Luminosity studies using muons from the CMS L1 scouting system

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Outline

- Overview of Luminosity and Its Significance

- Luminosity Measurements at CMS

- Overview of the L1-scouting System

- Aim and Current Results

- Future Work

Luminosity and Its Significance

Instantaneous luminosity

$$\mathcal{L} = \frac{R}{\sigma} \ (\text{cm}^{-2}\text{s}^{-1})$$

R: observed event rate of a process

σ: cross section of the process

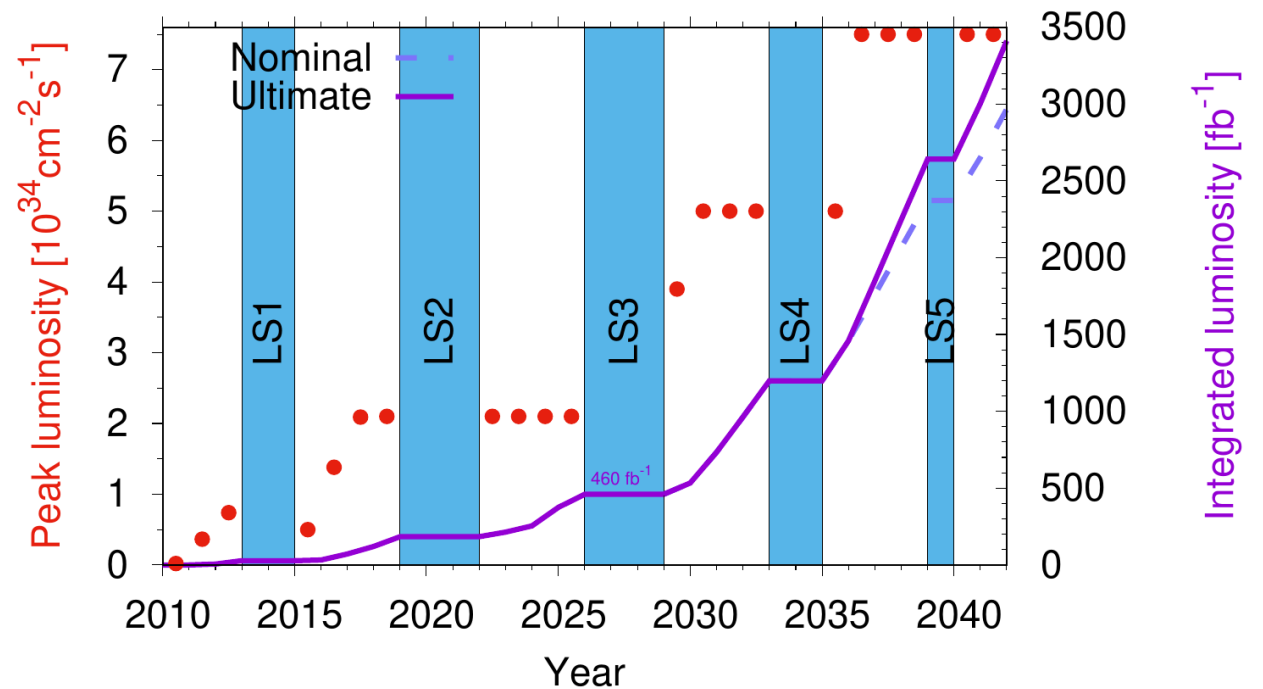## Lumisection

$$\frac{2^{18} \ (orbits)}{11.245 \ (kHz)} \sim 23 \ s$$

Integrated luminosity

$$L = \frac{N}{\sigma} \ (\text{cm}^{-2})$$
