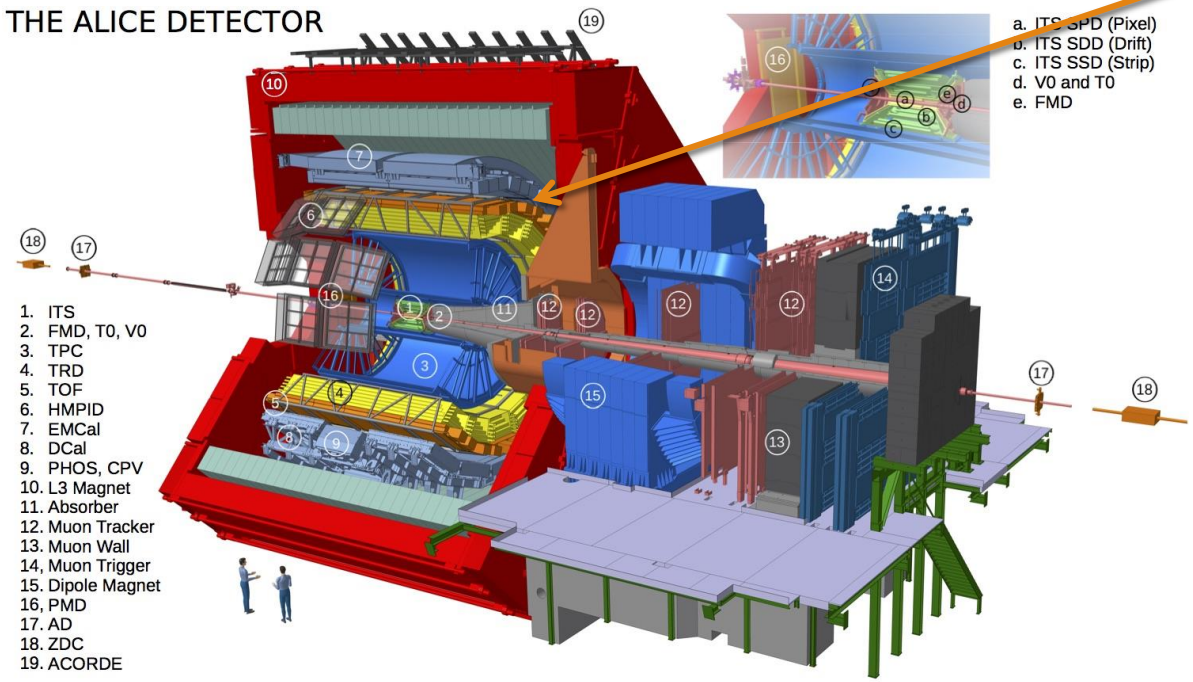
Analysis of the TOF single-channel performance by using cosmic rays triggered in the ALICE experiment during the 2016/17 data taking campaign

ZUZANA MORAVCOVÁ, CTU IN PRAGUE, CZECH REPUBLIC

SUPERVISOR: MANUEL COLOCCI, UNIVERSITY AND INFN BOLOGNA, ITALY

ALICE (A Large Ion Collider Experiment)

Heavy-ion experiment at the LHC devoted to study Quark Gluon Plasma



Time-Of-Flight detector

Multigap Resistive Plate Chamber (**MRPC**)

18 supermodules x 5 modules x 15-19 MRPCs = **152928 readout channels**

Large coverage (active area = 141 m^2)

Crucial in **PID** (from 0.3 GeV/c)

3 σ up to 2.5 GeV/c (π/K)

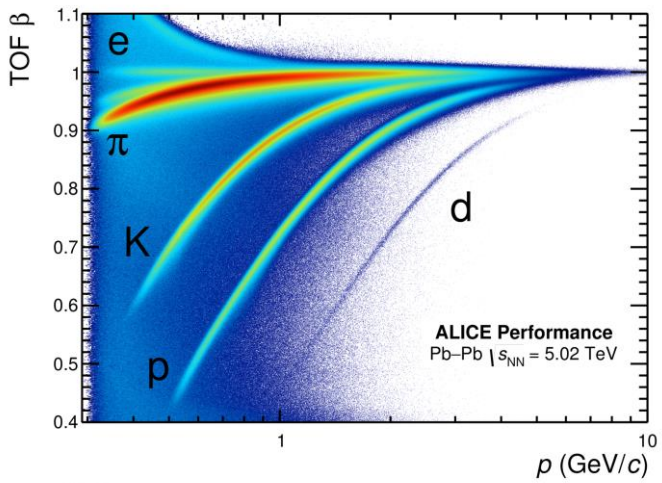
3 σ up to 4 GeV/c (p/K)

