
CERN

Comparative Analysis of Luminosity Measurements: BRAN vs Experiments

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Introduction

BRAN and Experiment Luminosity

Calibration factor

Evolution of luminosity difference

Noise level

Introduction

Goal of analysis

Comparison of measurements: BRAN vs Experiments luminosity

- Linearity
- Consistency of calibration factor
- Evolution of fill
- Noise level

Data

Experiments: ATLAS (IP1), CMS (IP5)
Data in timber:

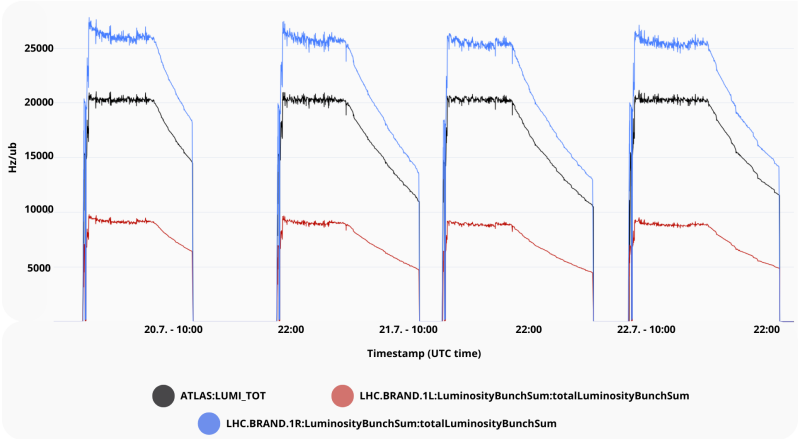
- ATLAS:LUMI_TOT_INST
- LHC.BRAND.1L:LuminosityBunchSum:totalLuminosityBunchSum
- LHC.BRAND.1R:LuminosityBunchSum:totalLuminosityBunchSum
- CMS:LUMI_TOT_INST
- LHC.BRAND.5L:LuminosityBunchSum:totalLuminosityBunchSum
- LHC.BRAND.5R:LuminosityBunchSum:totalLuminosityBunchSum

Pre-selection

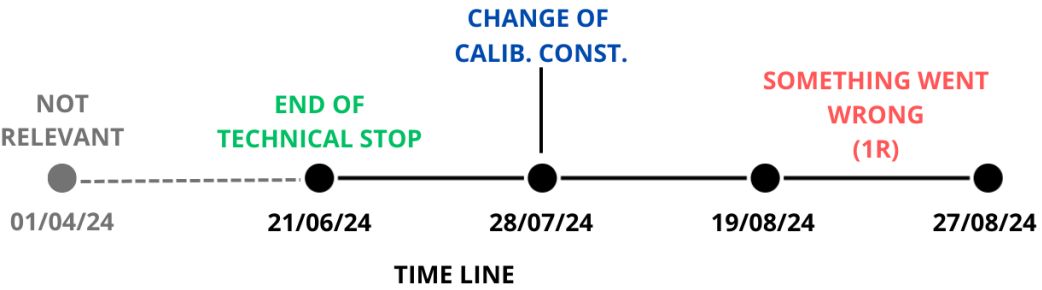
- Mode: contains "INPHYSICS"
- Minimum fill duration: 3 hours
- Manual selection of anomalous fills
- Data taken in: 1.4.2024 - 2.9.2024

BRAN and Experiment Luminosity

Example of luminosity evolution



Time Ranges


CHANGE OF
CALIB. CONST.
NOT
RELEVANT
END OF
TECHNICAL STOP
SOMETHING WENT
WRONG
(1R)
01/04/24
21/06/24
28/07/24
19/08/24
27/08/24
TIME LINE