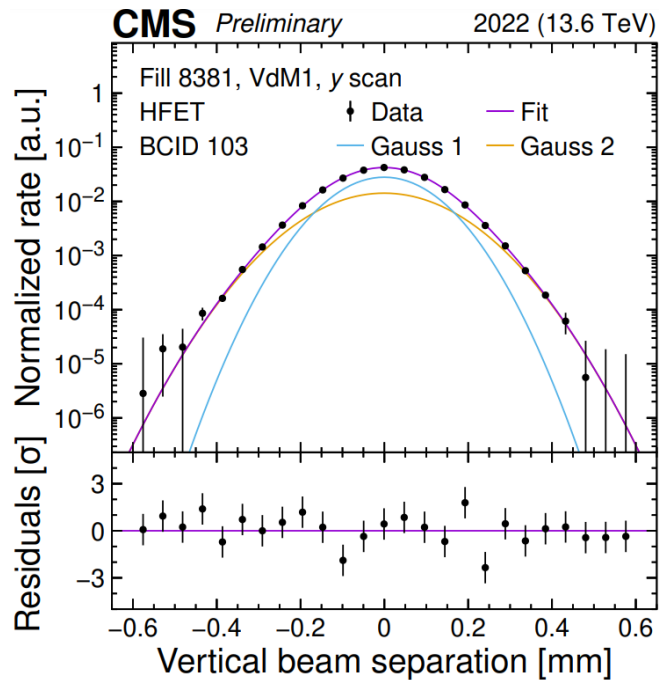
N: number of events

lhc-commissioning.web.cern.ch/schedule/HL-LHC-plots.htm

Luminosity Measurements

Van der Meer Scan (VdM):

A method used to achieve an absolute luminosity calibration through peak instantaneous luminosity measurement.

cds.cern.ch/record/2890833

Luminometers:

Subdetectors dedicated for online and/or offline luminosity measurements.

(online)
counts tracks of charged particles

(online)
monitors the beam conditions (e.g., alignment, shape, size, intensity)

(offline)
monitors radiation levels throughout the LHC

(online/offline)
utilizes the CMS pixel detectors to count clusters of pixels hit by charged particles."

