



Discussion on event activity estimators for Run3

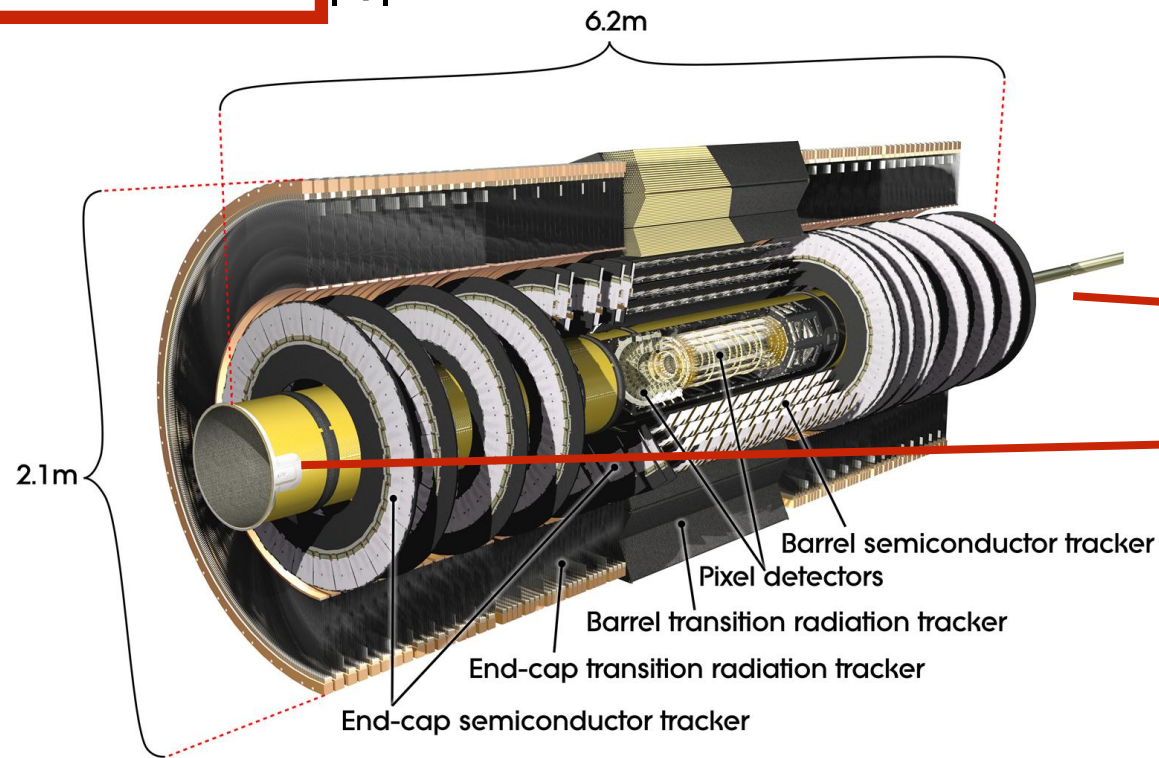
Dominik Derendarz,

Feb 8, 2021

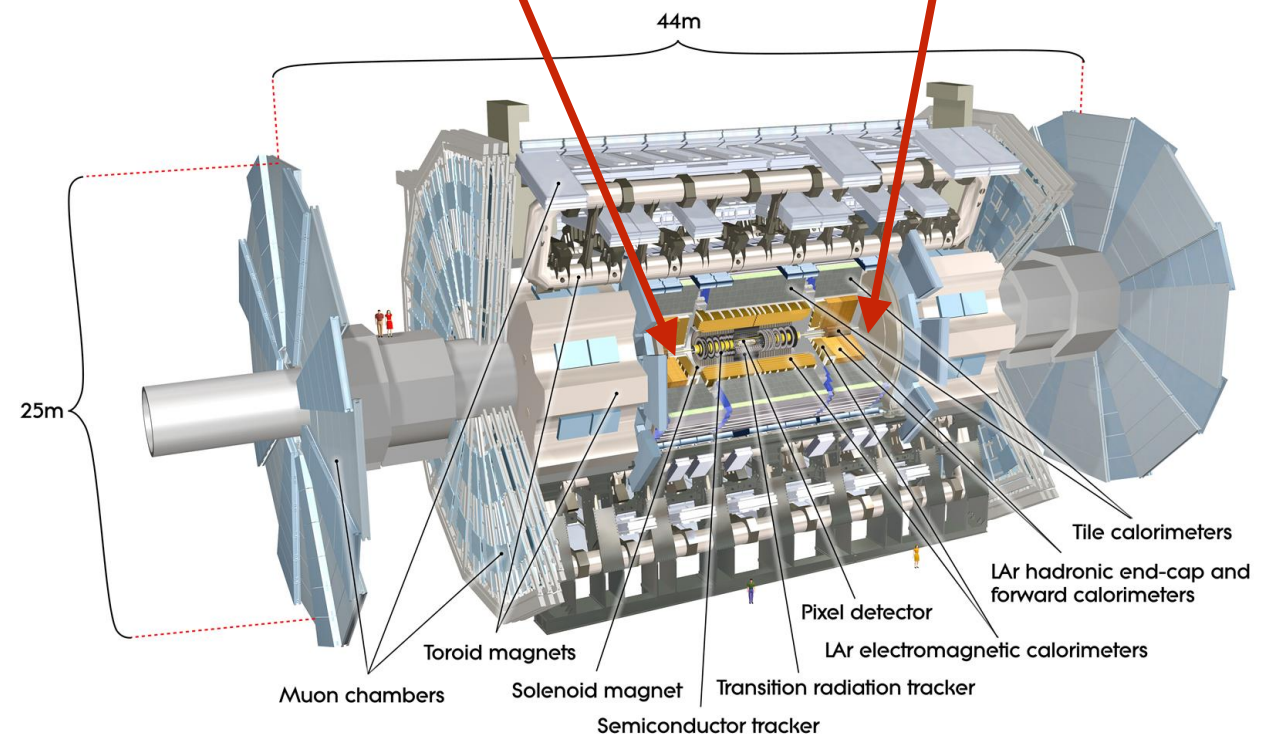
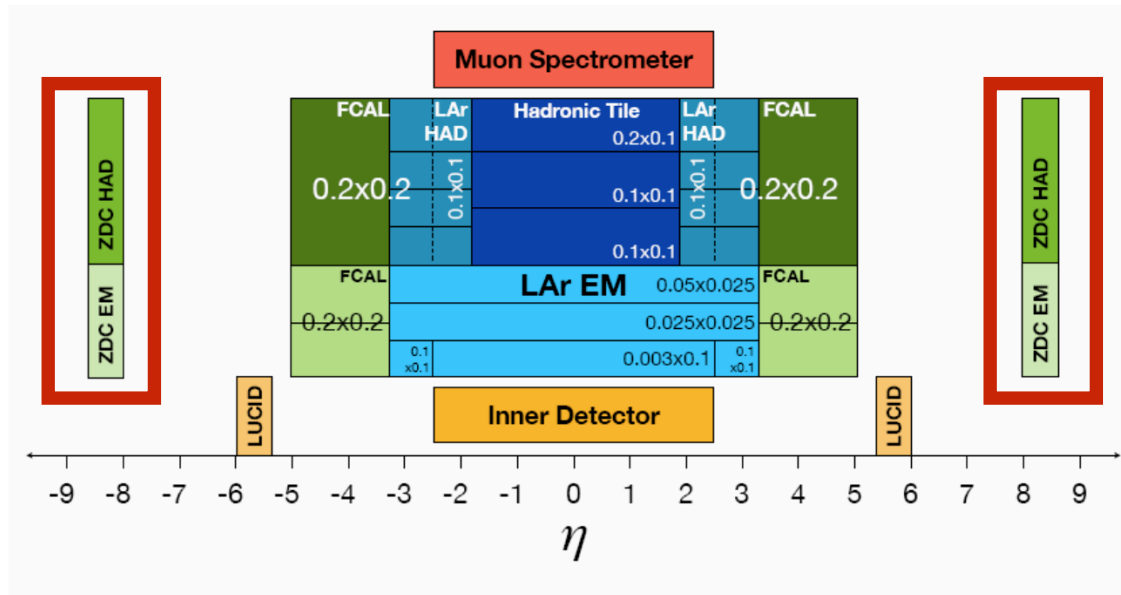
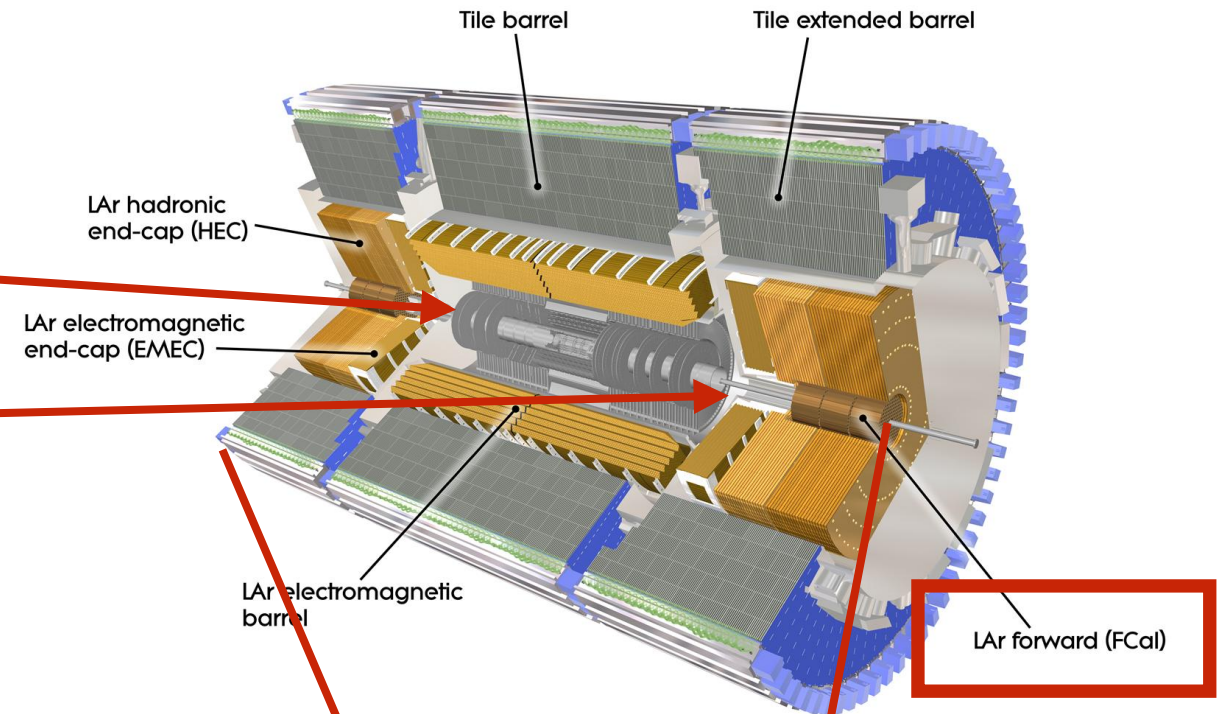
2nd LHC HI WG meeting

