Online Status and Settings Monitoring for the LHC Collimators*

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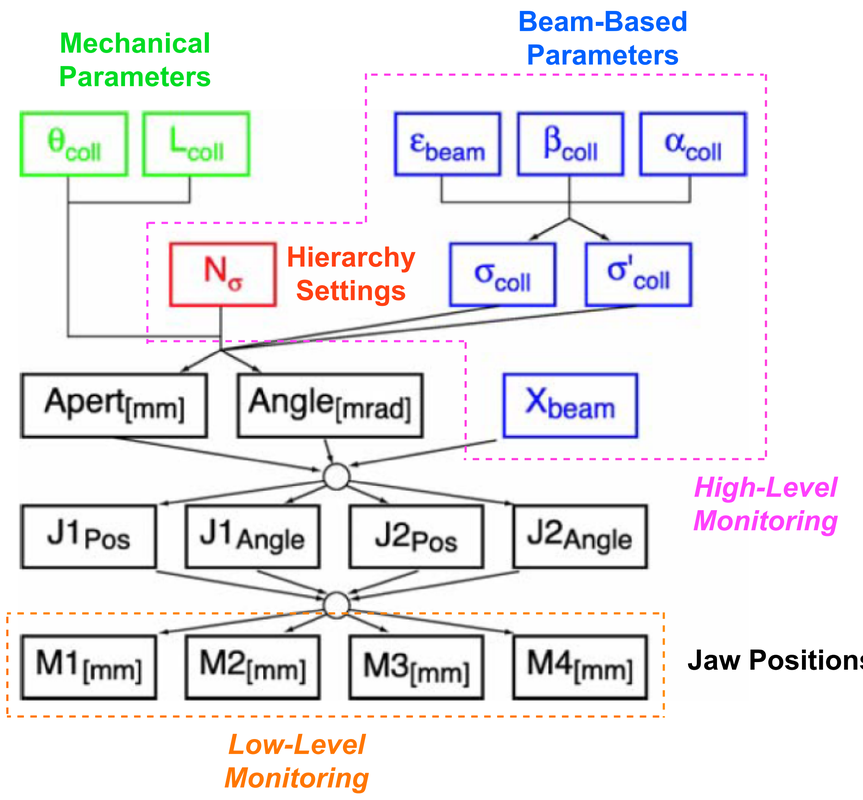
Abstract

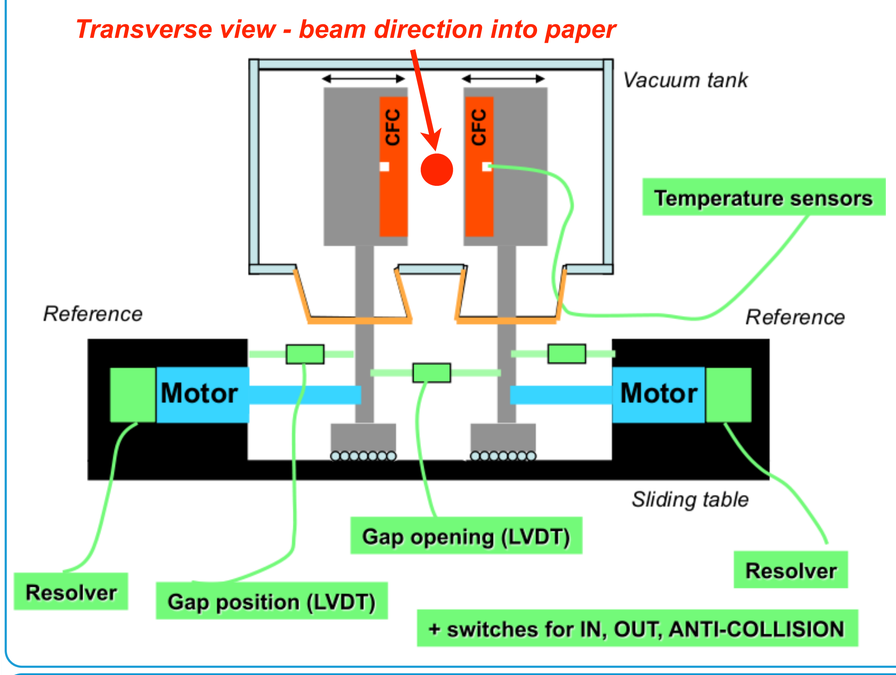
The Large Hadron Collider is equipped with 100 movable collimators. The LHC collimator control system is responsible for the accurate synchronization of around 400 axes of motion at the microsecond level, and with the precision of a few micrometres. The status and settings of the collimators can be monitored by three displays in the CERN Control Center, each providing a different viewpoint onto the system and a different level of abstraction, such as the positions in mm or beam size units. Any errors and warnings are also displayed. In this paper, the display operation is described, as well as the interaction that occurs when an operator is required to identify and understand an error in the collimator settings.

