ATLAS Muon Reconstruction Efficiency

William Spearman
Harvard University

ABSTRACT

Di-muon decays of J/ψ mesons and Z bosons have been studied to use the muon reconstruction and identification efficiency of the ATLAS detector as a function of the muon transverse momentum, from p_T=4 GeV to p_T=100 GeV, and the number of inelastic collisions per event. The results show a steep efficiency turn-on curve reaching its plateau value of 100% at p_T = 6 GeV and no dependence of the muon reconstruction efficiency on the pile-up level. The studies also reveal that the use of inner detector tracks allows us to distinguish between isolated muons and non-isolated muons produced in jets with high separation power even at the highest pile-up levels.

EFFICIENCY FROM J/ψ AND Z EVENTS

Tag and Probe
- Select events with a triggered muon and a track the invariant mass of which is consistent with a resonance, J/ψ or Z, decaying to muons.
- If the triggered muon is well reconstructed, select it as the tag.
- The track becomes the probe.

The efficiency is the number of reconstructed probes (matched) divided by the total number of probes [matched-unmatched].

The event display shows two muons with p_T of 26 GeV and 15 GeV consistent with a boosted J/ψ-Wγ. The separation, ΔR, for such events is relatively small but to avoid a trigger bias at ΔR ≈ 0.3 is used to prevent the two muons from appearing in the same trigger Region of Interest (ROI).

MUON p_T THRESHOLDS FOR 2011 ATLAS ANALYSES

LOW p_T: MUON EFFICIENCY: J/ψ

COMBINED AND COMBINED + SEGMENT TAGGED EFFICIENCY

Below 30 GeV: muon efficiencies and scale factors measured using J/ψ Tag and Probe.

Tag: Chain 1 combined muon.
Probe: a calorimeter-tagged muon from the barrel region.

Efficiency: plateau at p_T≈6 GeV.

PILE UP IN 2011

Efficiency Dependence on Run Period in 2011
- In 2011, p+p collisions form a center of mass energy of 7 TeV.
- The beam was squeezed in September in [8 = 1.5 m to 8 = 1.0 m] leading to a higher mean number of interactions per crossing.
- Blue line: operating conditions before September.
- Red line: operating conditions after September.

Isolation Efficiency

Muon isolation is required by many physics analyses. As a result measuring the muon isolation scale factors is necessary to properly model the effect of isolation cuts.

Track Isolation: Little pile-up dependence.
Calorimetric Isolation: Some pile-up dependence but good agreement between data and MC.

PLHC 2012 4-9 June, Vancouver