) \( \pi^0 \) mesons. In order to remove the resulting fake photons, track isolation is used. The variable is defined as the sum of the \( p_T \) of all tracks with \( p_T > 1 \) GeV within AR < 0.3, where AR is the \( \eta - \phi \) distance between the track position at the vertex and the cluster centroid. Track \( p_T > 1 \) GeV is imposed to minimize the effect of pile-up and underlying events. Tracks from photon conversions must obviously first be excluded from this variable, which is accomplished through additional selection requirements.

**PHOTON IDENTIFICATION PERFORMANCE**

The table below summarizes the average efficiencies of the calorimeter and track isolation cuts.

<table>
<thead>
<tr>
<th>Efficiency</th>
<th>r (calorimeter cut)</th>
<th>r (track isolation cut)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normalized geometry no pileup</td>
<td>0.67(0.02)%</td>
<td>(0.00(0.1)%</td>
</tr>
<tr>
<td>Normalized geometry with pileup</td>
<td>0.61(0.5)%</td>
<td>(0.00(0.2)%</td>
</tr>
<tr>
<td>Distorted geometry with pileup</td>
<td>0.61(0.2)%</td>
<td>(0.01(0.1)%</td>
</tr>
</tbody>
</table>

The plot shows the fake rate, defined as the inverse of the rejection, as a function of pseudorapidity for all jets with \( E_T > 25 \) GeV. There is a small increase for higher |\( \eta \)| due to the increase in material in front of the calorimeter, which imposes slightly looser cuts to preserve a constant efficiency.

**CONCLUSION**

The performance of the ATLAS electromagnetic calorimeter and tracker have been extensively studied with simulation analysis, test beam data-taking and recently cosmic ray data in order to identify all sources of energy losses upstream of the calorimeter and outside the cluster. Detailed Monte Carlo studies have shown that currently available photon identification are adequate for physics analysis in rejecting background while retaining photons with high efficiency. It is, however, of crucial importance to reevaluate the identification performance with beam-collision data.