Emittance Scans with ATLAS Detector

KTH, ROYAL Institute of Technology

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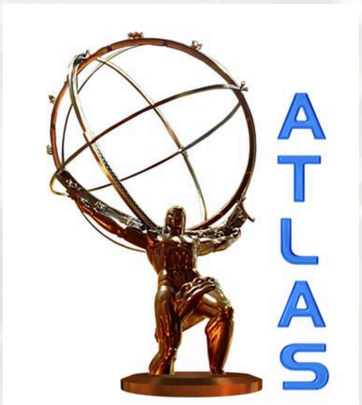


Emittance Scans Studies

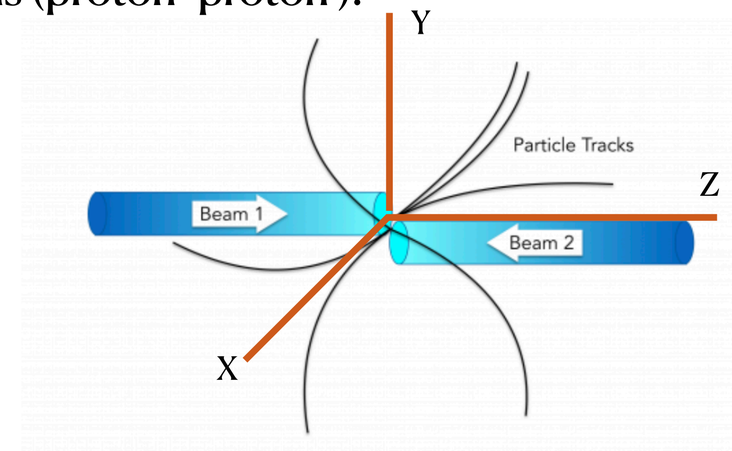
- Luminosity is an important parameter of the LHC accelerator. It measures the rate of interactions (proton -proton).

$$L = \frac{1}{\sigma}\frac{dN}{dt}$$

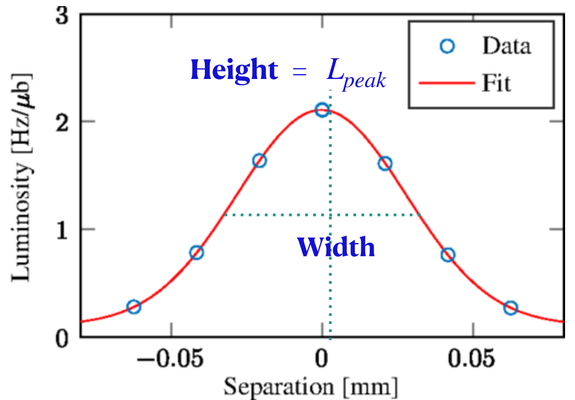
$\frac{dN}{dt}$ number of events per seconds

σ is the cross section = 80 mb

Jannik Geisen already explain about luminosity in his talk : Performance and operations of the ATLAS detector



- KTH is working on luminosity measurements with the Track Counting (TC) algorithm.
- The topic of talk is about the Emittance Scans studies using the TC algorithm.
- Emittance Scans allow us to understand the beam quality (by measuring the width of the beam) and also used to monitor the stability of our algorithms.
- The beams are scanned through each other in the transverse planes (x , y) and the luminosity is measured at different separation steps.
- Every scan usually consists of 9 separations steps i.e: when beams are completely overlapping (at 0 separation) we get the maximum luminosity.
- The scan data points are fitted in order to get the height and width of the bell-shaped gaussian curve.
- Size of the beam (x or y) $= S = \frac{Width}{Height}$
  - The S can be different in x and y planes.
  - It is used to measure the beam luminosity.