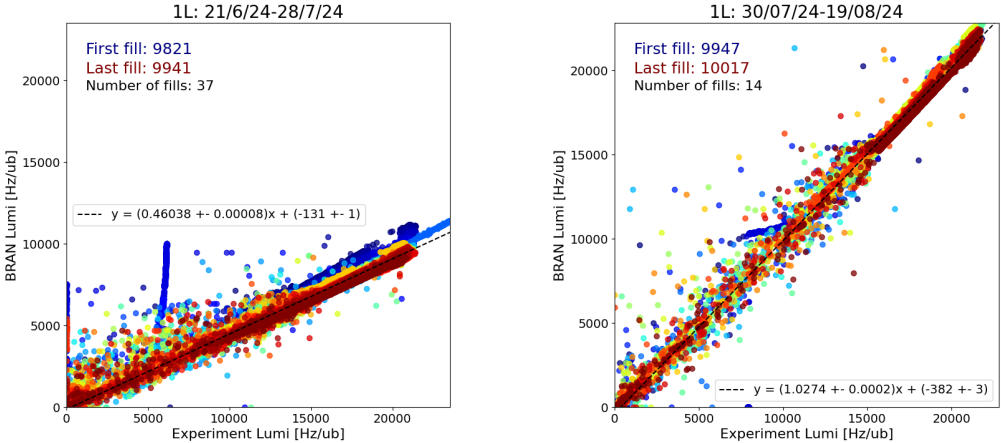
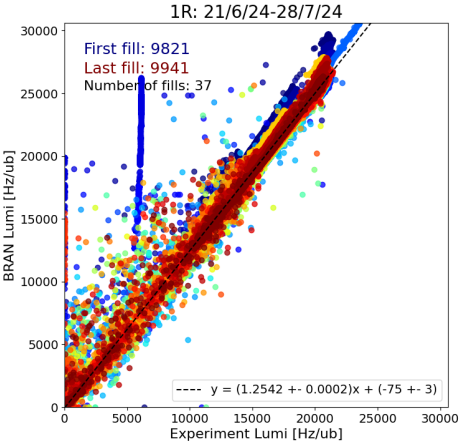


Figure: Device: 1L



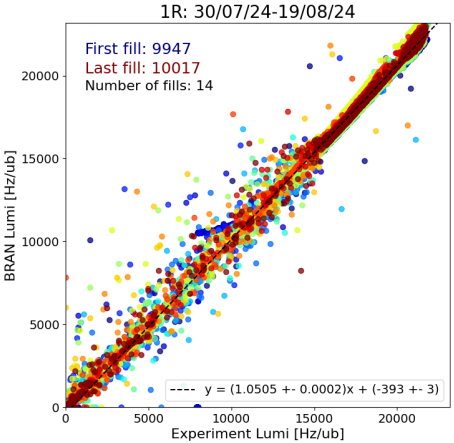
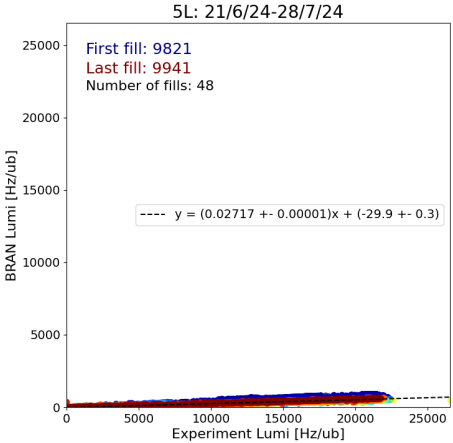