(offline)
measures the position and momentum of muons

(online)
Detects hadronic showers and measures their associated energies

indico.nucleares.unam.mx/event/2060/contribution/76
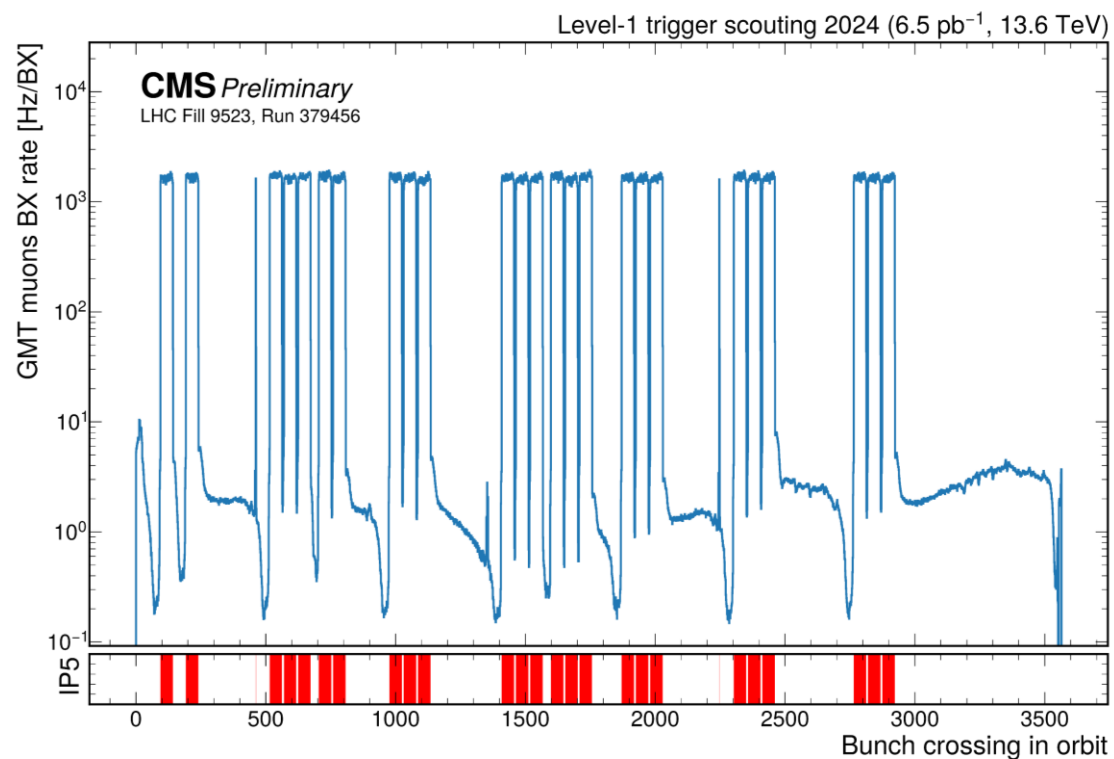
Overview of the L1-scouting System
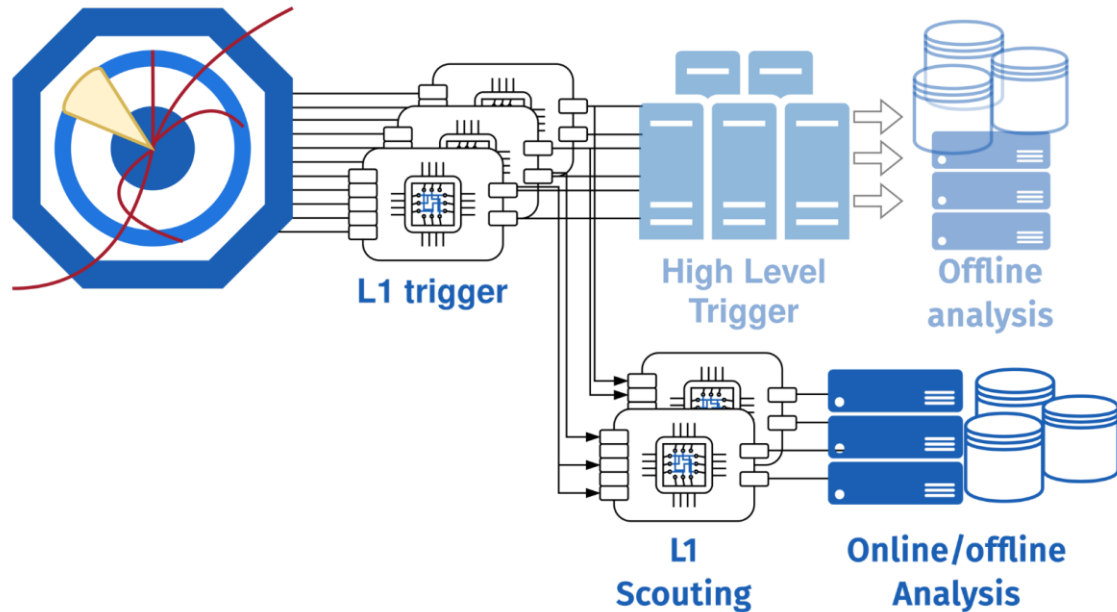
indico.cern.ch/event/1288327/contributions/5416071

- A novel data-collection system that captures intermediate data from the L1 trigger at 40 MHz with limited resolution.

- Performs online analysis.

- Operates independently of the CMS Trigger/DAQ system and does not make trigger decisions.

