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CMS Tracker Alignment activities during LHC Long Shutdown 2

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The innermost tracking system of the CMS experiment, called the tracker, consists of two tracking devices, the Silicon Pixel and Silicon Strip detectors. The tracker was specifically designed to very accurately determine the trajectory of charged particles or tracks. This is achieved by ensuring an accuracy or so-called intrinsic resolution on the position measurement of the electrical signals registered in the detector modules as the particles pass through the tracker layers of 10 to 30 μm. The high-quality track reconstruction, in turn, paves the way for precise primary and secondary vertex reconstruction.

The closest detector in proximity to the interaction point, the Silicon Pixel detector, deals with the highest intensity of particle collisions and, therefore, suffers more extensively the effects of the radiation damage. To tackle these effects, the pixel was extracted from the CMS experimental cavern, underwent extensive repairs, was provided of a new innermost layer, and reinstalled during the LHC Long Shutdown 2. After the reinstallation, the accuracy in the knowledge of the geometrical position of the pixel modules needed to be improved, to reach the precision of the intrinsic resolution of the sensors stated above. This, together with the movements of the structures of the Silicon Strip detector driven by the maintenance work during the shutdown, made it necessary to correct the position, orientation, and curvature of the tracker modules in a process known as tracker alignment.

The strategies for and the performance of the CMS tracker alignment during the 2021-2022 LHC Commissioning preceding the Run 3 data-taking period are described. The results of the very first tracker alignment after the pixel reinstallation, performed with cosmic ray muons recorded at 0T magnetic field are presented. Also, the performance of the first alignment of the commissioning period with collision data events, collected during pilot test beam at a center of mass energy of 900 GeV, is presented. Finally, the tracker alignment effort during the final countdown to LHC Run 3 is discussed.

In-person participation

Yes

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