



Contribution ID: 357

Type: **Poster submission**

Luminosity Measurement of proton-proton collisions at the CMS experiment

Monday 5 August 2019 15:40 (20 minutes)

Summary

Precision luminosity calibration is critical to determine fundamental parameters of the standard model and to constrain or to discover beyond-the-standard-model phenomena at LHC. The luminosity determination at the LHC interaction point 5 with the CMS detector, using proton-proton collisions at 13 and 5.02 TeV during Run 2 of the LHC (2015–2018), is reported. The absolute luminosity scale is obtained using beam-separation (“van der Meer”) scans. The dominant sources of systematic uncertainty are related to the knowledge of the scale of the beam separation provided by LHC magnets and the non-factorizability between the spatial components of the proton bunch density distributions in the transverse direction. When applying the van der Meer calibration to the entire data-taking period, a substantial contribution to the total uncertainty in the integrated luminosity originates from the measurement of the linearity and stability of the CMS luminometers. The reported integrated luminosity in 2015–2016 is among the most precise luminosity measurements at bunched-beam hadron colliders. Prospects for luminosity precision for LHC Run 3 and HL-LHC are also discussed.

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Session Classification: Poster Session (Mon/Tue)

Track Classification: Accelerators, Detectors and Computing for HEP