



# Measuring luminosity with track counting in the ATLAS experiment

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Physik bei höchsten Energien mit dem ATLAS-Experiment am LHC

FSP 103
ATLAS

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# Introduction

- What is Track-Counting?
  - Uses the average number of charged tracks of randomly triggered events in a dedicated event stream to measure the luminosity

$$\mathcal{L}_{inst} \sim n_b \frac{\mu_{vis} f_r}{\sigma_{vis}} \qquad \mu_{vis} = \frac{N_{Tracks}}{N_{Events}}$$

- Which tracks are counted?
  - Selections based on track properties

    → Study the stability of track-counting
  - $\mu_{vis}$ of the different track-counting selections calibrated in a special LHC fill:

    → $\langle\mu\rangle \sim 0.5$, isolated bunches, no crossing-angle

    → Extrapolate to physics regime

| $p_T$>900 MeV, Tight Primary | 2016 selection | 2017 selection | 2017+Si hit selection |
|---|---|---|---|
| Allowed pixel holes | =0 | ≤1 | ≤1<br>+1 add. silicon hit |
| Impact parameter | $\lvert d_0/\sigma_{d_0}\rvert$<7 | $\lvert d_0/\sigma_{d_0}\rvert$<7 | $\lvert d_0/\sigma_{d_0}\rvert$<7 |
| $\lvert\eta\rvert$ | $\lvert\eta\rvert$<2.5 | $\lvert\eta\rvert$<1.0 | $\lvert\eta\rvert$<1.0 |

# Investigated track-counting uncertainties

- The different track selections were studied under different LHC configurations

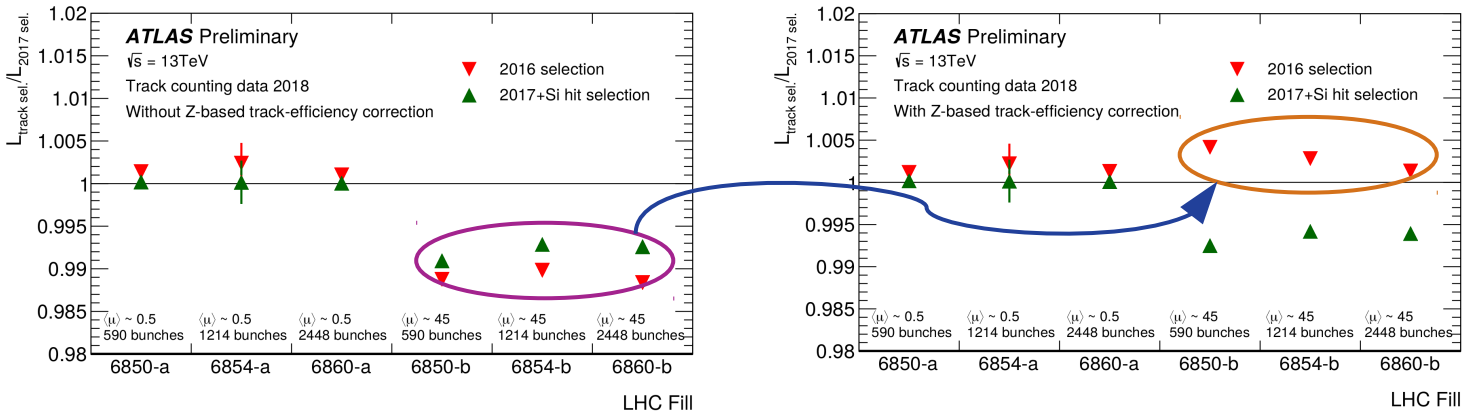
1) μ dependence

→ ~ 1% shift between low and high ⟨μ⟩

→ Partially corrected by applying efficiency corrections based on Z→μμ events (overcorrected by ~ 0.4%)

