



Contribution ID: 51

Type: Poster

## Relative nonlinearity of BRIL luminometers derived from CMS mu-scans

For precise calibration of luminosity measurements, it is necessary to understand nonlinear effects which affect the single bunch instantaneous luminosity (SBIL) measured by a luminometer. The CMS BRIL group uses data from the hadronic forward (HF) calorimeter, the Pixel Luminosity Telescope (PLT), and the Fast Beam Conditions Monitor (BCM1F) to measure the luminosity. A “mu scan” is a beam scan performed at specific conditions suitable for evaluating the luminometer linearity. During the scan the beam separation is varied so as to produce a resulting SBIL in the range 1–10 Hz/ $\mu\text{b}$ . Then, the analysis of luminometer linearity is carried out with respect to HFOC (HF using occupancy method for luminosity calibration). HFOC is considered to have the best linearity, so it is used as a reference scale. Also, a cross-check using the pixel cluster counting (PCC) method is used when PCC data is available. In this report, the summary of 2018 mu scans is presented, and the influence of nonlinear terms in measurements of luminosity is analyzed.

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**Session Classification:** Poster session

**Track Classification:** Perform. / Tools