- Useful for gaining insights into processes overlooked by the trigger and for early detection of interesting signals.
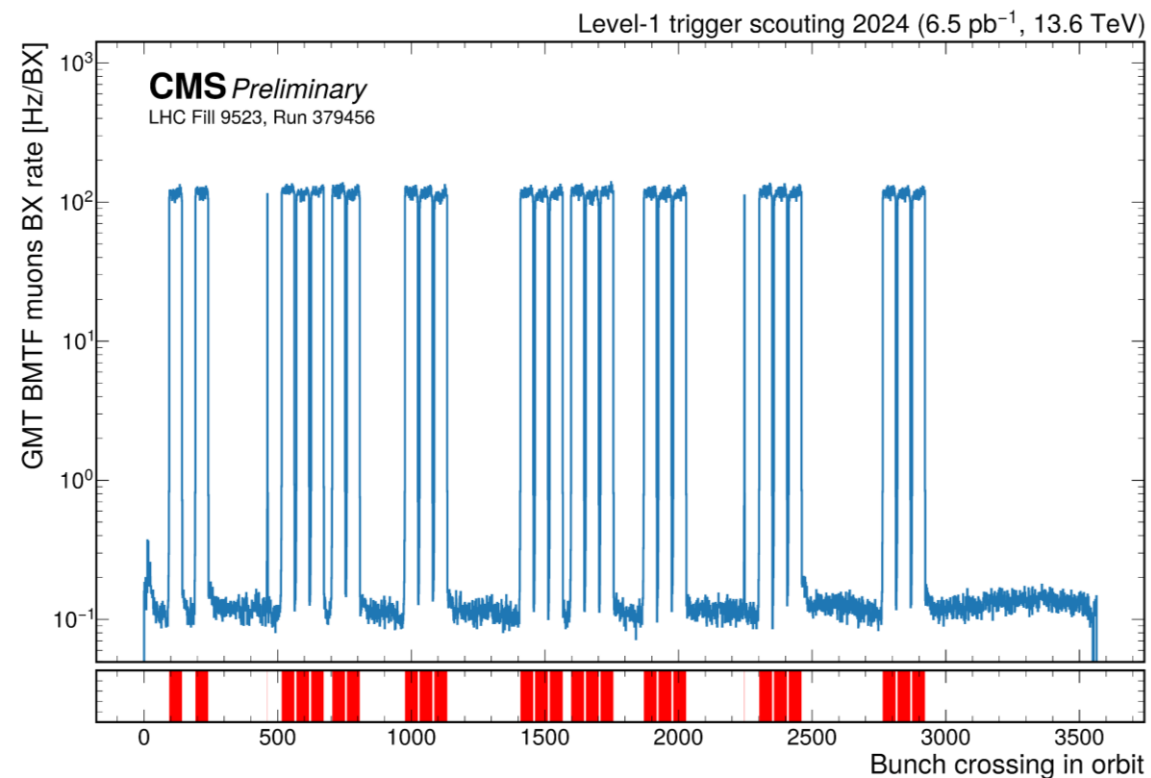
cds.cern.ch/record/2852916

Aim and Current Results

- Aim: to analyze data from the L1-scouting system to assess its linearity, reliability, and extensibility.

- Previous Results:

cds.cern.ch/record/2904692

Aim and Current Results

- Aim: to analyze data from the L1-scouting system to assess its linearity, reliability, and extensibility.

- Recent Results (not approved for public):

  - The muon count is highest in the Endcap region mainly due to its higher pseudorapidity coverage.