ATLAS acceptance

Inner Detector $|\eta| < 2.5$



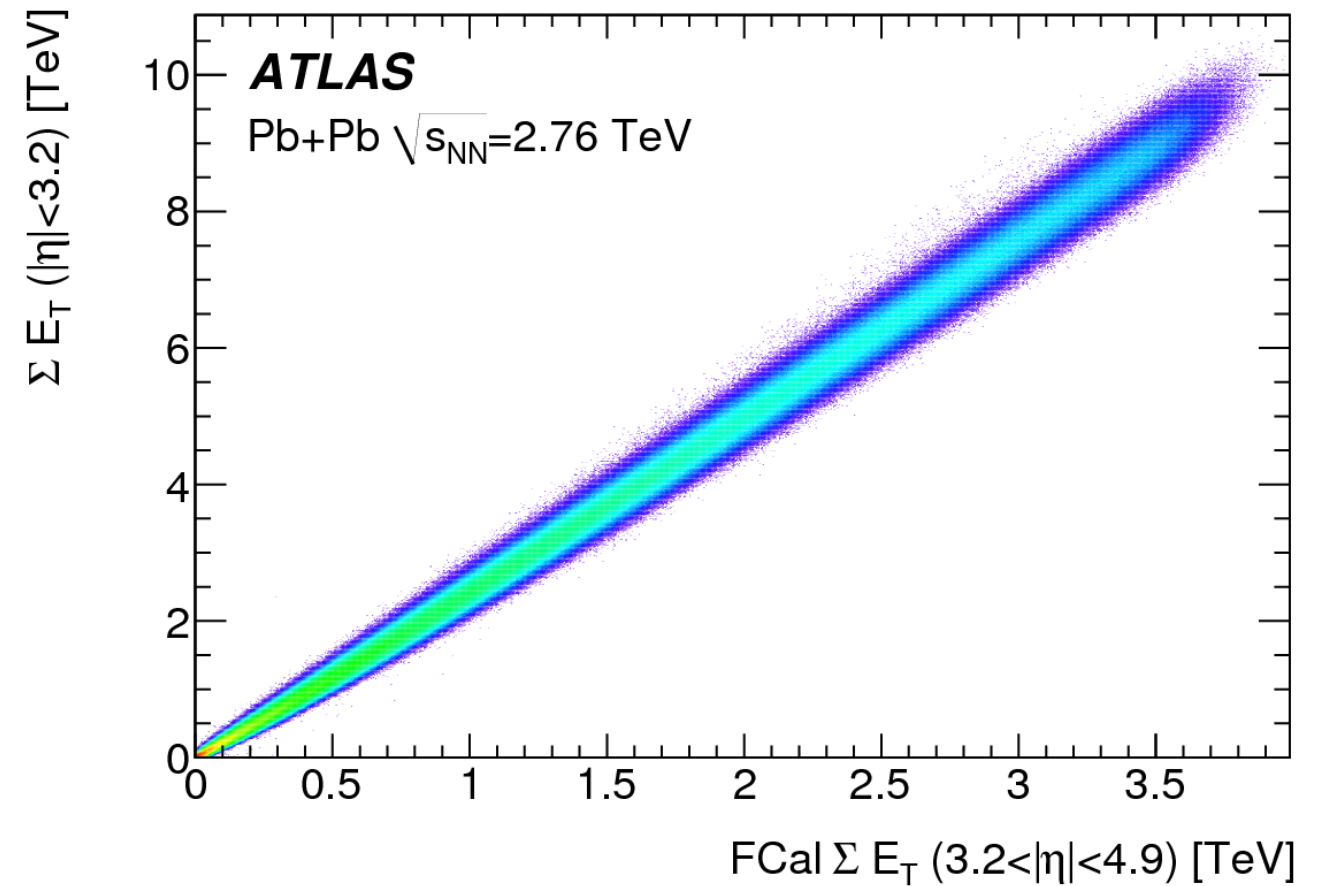
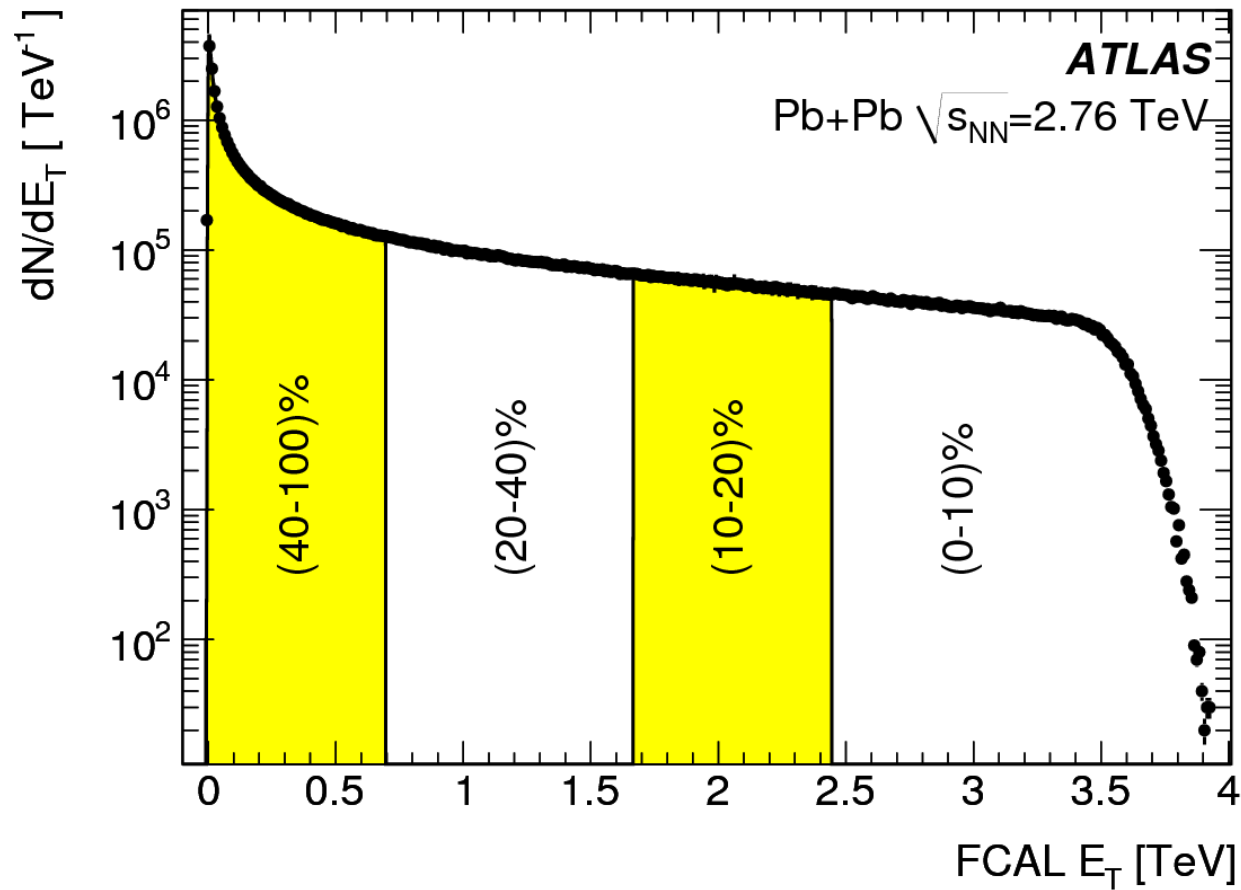
Calorimeters $|\eta| < 4.9$