Figure: Device: 1R



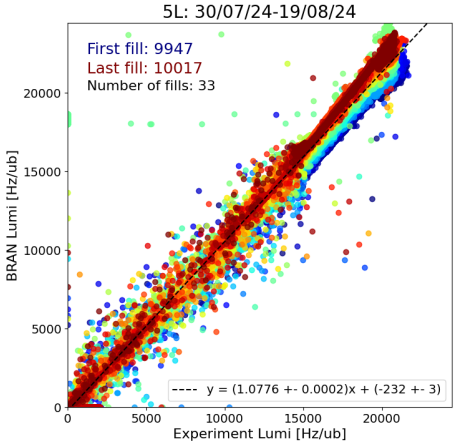


Figure: Device: 5L

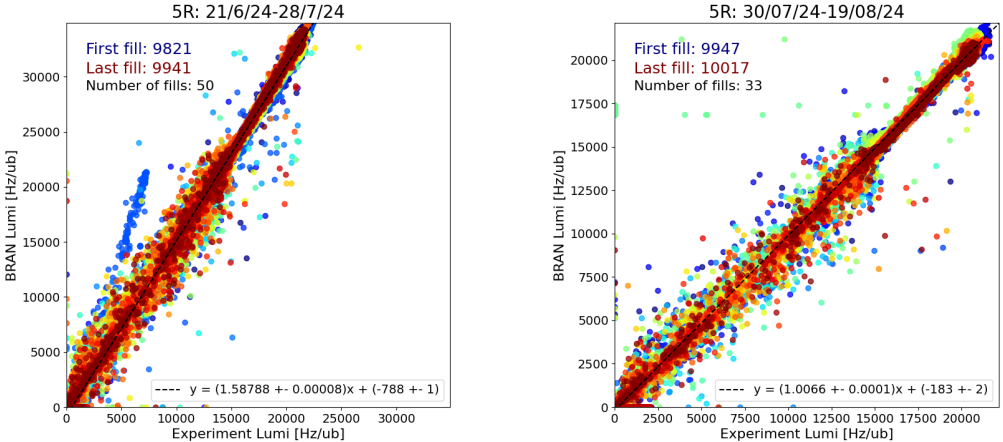
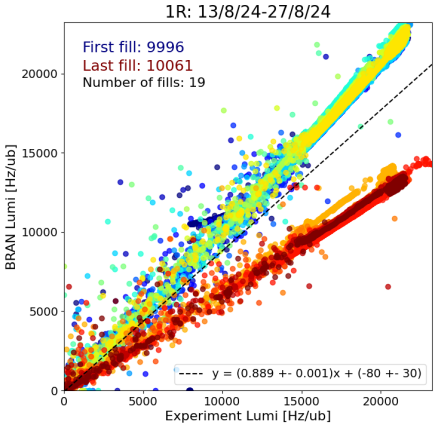
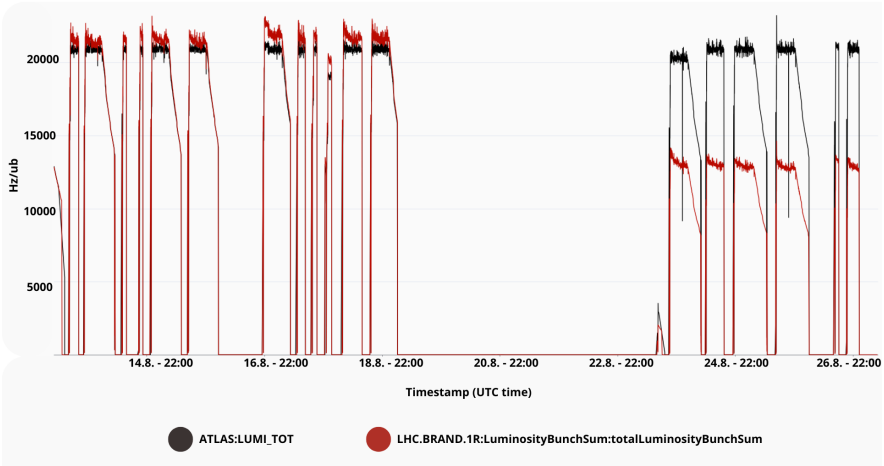


Figure: Device: 5R

Something went wrong



Something went wrong - 40% signal decrease



Something went wrong - Resolution

PROBLEM: 4 channels of BRAN stopped publishing

CAUSE:

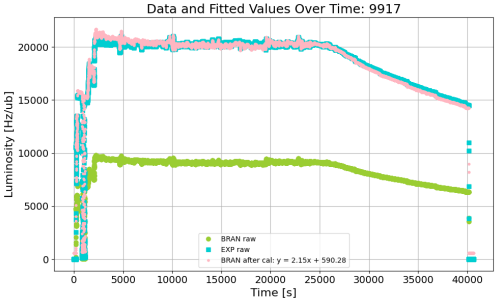
- 19 - 22.08.2024 $\rightarrow$ MD
- Trouble with RF settings
- Effect on the clock distribution

