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The Alignment of the CMS Silicon Tracker

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he CMS all-silicon tracker consists of 16588 modules, embedded in a solenoidal magnet providing a field of B = 3.8 T. The targeted performance requires that the alignment determines the module positions with a precision of a few micrometers. Ultimate local precision is reached by the determination of sensor curvatures, challenging the algorithms to determine about 200k parameters simultaneously, as is feasable with the Millepede II program. The main remaining challenge are global distortions that systematically bias the track parameters and thus physics measurements. They are controlled by adding further information into the alignment workflow, e.g. the mass of decaying resonances or track data taken with B = 0 T. To make use of the latter also to integrate the determination of the Lorentz angle into the alignment procedure, the alignment framework has been extended to treat position sensitive calibration parameters. This is relevant since due to the increased LHC luminosity in 2012, the Lorentz angle exhibits time dependence. Cooling failures and ramping of the magnet can induce movements of large detector sub-structures. These movements are now detected in the CMS prompt calibration loop to make the corrections available for the reconstruction of the data for physics analysis. The geometries are finally carefully validated. The monitored quantities include the basic track quantities for tracks from both collisions and cosmic muons and physics observables.

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