Refurbished ZDC for Run3

Very first figures from ATLAS (PbPb)

[Phys. Rev. Lett. 105 \(2010\) 252303](#)

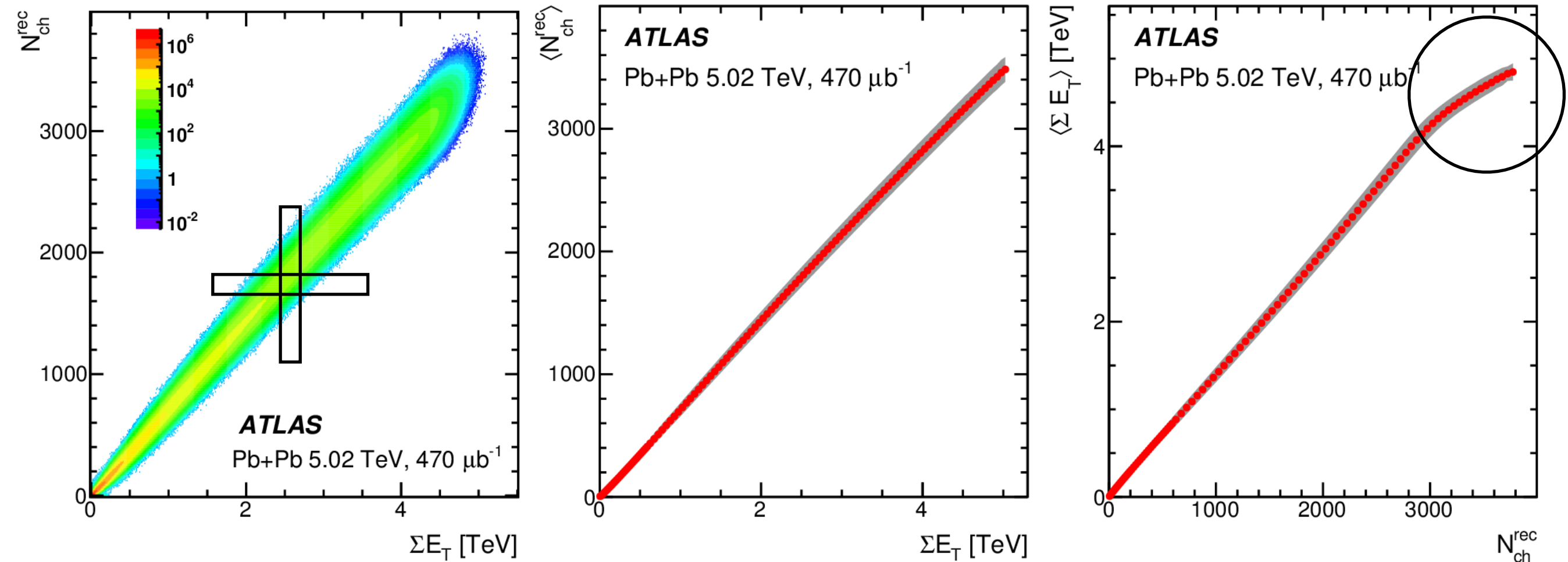


Main observable for centrality/event used in ATLAS since day one.

Tight correlation between forward and central rapidity.