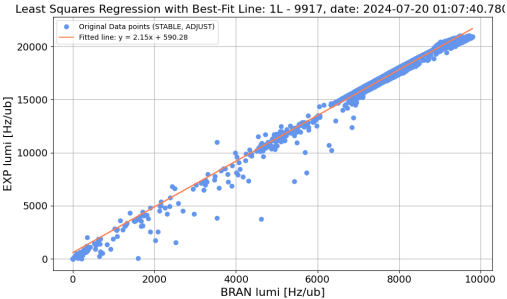
Something went wrong - Conclusion

BUFFER NOT PUBLISHING $\rightarrow$ RESET OF FPGA STATE MACHINE

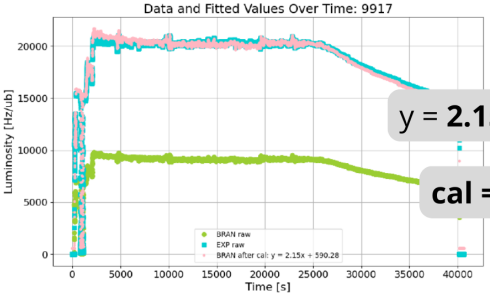
Calibration factor

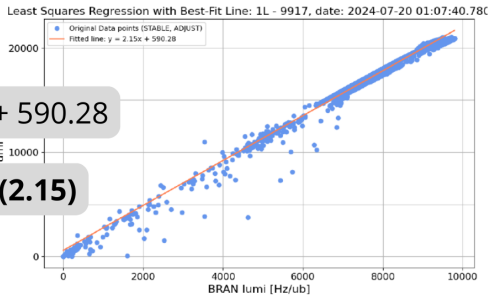
Example: Calibration factor of one fill





Example: Calibration factor of one fill





y = **2.15**x + 590.28

cal = 1/(2.15)