Collimator Parameter Space



- Beam-based parameters have to be measured via beam-based collimator alignment [3] at 4 stages: injection (450 GeV), flat top, squeezed beams, colliding beams (top energy).
- Functions are generated to ensure that the collimators are always at the optimal positions during dynamic changes of configuration.
- The jaw positions are interlocked at all times, and the settings must be continuously monitored.

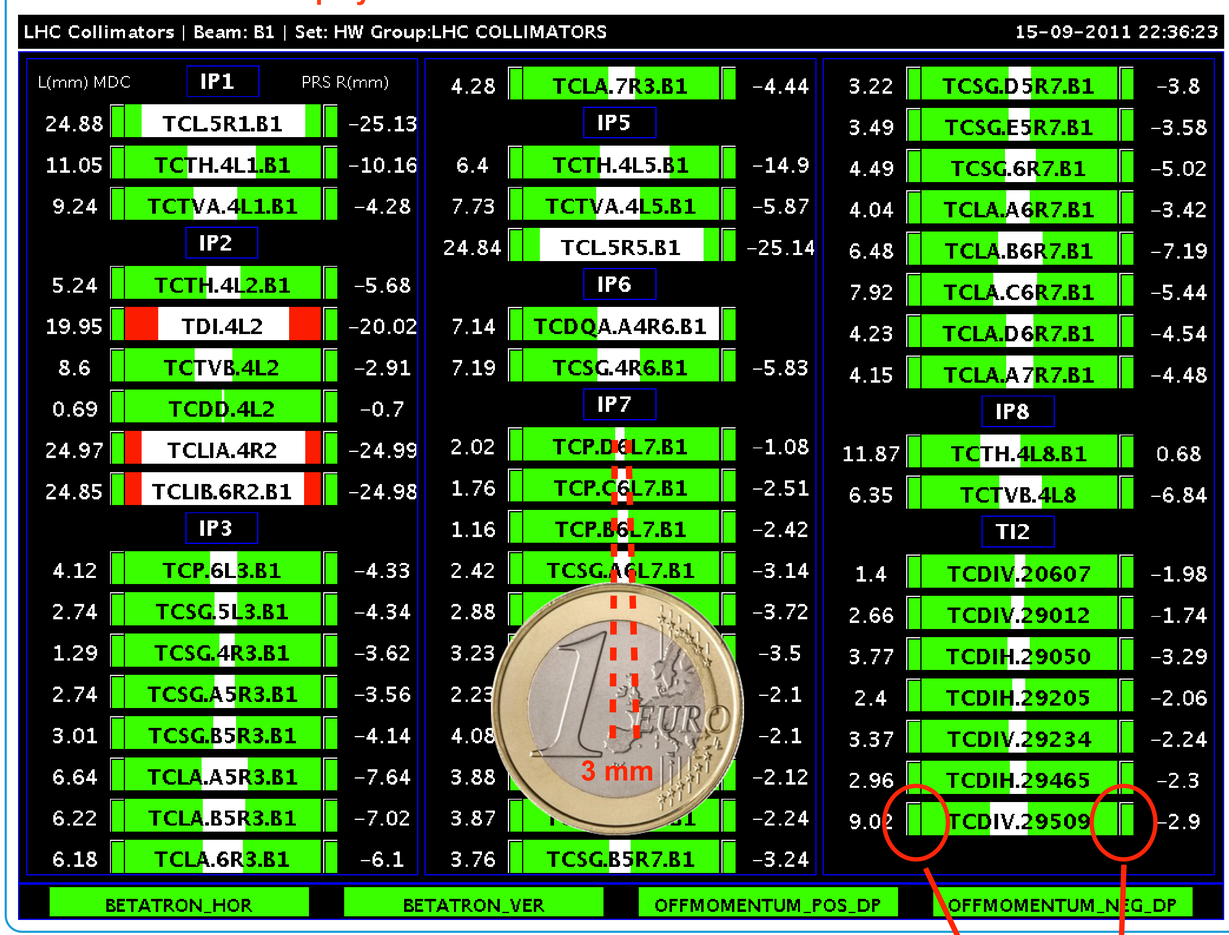
LHC Collimator



- 86 collimators are installed in the 27 km LHC ring [1].
- Each of the four jaw corners can be moved individually by a dedicated stepping motor. Jaw movement requests are sent via the Motor Drive Control (**MDC**) PXI-based module.