FCal Sum ET vs Nch correlation

[JHEP 01 \(2020\) 51](#)

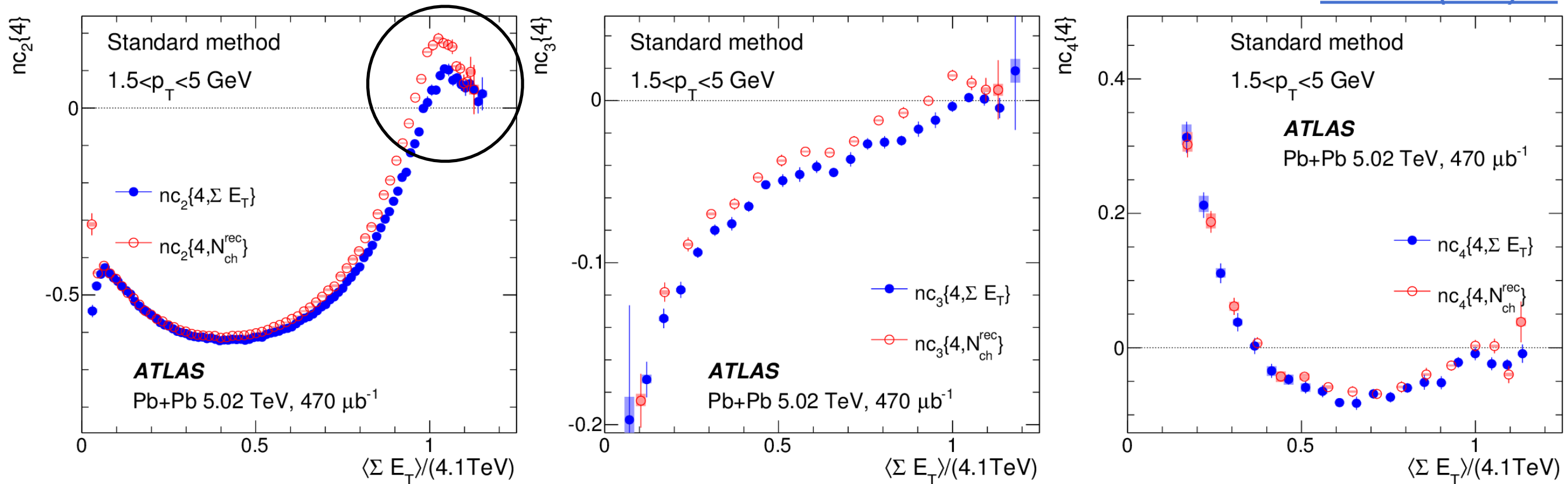


- In depth studies of the effect of centrality fluctuations
- Correlation between FCal Sum ET and Nch studied with events classified in narrow intervals of FCal Sum ET and Nch and match to the corresponding mean
 - ➔ Different reference event classes might have different sensitivity to the relative fluctuations

FCal Sum ET vs ntrk correlation

[JHEP 01 \(2020\) 51](#)

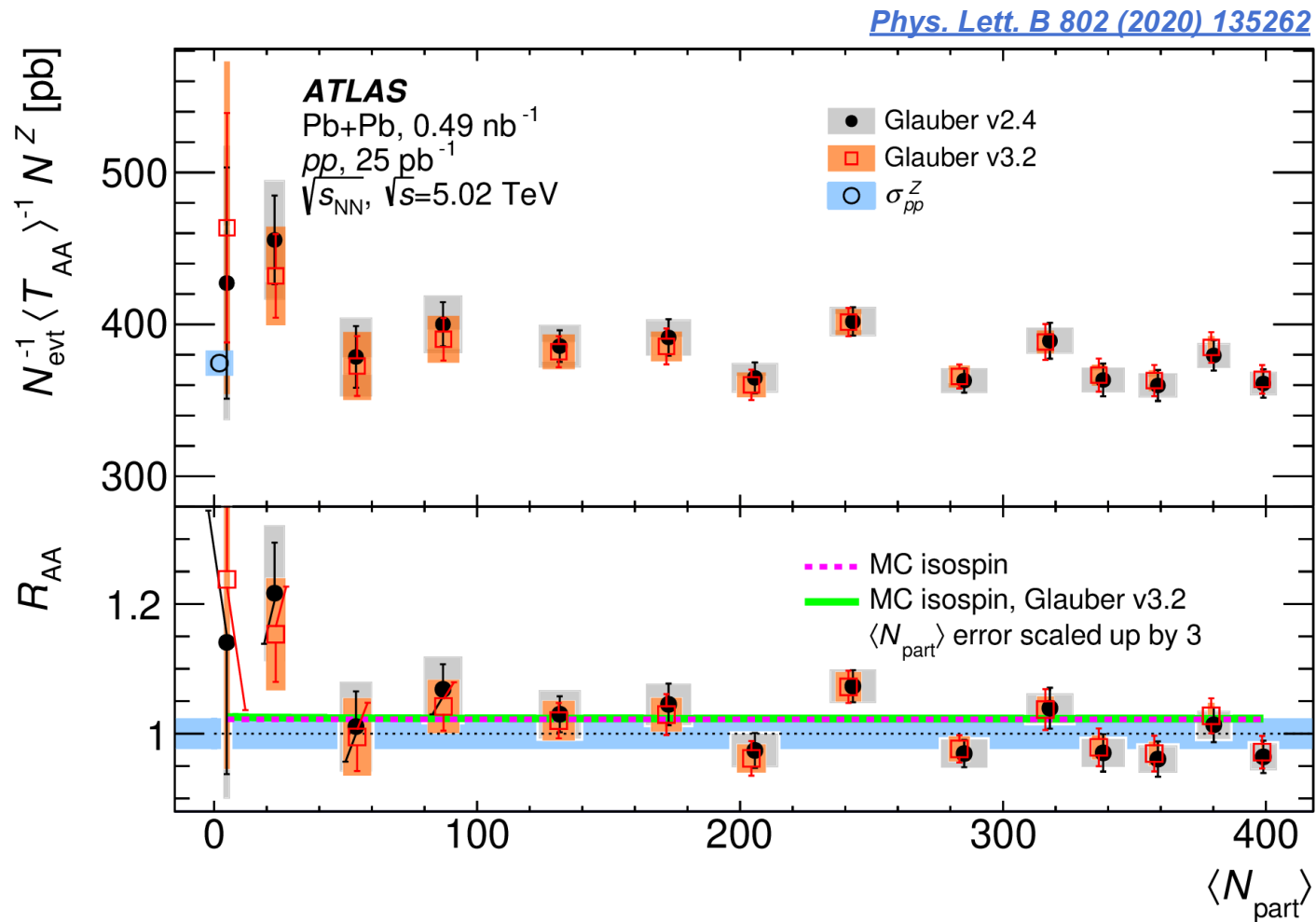
$$nc_n\{4\} = \frac{c_n\{4\}}{c_n^{a|c}\{2\}^2} = \frac{\langle v_n^4 \rangle}{\langle v_n^2 \rangle^2} - 2,$$



- Significant differences between the two reference event classes
 - ➔ Centrality fluctuations are the most significant in the ultra central region (steeply falling FCal Sum ET and Nch distributions), but ...
 - ➔ Not limited to the ultra central - differences persist even in mid-central
 - ➔ Different smearing of "real centrality" at mid and forward, due to ?