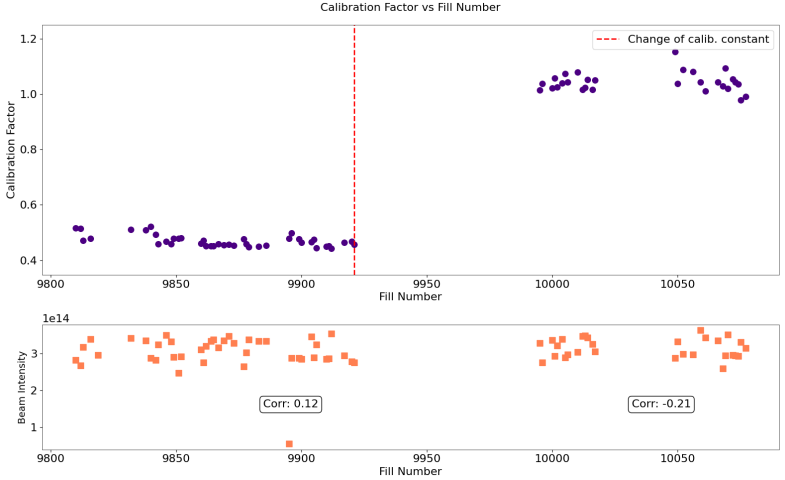


Figure: Evolution of calibration factor: 1L

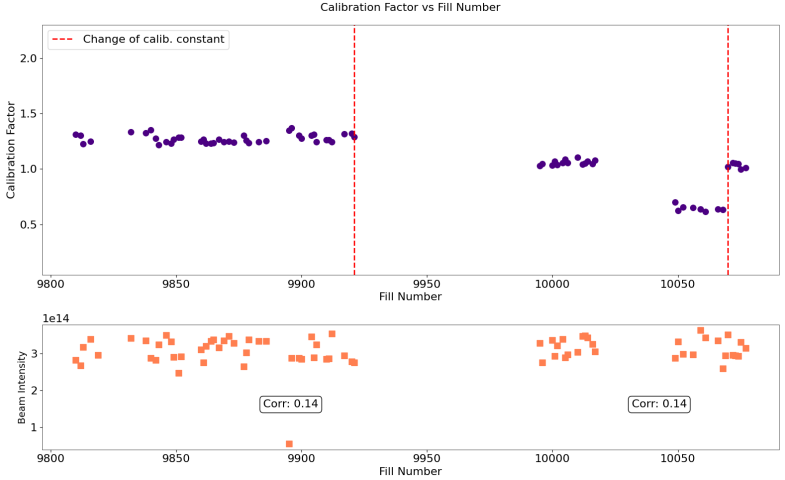


Figure: Evolution of calibration factor: 1R

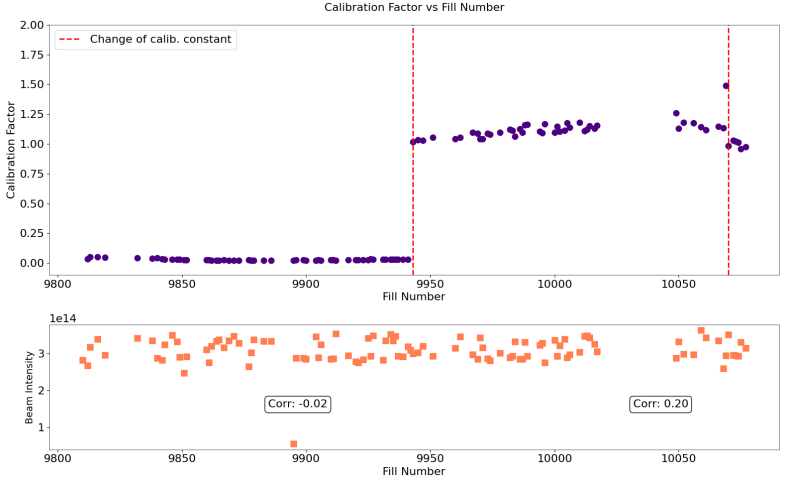


Figure: Evolution of calibration factor: 5L

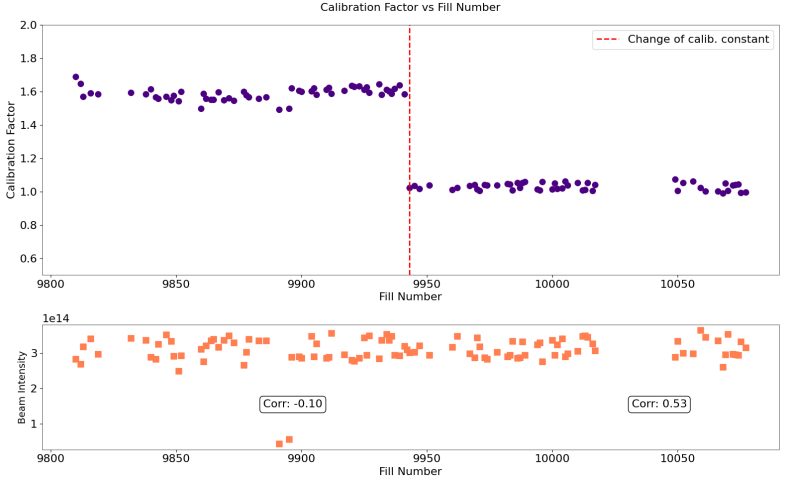
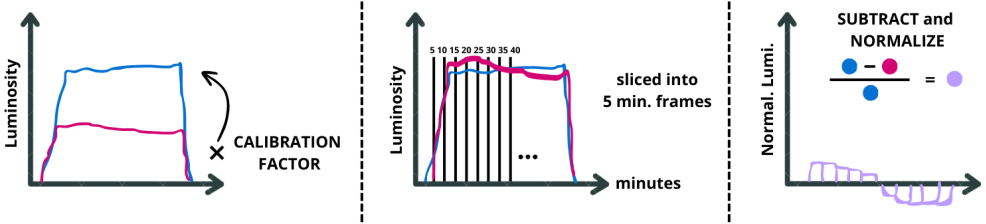


