

## **CMS emittance scans for luminosity calibration in 2017**

Emittance scans are short van der Meer type scans performed at the beginning and at the end of LHC fills. The beams are scanned against each other in X and Y planes in 7 displacement steps. These scans are used for LHC diagnostics and since 2017 for a cross check of the CMS luminosity calibration. An XY pair of scans takes around 3 minutes. The BRIL project provides to LHC three independent online luminosity measurement from the Pixel Luminosity Telescope (PLT), the Fast Beam Condition Monitor (BCM1F) and the Forward calorimeter (HF). The excellent performance of the BRIL detector front-ends, fast back-end electronics and CMS XDAQ based data processing and publication allow the use of emittance scans for linearity and stability studies of the luminometers. Emittance scans became a powerful tool and dramatically improved the understanding of the luminosity measurement during the year. Since each luminometer is independently calibrated in every scan the measurements are independent and ratios of luminometers can directly be used as a final validation for 2017 data. Two independent analyses of emittance scans are launched: a Python-based offline framework and an online XDAQ-based application. Results are published on the monitoring web-pages in real-time for the XDAQ-based analysis and typically within 15 minutes for the Python-based framework, which has however the advantage of being rerunnable.

### **Summary**

Emittance scans were used for stability monitoring and nonlinearity correction for CMS luminosity measurements in 2017. It improved understanding of the CMS luminometers and it is valuable feedback to the LHC and will be used in 2018 on regular bases.

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