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Commissioning Experience and Upgrade Plans of the Pixel Luminosity Telescope for Luminosity Measurement at CMS

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The Pixel Luminosity Telescope (PLT) is a dedicated system for luminosity measurement at the CMS experiment using silicon pixel sensors. It was installed during LS1 and has been providing luminosity measurements throughout Run 2. The online bunch-by-bunch luminosity measurement employs the "fast-or" capability of the pixel readout chip (PSI46) to quickly identify likely tracks at the full 40MHz interaction rate. In addition, the full pixel information is read out at a lower rate, allowing for more detailed offline analysis. In this talk, we will present details of the commissioning and operational history of the currently installed hardware and experience with offline analysis, in addition to upgrade plans for LS2.

Summary

The Pixel Luminosity Telescope (PLT) is a dedicated system for luminosity measurement at the CMS experiment using 48 silicon pixel sensors arranged into 16 "telescopes", each consisting of three planes. The PLT was installed during LS1 at the beginning of 2015 and has been providing online and offline luminosity measurements throughout Run 2. The PLT is located outside the CMS pixel endcaps, with eight telescopes on either side of CMS installed around the beampipe. The silicon sensors and PSI46 pixel readout chips are the same as used in the CMS pixel detector.

The online bunch-by-bunch luminosity measurement exploits the "fast-or" capability of the PSI46 readout chip, not used by the CMS pixel detector, which reads out a signal indicating if any of the pixels on the sensor was hit at the full bunch crossing rate of 40 MHz. Triple coincidences where a fast-or signal is received for all three telescopes in a plane are then measured in order to obtain an estimate of the luminosity, which provides an online bunch-by-bunch luminosity measurement with excellent statistical precision.

In addition, the full pixel information is read out at a lower rate, from which the track information can be fully reconstructed. This allows for the calculation of corrections to the online luminosity from effects such as the miscounting of tracks not originating from the interaction point and detector efficiency, as well as monitoring of the operational status and performance of the detector.

The luminosity measurement is calibrated using Van der Meer (VdM) scans, in which the separation of the two colliding beams is scanned in order to measure the cross-sectional profile of the beams, from which the absolute luminosity can be determined. These scans were performed successfully in 2015 and 2016 during proton-proton, lead-lead, and proton-lead running and used to calibrate the PLT.

In this talk, we will present details of the commissioning and operational history of the currently installed hardware and experience with offline analysis, in addition to upgrade plans for LS2.

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