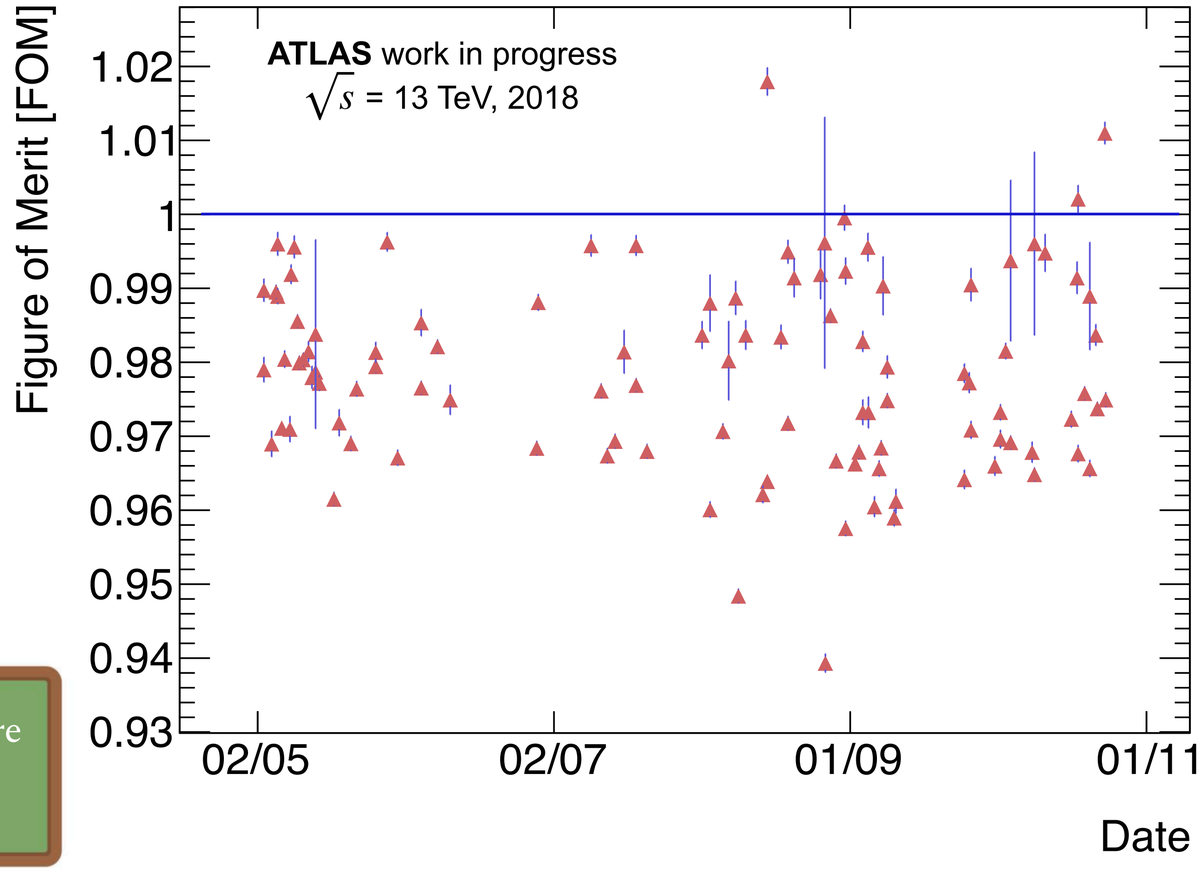


Luminosity Measurements

- Luminosity can be determined in two alternative ways.
  - From the height of the scan curve $\longrightarrow L_{peak}$.
  - From the beam parameters $\longrightarrow L_{beam}$.

$$L_{beam} = \frac{f_r n_1 n_2}{2\pi S_x S_y}$$

f_r	Frequency of the LHC.
S_x, S_y	Beam sizes in x and y direction.
$n_1 n_2$	Bunch Intensities



- The ratio of the two Luminosity values is equal to the Figure Of Merit (FOM).

