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Alignment of the ATLAS Muon Spectromter with Tracks and Muon Identification at High Luminosities

The ATLAS muon spectrometer consists of three layers of precision drift-tube chambers in an air-core toroid magnet system with an average field of 0.4 T. The muon momenta are determined with high accuracy from the measurement of the sagitta of the muon tracks in the three chamber layers. In order
to achieve the required momentum resolution of the muon spectrometer of better than 4% for transverse momenta below 400 GeV/c and of 10% at 1 TeV/c,
the relative positions of the muon chambers are measured by a system of optical sensors with an accuracy of 30 μm. In order to verify the correctness of the optical alignment, a method has been developed to measure the relative chamber positions with muon tracks which are recorded during the operation
of the experiment. For muons of pT < 40 GeV/c the momenta can be determined with high-enough precision independently of the relative misalignment
of the chambers from the comparison of the local track direction measurements in the individual chamber layers. This method allows for monitoring of the chamber positions with an accuracy of about 30 μm in time intervals of a
few hours during LHC operation.
During the operation of the experiment the chambers will be exposed to a high flux of neutrons and γ rays which may lead to occupancies of up to 20%.
Even higher occupancies are expected for a possible luminosity upgrade of the
LHC. We investigated on test-beam measurements at the Gamma-Irradiation
Facility at CERN and Monte-Carlo data how pattern recognition algorithms can cope with the increased hit rates.

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