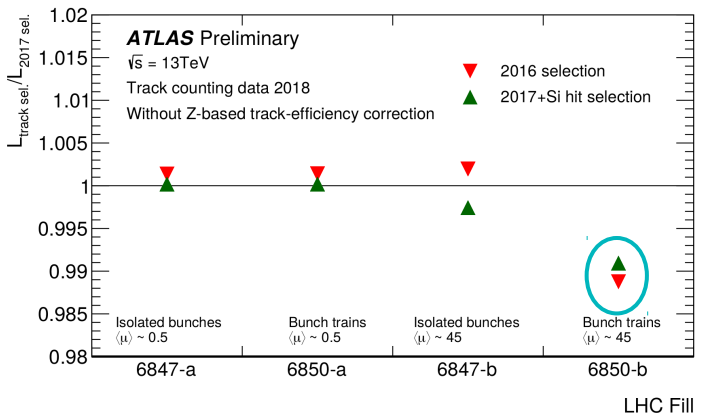
2) Bunch structure dependence

→ ~ 1% shift between isolated bunches and bunch trains at high ⟨μ⟩



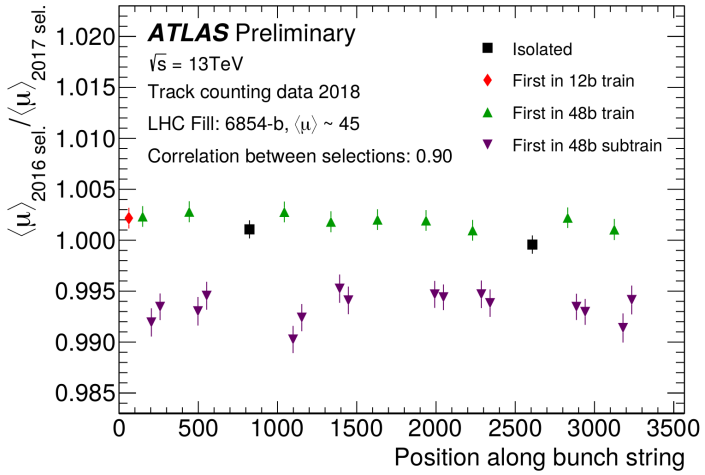




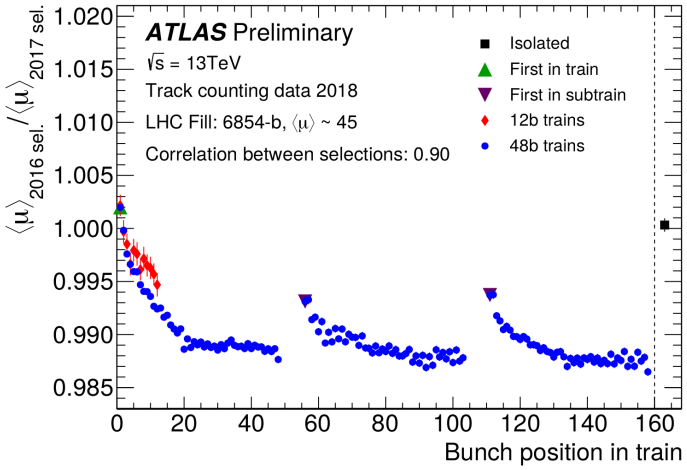


# Bunch Structure Dependence – High $\langle\mu\rangle$

- Dependence on position along bunch string
  - Similar behaviour between isolated bunches and bunches that are first in train
  - Different behaviour for bunches that are first in subtrain




- Dependence on bunch position in train
  - Linear decrease in ratio for nearly 20 bunch positions inside train until plateau is reached




## Conclusion

→ Track counting luminosity measurement stable within 1.4%

→ Two effects observed:

1) ~1% shift between low and high $\langle\mu\rangle$ → Partially corrected by applying corrections based on $Z \rightarrow \mu\mu$ events
2) ~1% shift between isolated bunches and bunch trains at high $\langle\mu\rangle$ → Investigating possible corrections