Figure: Evolution of calibration factor: 5R

Evolution of luminosity difference

Principle of analysis



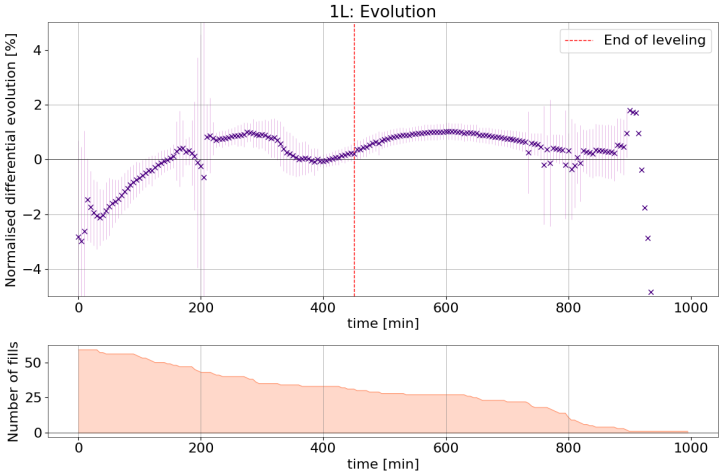


Figure: Evolution of stable mode over all fills: 1L

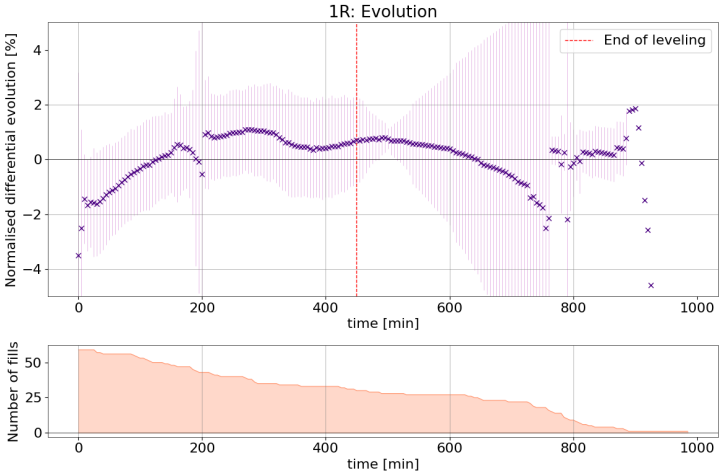


Figure: Evolution of stable mode over all fills: 1R

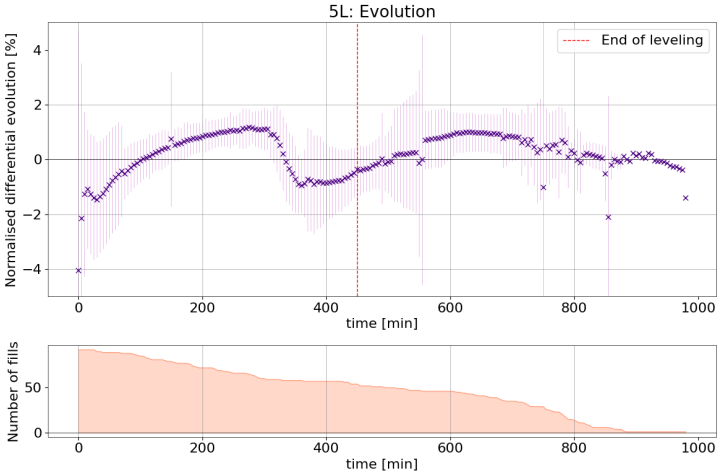


Figure: Evolution of stable mode over all fills: 5L

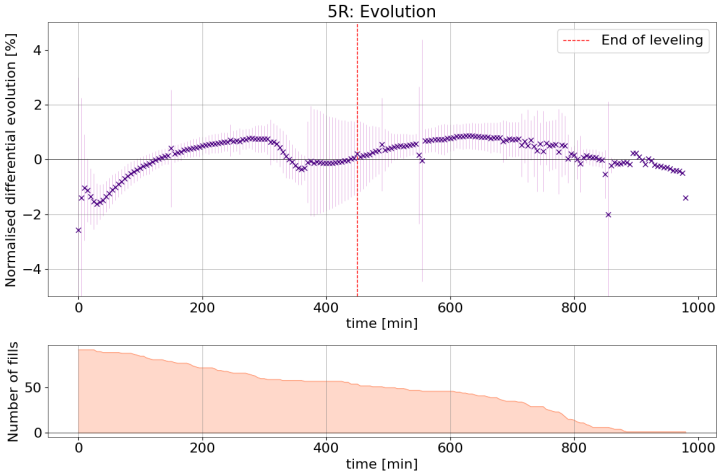
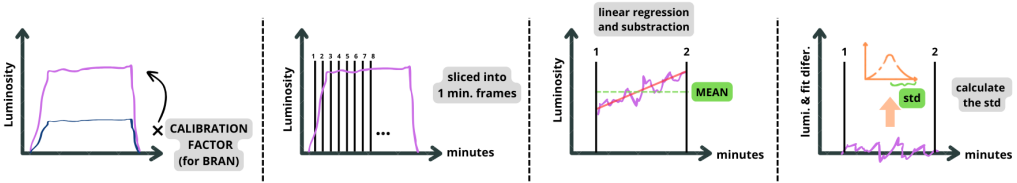


