Contribution ID: **83** Type: **Poster**

LHCB PLUME Probe for LUminosity MEasurement

Tuesday 20 September 2022 16:40 (20 minutes)

PLUME (**P**robe for **LU**minosity **ME**asurement) is a dedicated luminosity meter (luminometer) for the LHCb detector which will operate during Run 3 at a luminosity level five times higher than in the previous runs. It was designed to measure, in real time, the instantaneous luminosity with an accuracy better than 5 %.
The detector relies on the registration of Cherenkov light emitted by particles passing through an hodoscope composed by small elementary detectors placed upstream the collision region. Each elementary detector is a photomultiplier coupled to a Fused Silica tablet.
The detector, was installed and commissioned January 2022.

Summary (500 words)

PLUME (Probe for LUminosity MEasurement) is a dedicated luminosity meter (luminometer) for the LHCb detector which will operate during Run 3 at a luminosity level five times higher than in the previous runs up to 2×1033 cm−2 s−1. It was designed to measure, in real time, the instantaneous luminosity with an accuracy better than 5 %. This system will also contribute to monitor the beam conditions: measurement of the radiation background induced by the accelerator or poor-quality vacuum, cross-check of the LHC filling scheme, measurement of the level of the ghost charges in real time and production of alarms for the LHC. It will also provide an accurate offline luminosity determination.
The technical requirements for the luminometer development were:
- a fast response, required to be well within the minimum distance of 25 ns between two sequential beam crossings in order to avoid spill over
- an operation under high radiations with an integrated (over 4 years of running) Gamma dose of 200 kGy and a fluence around 1014 neutrons/cm²
- a compact size
- an independent DAQ system to provide continuous monitoring even when the other detectors in LHCb are not running

The PLUME detector is positioned upstream the collision region, just ahead the VELO detector. It is composed of 48 modules arranged in a projective geometry and forming a two-layer hodoscope. The radiation resistance and fast response requirements for the system were the most critical aspects of this project. PLUME elementary detector is based on a photomultiplier (PMT) registering the Cherenkov light emitted by particles traversing a Fused Silica radiator (thereafter referred as Quartz).

The PLUME information should be available both online, for fast online luminosity determination, and offline together with the rest of the LHCb data. Both functions are realized by the same readout system, connected to the LHCb Experiment Control (ECS) and Data Acquisition (DAQ) systems.

To ensure a precise measurement of luminosity, a crucial part of the PLUME detector is its calibration and monitoring system. The gain and efficiency of a PMT can change with time, depending on its current or detector occupancy, temperature and radiation dose. Two quantities will be monitored: the gain to ensure measurement linearity, and the hit efficiency for constant hit counting. The monitoring system comprises two independent solutions: a LED calibration system and a calibration algorithm using upstream VELO tracks, i.e. those travelling away from the LHCb spectrometer. The LED calibration continuously monitors the PMT responses to a fixed and known amount of light. It will be accurate at least during short periods of the order of fills. The gain and efficiency of the PMTs will vary, but their responses in the number of photons per track from IP will be stabilized and kept approximately constant by adjusting the high voltage and the timing, e.g.

after every fill.
The detector was installed and commissioned in January 2022. The first luminosity measurements should be available before the summer. I hope to be able to present these results.

Primary authors: DUARTE, Olivier (Université Paris-Saclay (FR)); BARSUK, Sergey (Université Paris-Saclay (FR)); PUILL, Veronique (IJCLab IN2P3)

Presenter: DUARTE, Olivier (Université Paris-Saclay (FR))

Session Classification: Tuesday posters session

Track Classification: Systems, Planning, Installation, Commissioning and Running Experience