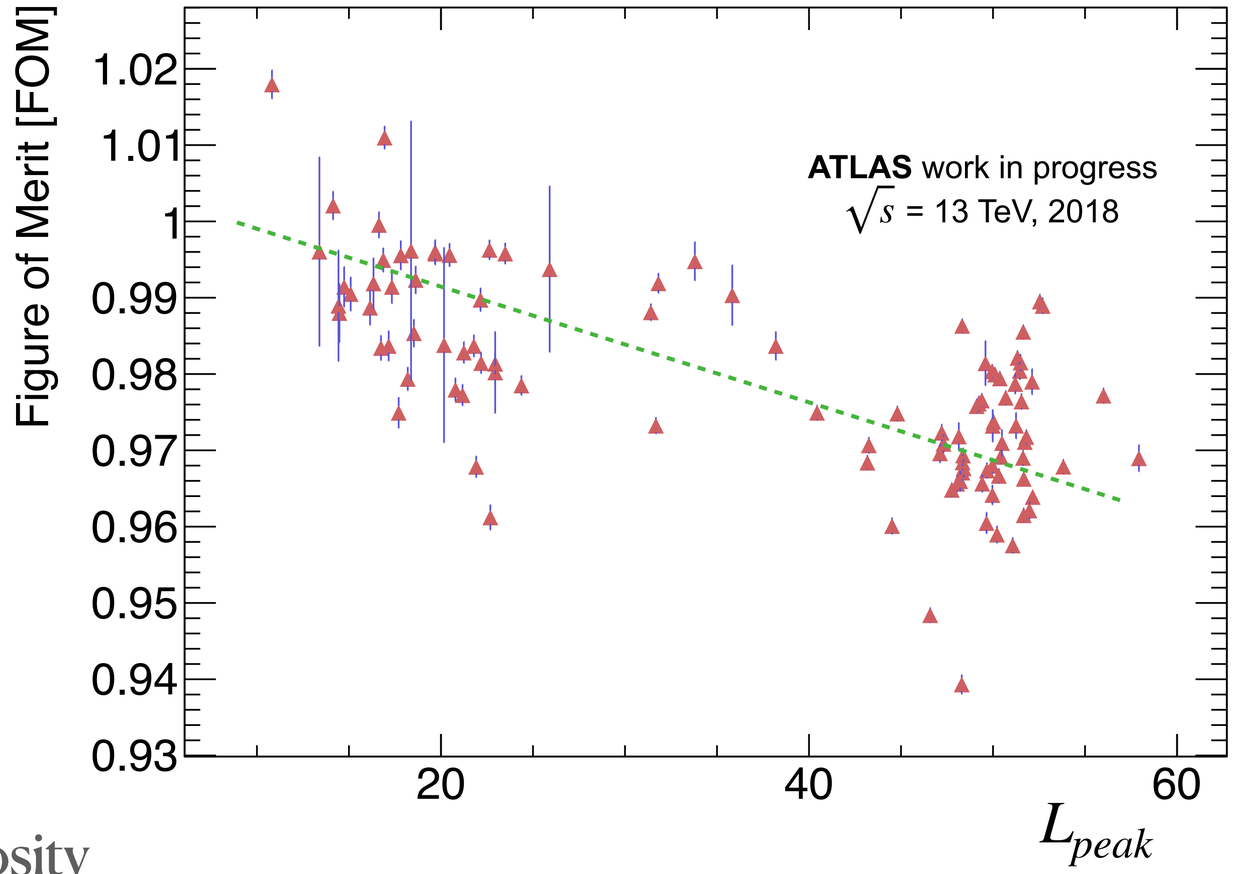
$$FOM = \frac{L_{peak}}{L_{beam}}$$

FOM should be equal to 1
Since it is the ratio of
Same quantities

- Uncertainty of all the measurements is calculated via error propagation by taking in to account the correlations between the fit parameters.

Summary and Conclusion

- By looking the FOM as a function of the luminosity (L_{peak}), a downward trend can be seen.
  - **Point to Ponder:**
    - Is this a real trend?
    - If so then we should know the reason?



Conclusion:

- The results obtained for 2018 Emittance scans has been shown .
- The FOM values are quite stable throughout the year.
- Its important to understand if there is any real luminosity dependence on the FOM values.

Investigations are going on !!!!!