Figure: Evolution of stable mode over all fills: 5R

Noise level

Principle of analysis



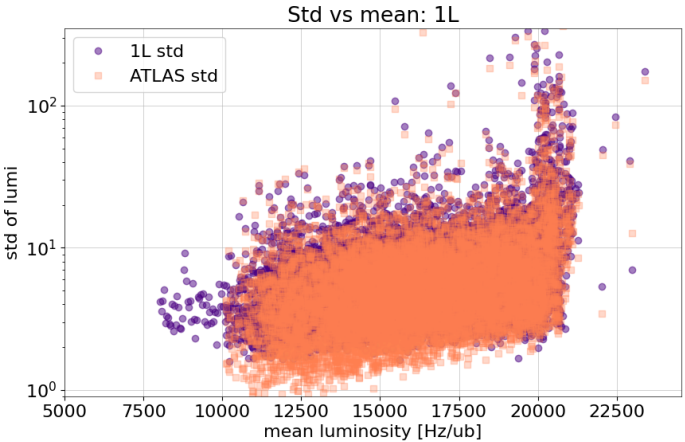


Figure: Mean vs least square: 1L (10%)

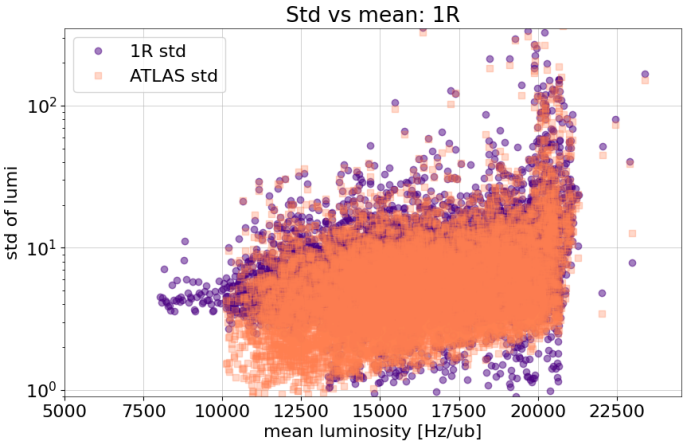


Figure: Mean vs least square: 1R (1%)

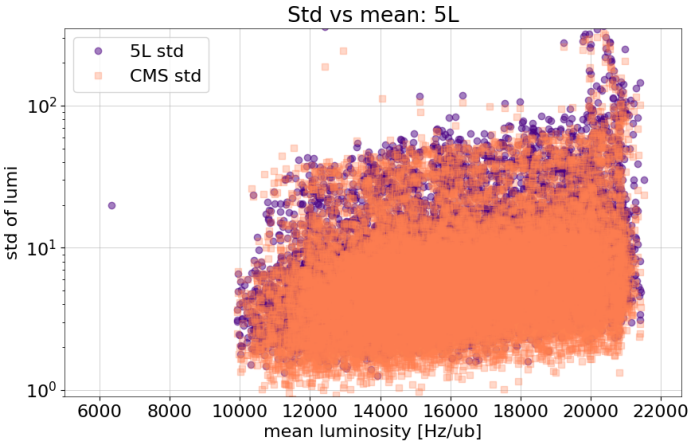


Figure: Mean vs least square: 5L (10%)

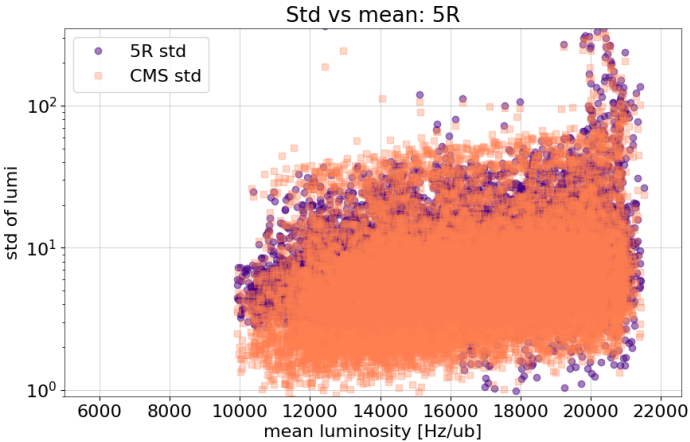


Figure: Mean vs least square: 5R (1%)