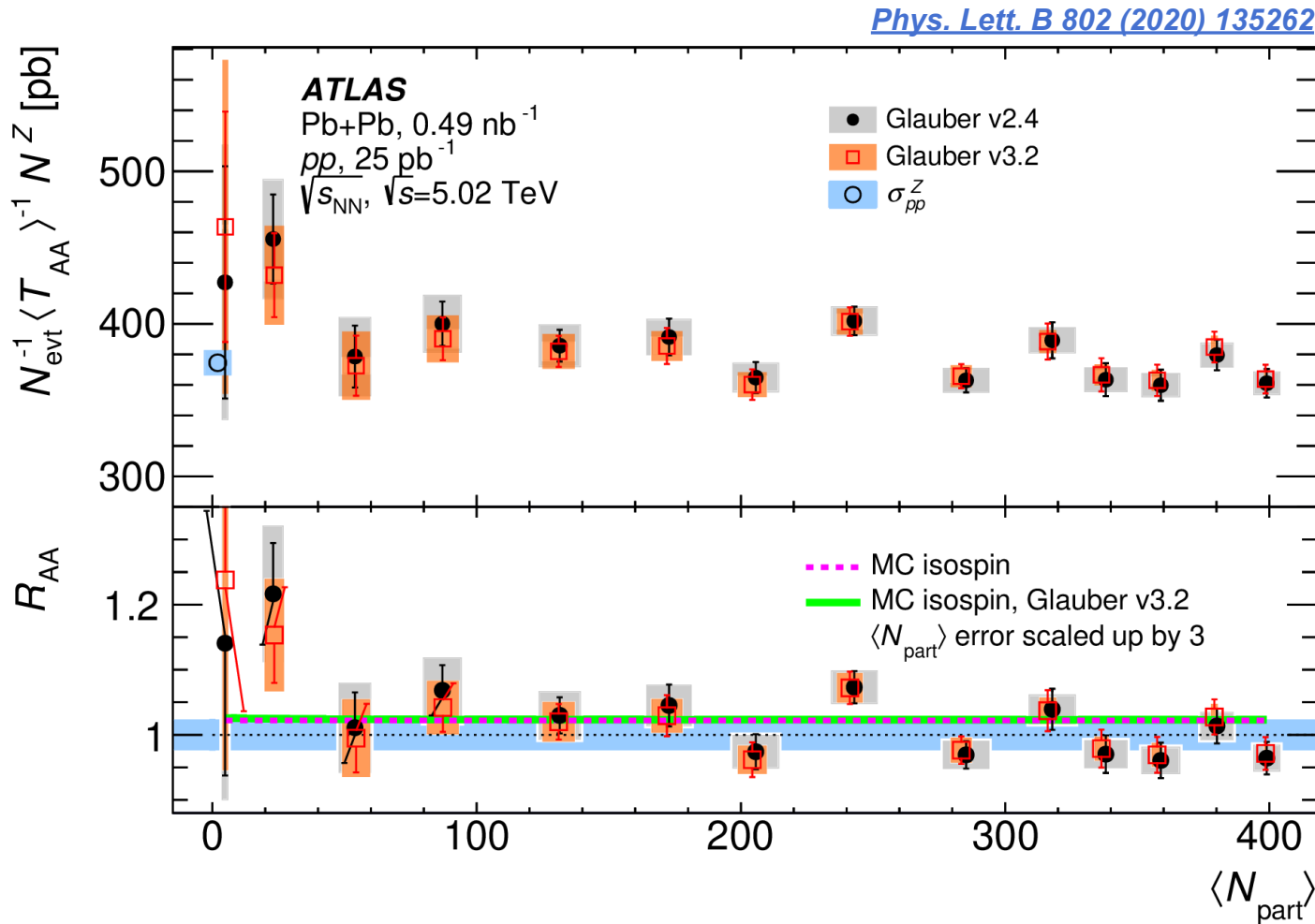
Calibration of centrality

- Non interacting probes to validate centrality
 - ➔ Limited stat./precision

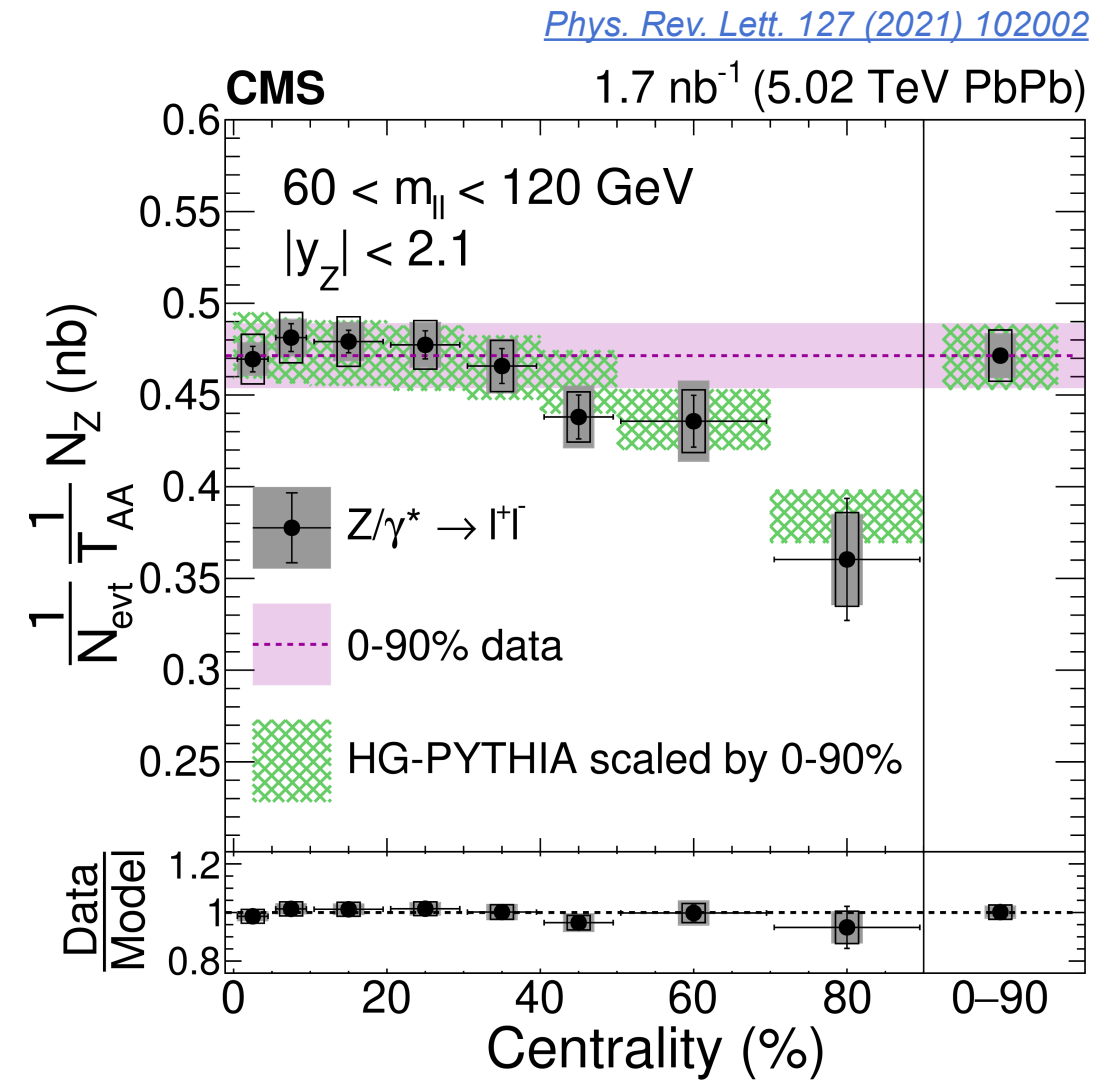


Calibration of centrality

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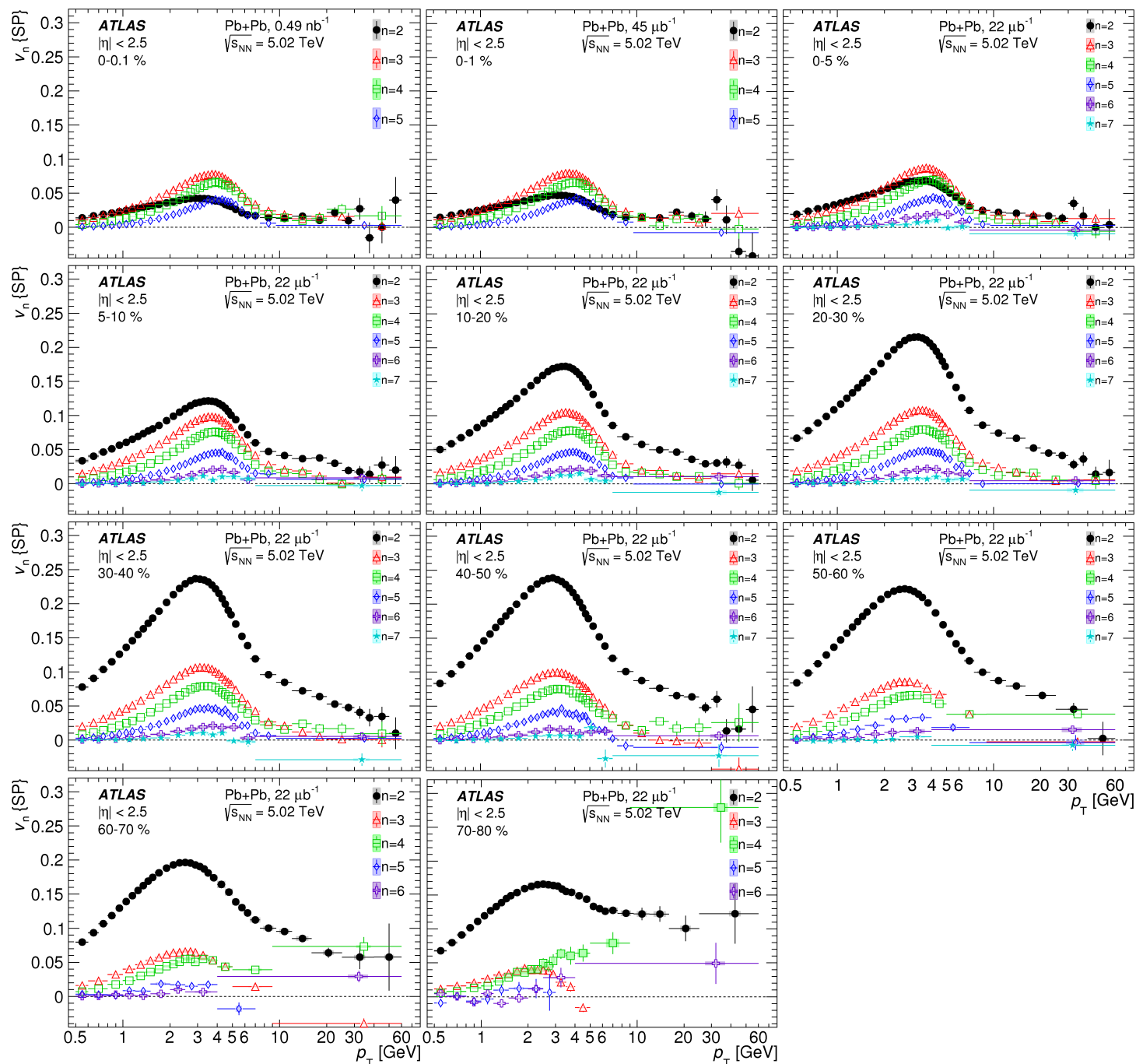
However ...



