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High precision TFPX-TBPX adjustable mechanical connection for the Phase II installation of the CMS Inner Tracker

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During LHC Phase II, the CMS tracker will be updated to increase its performance given by the higher luminosity. One of the goals of this upgrade is to cover the maximum surface and to not leave gaps around the interaction point, to increase the global performance of the detector. In order to reach it, TBPX (Tracker Barrel Pixel) design is divided into two halves, staggered layer by layer, to cover the whole area around the interaction point with sensors. Due to the high precision required for the position of the sensors, the connection between separate parts becomes critical. Indeed TBPX, the closest structure to the interaction point, is connected to TFPX (Tracker Forward Pixel), a longer system which reaches its final position sliding on rails, supporting TBPX in cantilevered way. To avoid collision between layers of different halves, a tunable connection to decouple the two structures has been realized. Such connection allows TBPX positioning with respect to a precise reference system, independently from the TFPX position.
This talk presents the design solution to manage the position and orientation regulation, the connection details to reach the proper required precision, and to solve many constraints due to lack of space, high rigidity and low mass, radiation hard and low thermal expansion materials. Furthermore, it will be explained the criteria chosen to pass from the orientation extrapolation by the measurements to the regulation estimation in order to reduce the number of adjustments needed. For such a design it was taken into account the installation procedure and environment, which affects the mounting criteria.
Also presented will be the changes done to the structures in order to implement the new connection, to facilitate the manufacturing aspect of the structure.
Finally, this connection has been realized and tested in a clean room under a measuring machine, to validate its precision. This design allows to reach manually a positioning precision below 50 microns, and an angular precision below 0.1 degrees, decreasing potential misalignment.

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