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The CMS Precision Proton Spectrometer timing system: precision timing with scCVD diamond crystals.

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In the last few years, fast timing detectors have become more and more important for high energy physics and for technological applications. The CMS Proton Precision Spectrometer (PPS), operating at the LHC, makes use of 3D silicon tracking stations to measure the kinematics of protons scattered in the very forward region, as well as timing detectors based on planar single crystal CVD diamond to measure the proton time-of-flight with high precision. The time information is used to reconstruct the longitudinal position of the proton interaction vertex and to suppress pile-up background. To move PPS detectors closer to the circulating LHC beams they are housed in special movable vacuum chambers, the Roman Pot, placed in the beam pipe. A novel architecture with two diamond sensors read out in parallel by the same electronic channel had been used to enhance the timing performance of the detector. A dedicated amplification and readout chain had been developed to sustain particle fluency of $\sim$1 MHz/channel. The PPS timing detector has operated demonstrating its capability to reconstruct the interaction vertex and to be used to suppress pile-up background. In Run 2 detectors were exposed to a highly non-uniform irradiation, with local peaks above 10^{16}neq/cm^2, a similar value is expected in the future in Run 3. LHC data and subsequent test beam results show that the observable radiation damage only led to a moderate decrease of the detector timing performance. We will present the PPS timing system in detail. Detector Performance in Run2 will be reported, inclusive of the recent studies of radiation effects. The timing system has been upgraded and new detectors packages are currently being installed, with the goal of reaching an ultimate timing resolution of better than 30 ps on protons in the TeV energy range.

Collaboration

CMS and TOTEM

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