- ➔ Centrality definition ?
- ➔ Event selection ?

(Wild idea) Calibration of centrality

- Use well understood and well measured observable that depend on centrality - to cross validate centrality in the experiments



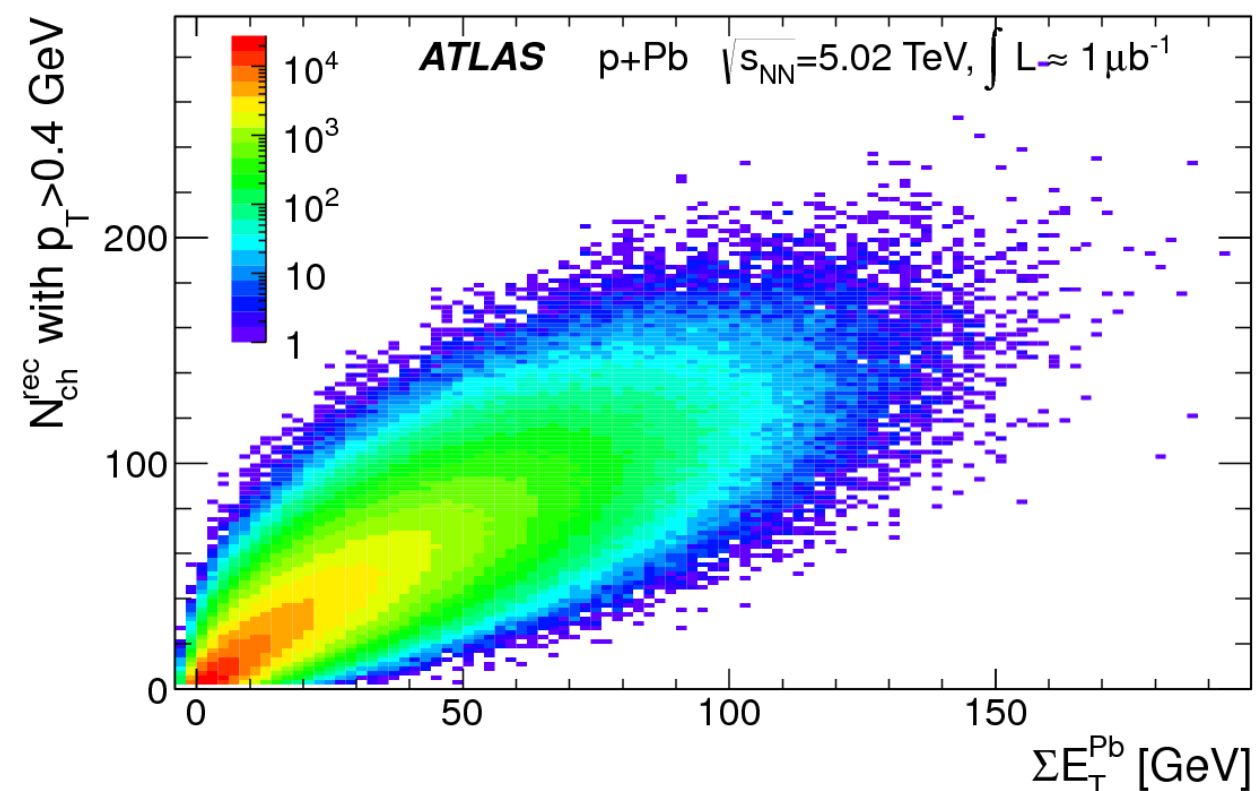
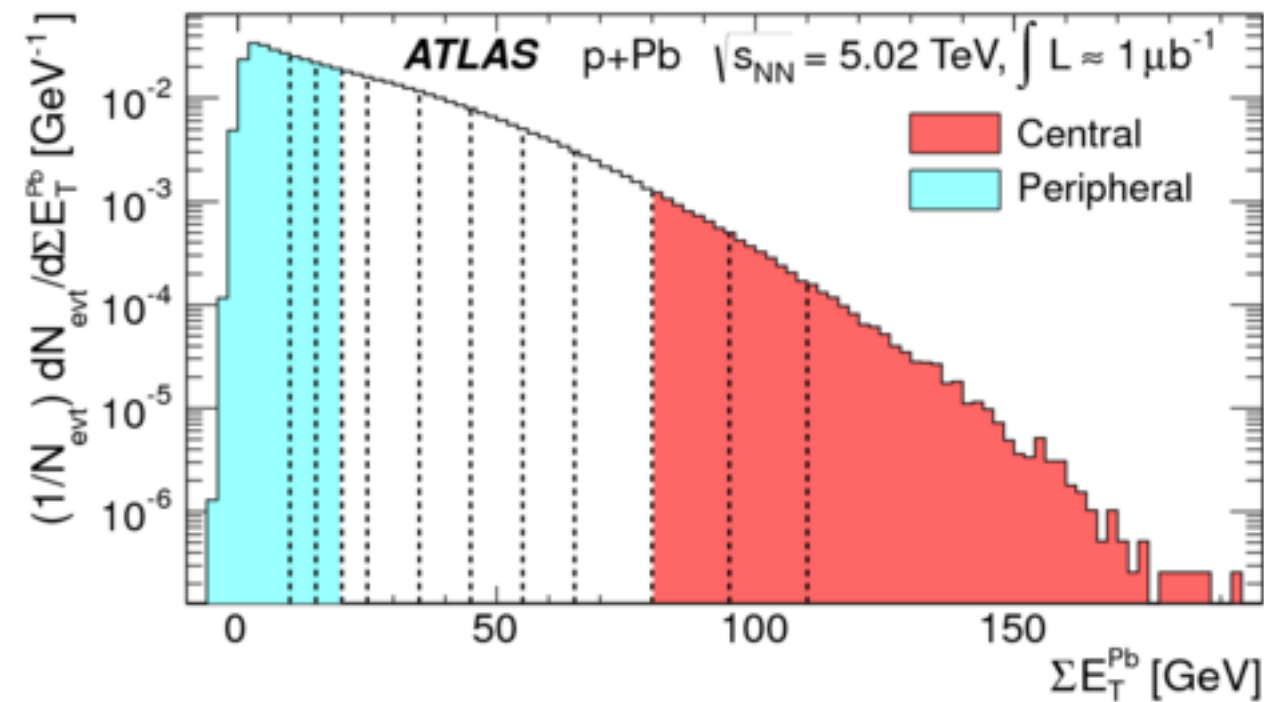
With the fixed