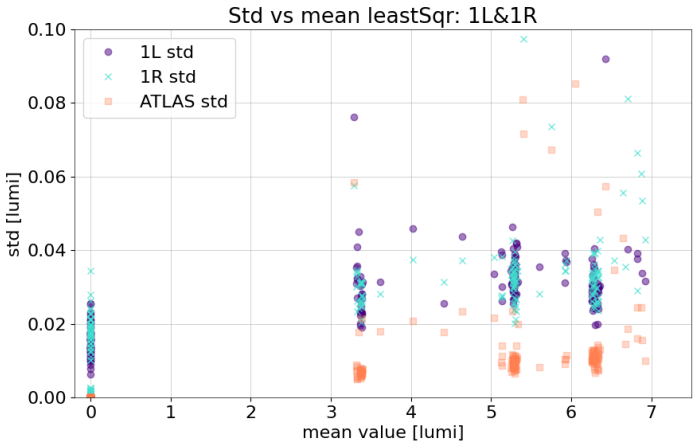


Figure: Mean vs least square of ATLAS vs 1L (10%) vs 1R (1%) for low luminosity

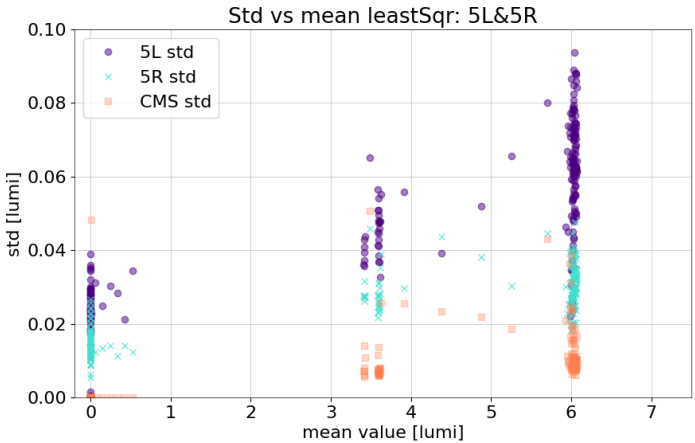


Figure: Mean vs least square of CMS vs 5L (10%) vs 5R (1%) for low luminosity

Conclusions

- Linear behaviour
- Constant calibration factor
- Noise level higher than experiment
- Acquisition: 1% vs 10%

  $\Rightarrow$ decision after PbPb

THANK YOU FOR YOUR ATTENTION!

BACKUP

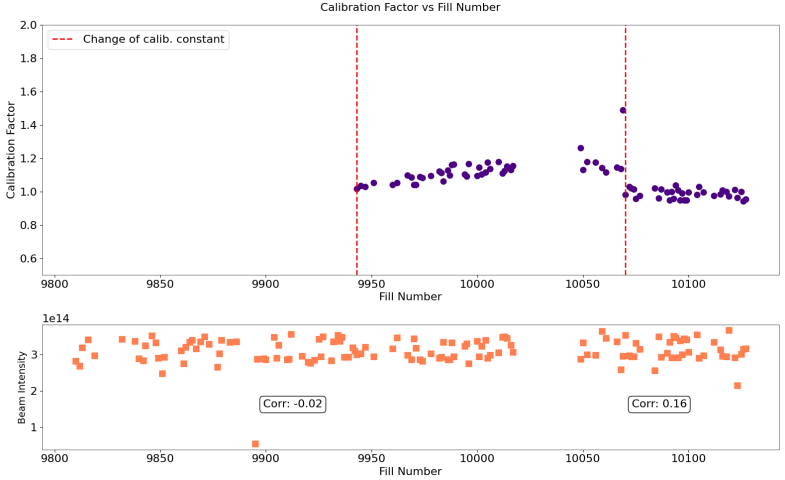


Figure: Evolution of calibration factor: 5L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