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A System for Monitoring and Tracking the LHC Beam Spot within the ATLAS High Level Trigger

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The parameters of the beam spot produced by the LHC in the ATLAS interaction region are computed online using the ATLAS High Level Trigger (HLT) system. The high rate of triggered events is exploited to make precise measurements of the position, size and orientation of the luminous region in near real-time, as these parameters change significantly even during a single data-taking run. We present the challenges, solutions and results for the online determination, monitoring and beam spot feedback system in ATLAS. A specially designed algorithm, which uses tracks registered in the silicon detectors to reconstruct event vertices, is executed on the HLT processor farm of several thousand CPU cores. Monitoring histograms from all the cores are sampled and aggregated across the farm every 60 seconds. The reconstructed beam values are corrected for detector resolution effects, measured in situ from the separation of vertices whose tracks have been split into two collections. Furthermore, measurements for individual bunch crossings have allowed for studies of single-bunch distributions as well as the behavior of bunch trains, calibrated to the beam average. Run control invokes a comparison of the nominal and measured beam spot values, and when threshold conditions are satisfied the farm configuration is updated. To achieve sharp time boundaries across the event stream, which is triggered at rates of several kHz, a special datagram is injected into the event path via the Central Trigger Processor that signals the pending update to the trigger nodes. Thousands of clients then fetch the same set of values from the conditions database in a fraction of a second via an efficient near-simultaneous access made possible through a dedicated CORAL Server and Proxy tree.

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