- Measurement method
- Acceptance (particles and event activity)
- Binning

All the remaining difference would be sensitive to centrality definition

Small systems

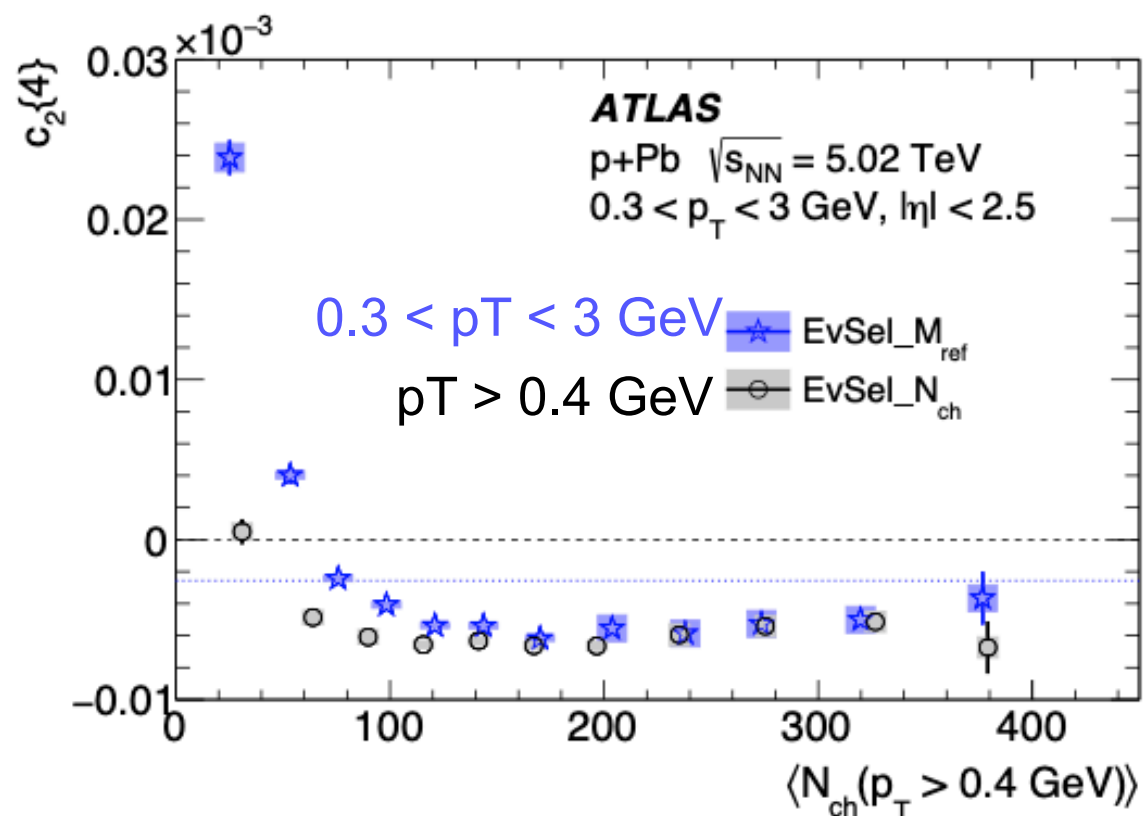
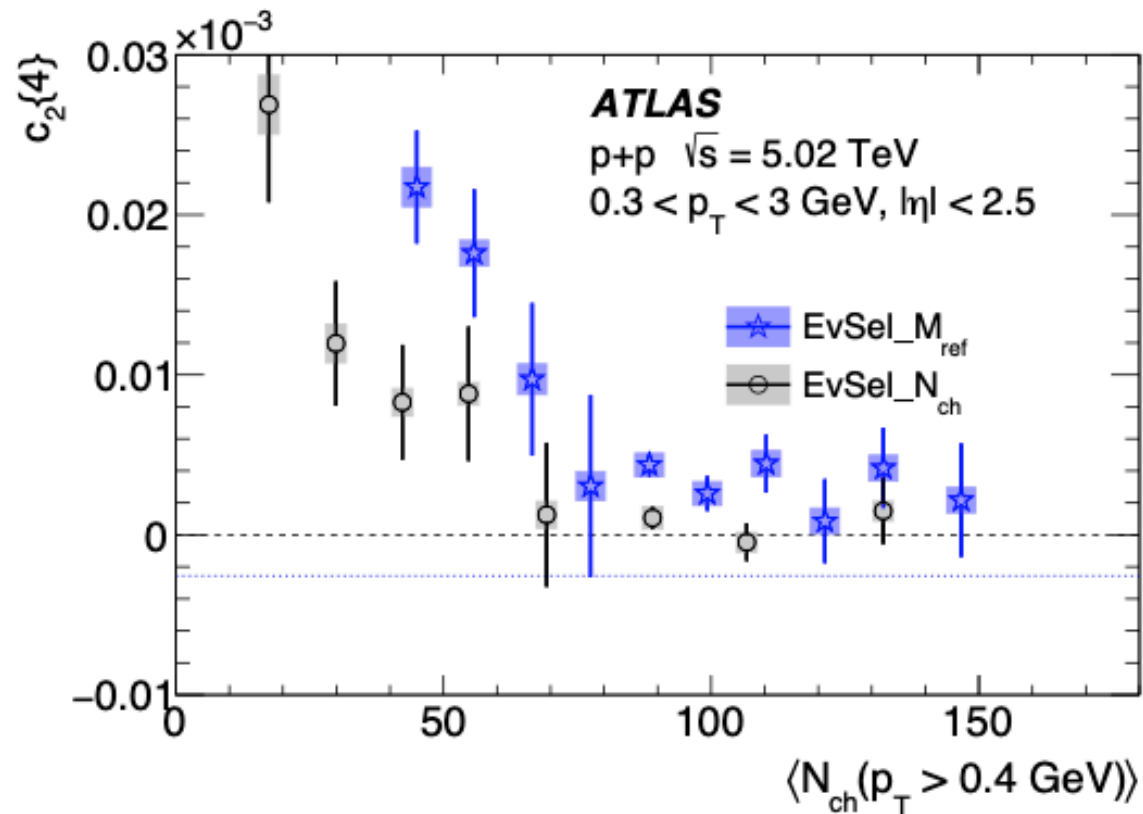
[Phys. Rev. Lett. 110, 182302 \(2013\)](#)



