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Track based alignment of the ATLAS Inner Detector tracking system

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ATLAS is a multipurpose experiment that records the LHC collisions. In order to reconstruct trajectories of charged particle, ATLAS is equipped with a tracking system built using different technologies, silicon planar sensors (pixel and microstrips) and drift-tube detectors. In order to achieve its scientific goals, the ATLAS tracking system requires to determine accurately its almost 700,000 degrees of freedom. The demanded precision for the alignment of the silicon sensors is below 10 micrometers. This implies to use a large sample of high momentum and isolated tracks. The high level trigger selects and stores those tracks in a calibration stream. Tracks from cosmic trigger during empty LHC bunches are also used as input for the alignment.

The implementation of the track based alignment within the ATLAS software unifies different alignment approaches and allows the alignment of all tracking subsystems together. Primary vertexing and beam spot constraints have been implemented, as well as constraints on the particle momentum as measured by the Muon System. As alignment algorithms minimize the track-hit residuals, one needs to solve a linear system with thousands of DoF. The alignment jobs are executed at the CERN Analysis Facility. The event processing runs parallel jobs. The output matrices from all jobs are added before solving.

We will present the results of the alignment of the ATLAS tracker using data recorded during 2010 and 2011 using the LHC proton-proton collision runs at 7 TeV. Validation of the alignment was performed by measuring the alignment observables as well as many other physics observables, notably resonance invariant masses in a wide mass range (K0s, J/ψ and Z decays in to μ+μ-) and the effect of detector systematic distortions on their invariant mass and μ momentum. Also the E/p for electrons has been studied. The results of the alignment with real data reveal that the precision of the alignment constants is approximately 5 microns.

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