- Linear Variable Differential Transformers (LVDTs) provide an independent measurement of the jaw positions as well as the jaw gap, via the Position Readout Survey (**PRS**) module.
- Four resolvers count the steps of each motor.
- A total of 400 axes of motion to be continuously monitored [2].

Low-Level Monitoring

Collimator Fixed Display

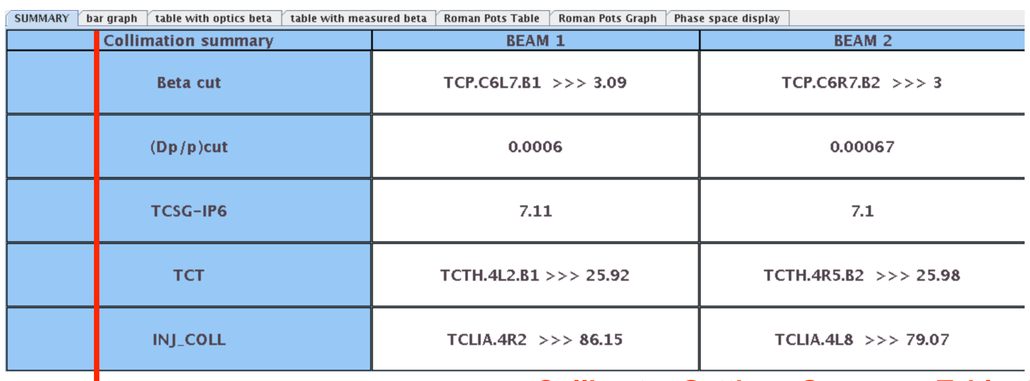


Collimator Status

Red: Error
Green: OK
Yellow: Warning
White: Gap Indication

- Online Monitoring of collimator jaw positions, collimator and MDC + PRS statuses.
- Collimators divided by location, one screen for each beam.
- Available on the web and in the CERN Control Center.