- Basically the same observables as used in PbPb used in the ATLAS measurements
 - ➔ Similar or stronger effect of centrality fluctuations
- Potential use of the ZDC for the centrality determination in pPb
- Multiplicity very useful in combining measurements from different small systems

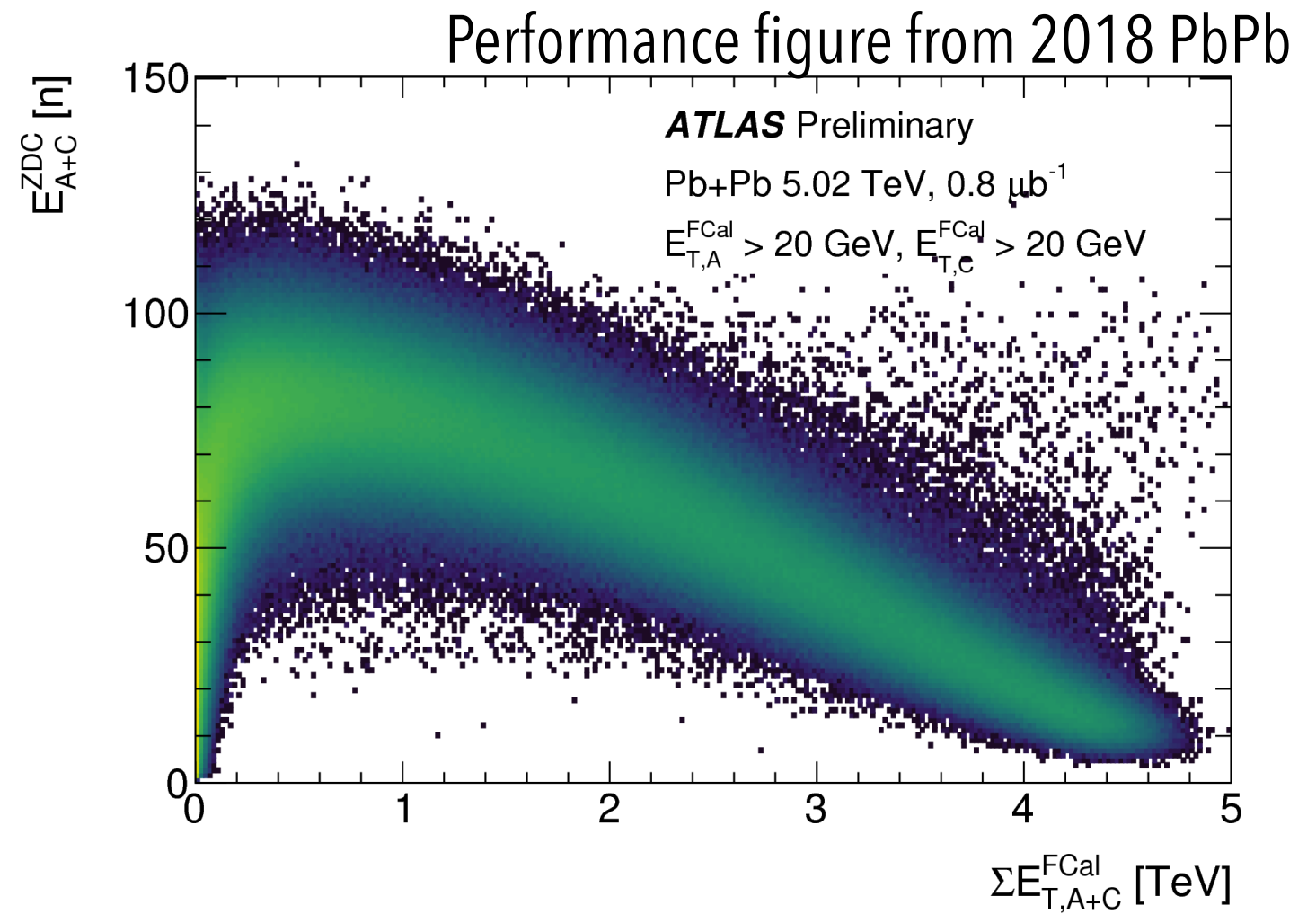
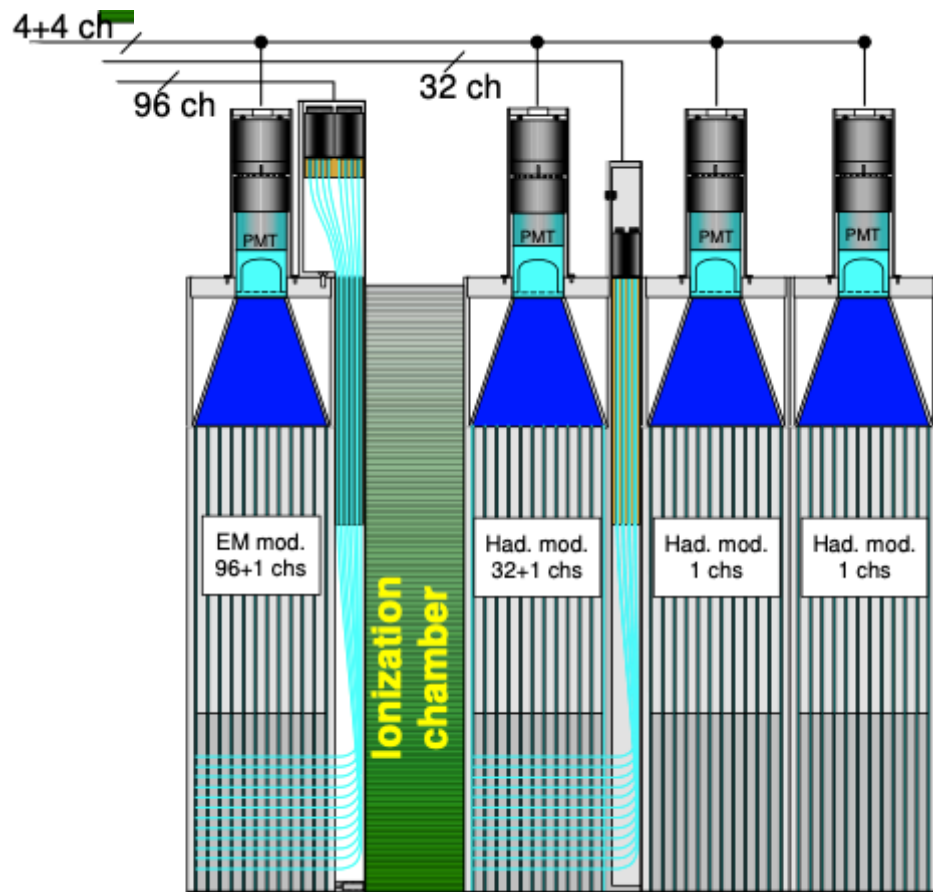
Small systems

[Eur. Phys. J. C 77 \(2017\) 428](#)



- Basically the same observables as used in PbPb used in the ATLAS measurements
 - ➔ Similar or stronger effect of centrality fluctuations
- Potential use of the ZDC for the centrality determination in pPb
 - ➔ ZDC installed in 2016 pPb
- Multiplicity very useful in combining measurements from different small systems

ZDC updates for the Run3



- New radiation-hard quartz Cherenkov radiator
- New air core cables connecting the detectors and the readout/trigger ($\sim 200\text{m}$)
- New readout and trigger electronics
- Reaction plane detectors