  - The Overlap and Barrel regions show greater consistency with BRIL (OMS) data, as indicated by the relative stability of their respective ratios.
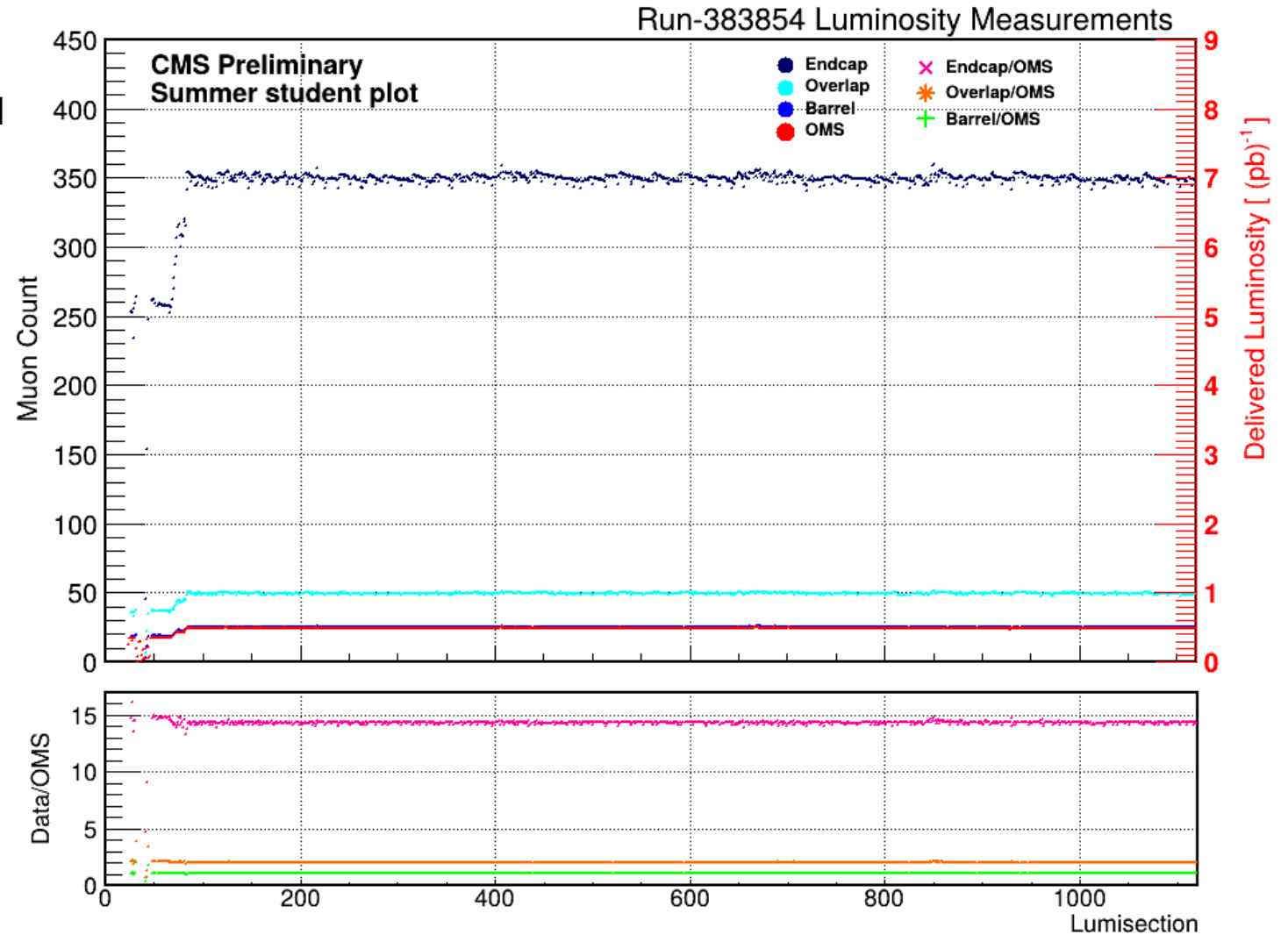
OMS: BRIL's "best" luminosity measurements by the subdetectors.

What's Next?

- Further investigate the behavior of the ratio in the endcap region within the L1-scouting data.

- Assess how various data cuts (e.g., detector regions, muon energies, momenta, and qualities) affect ratio linearity and consistency.

- Long-Term Goal: The L1-scouting system aims to provide vast amounts of data for detector diagnostics, luminosity measurements, and studying signatures that are either too common for the L1 trigger budget or have unique requirements.

  cds.cern.ch/record/2852916

Thank you!

Special thanks to:
Teammates: Davide and $Thomas_2$:)

For questions, insights, cookie recipes, or anything else,
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