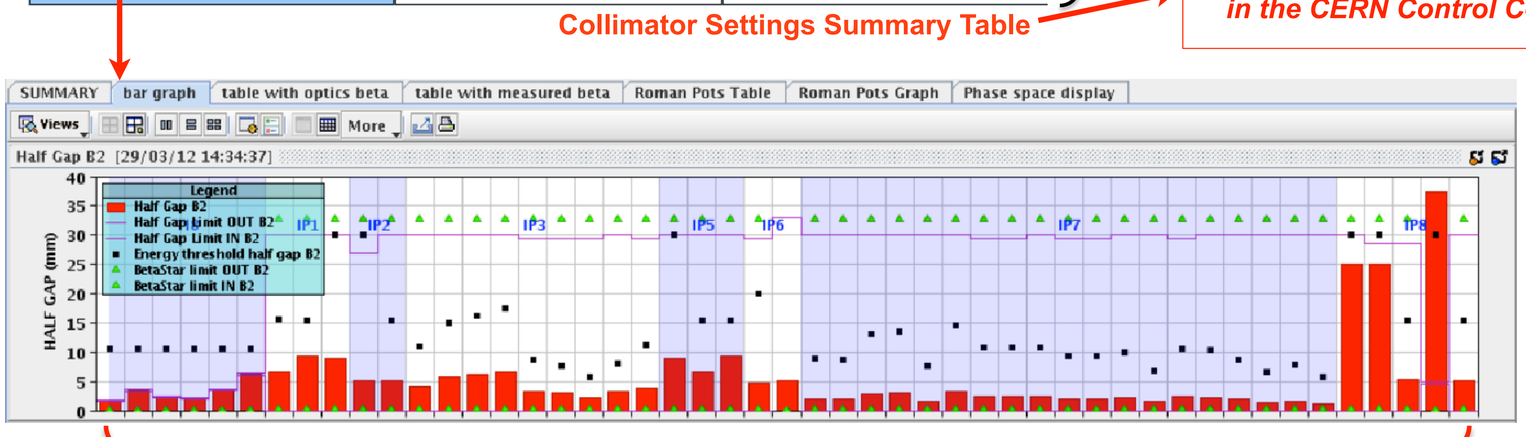
High-Level Monitoring



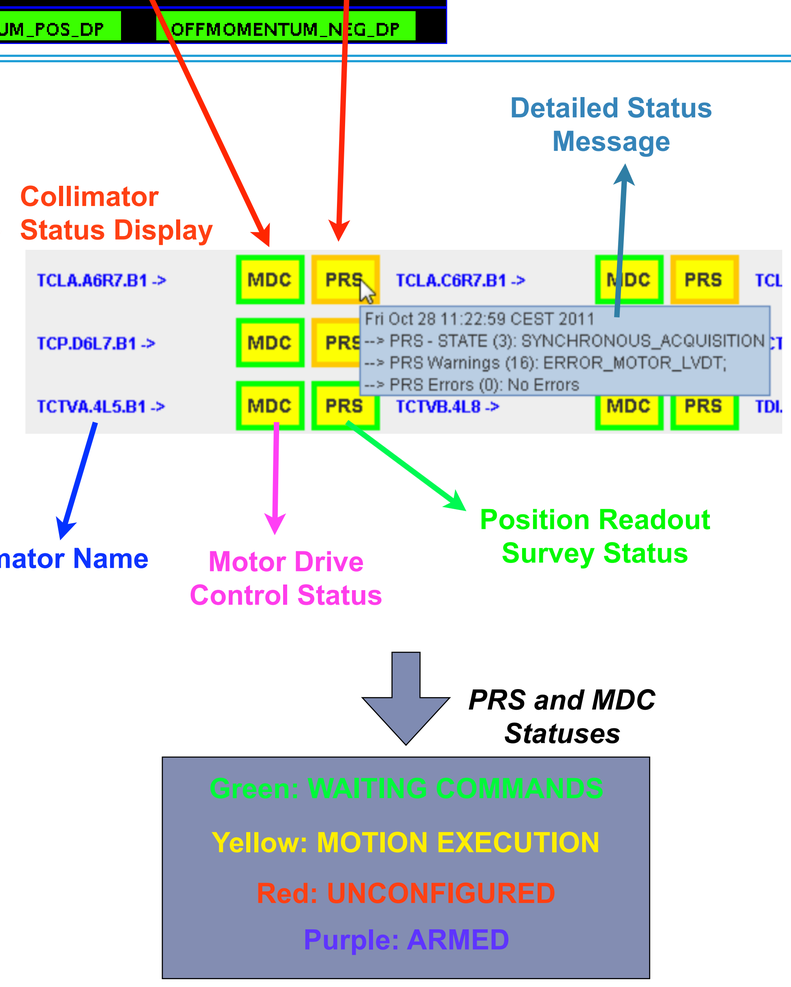
N_σ settings in beam σ for different collimator groups

Collimator Settings Summary Table

Both GUIs available to operators in the CERN Control Center



Collimator Gaps in mm or sigma



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[3] G. Valentino, R. W. Assmann, R. Bruce, S. Redaelli, A. Rossi, N. Sammut, D. Wollmann, "Semi-automatic beam-based LHC collimator alignment", *Phys. Rev. ST Accel. Beams* **15**, 015002 (2012).

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