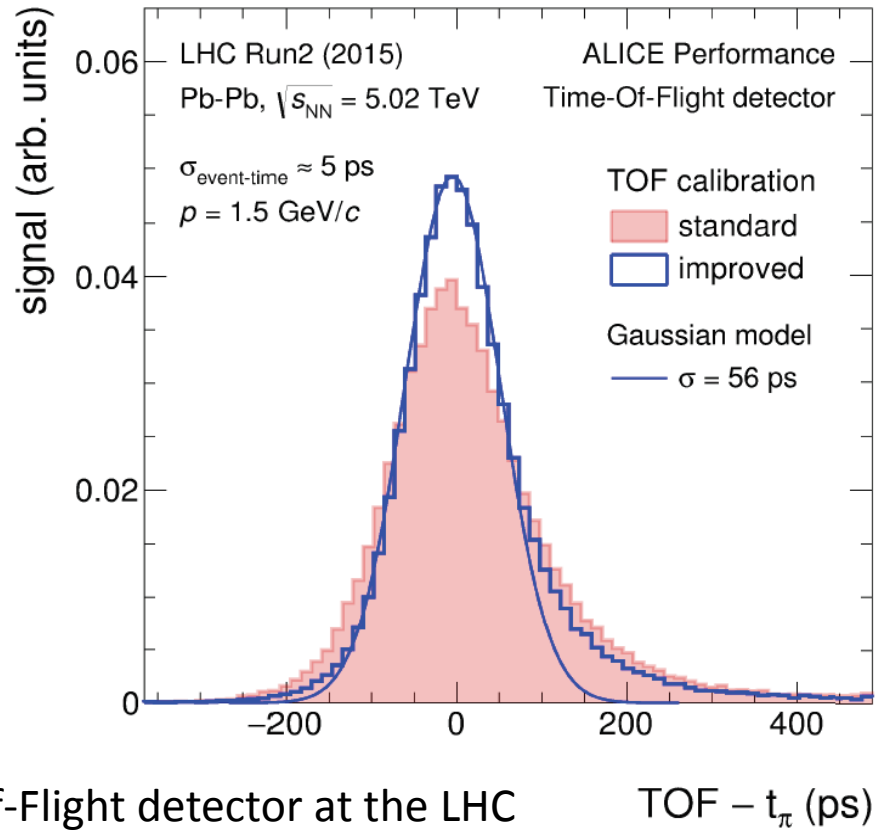
Time resolution σ = 56 ps

Time resolution in PbPb collisions

For fixed momentum (at p = 1.5 GeV/c π/K/p are well separated), high track multiplicity

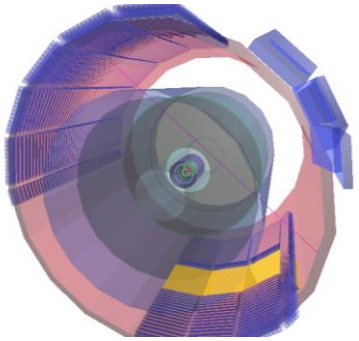
Resolution $\sigma = 56$ ps



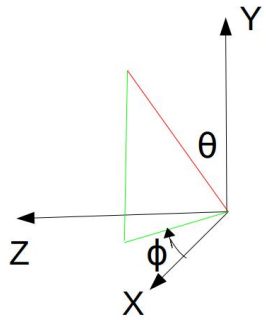


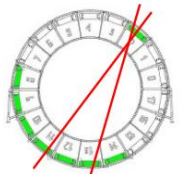
Performance of the ALICE Time-Of-Flight detector at the LHC
arXiv:1806.03825

Event selection

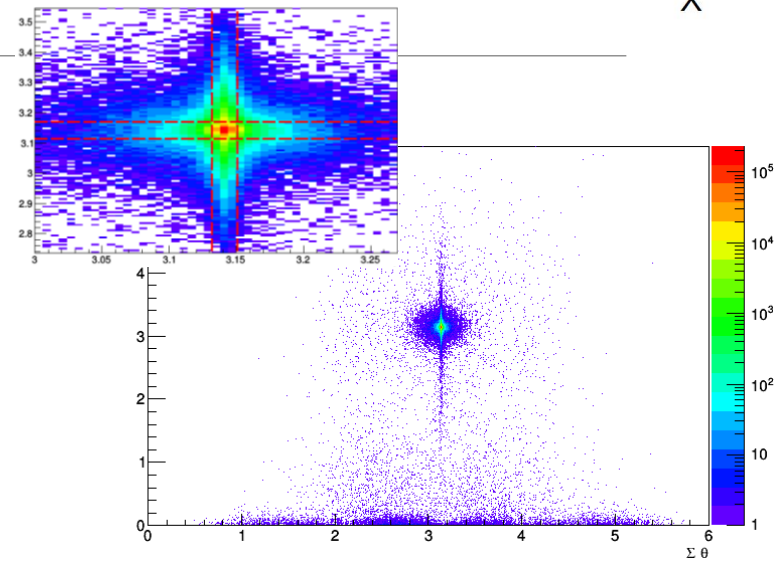


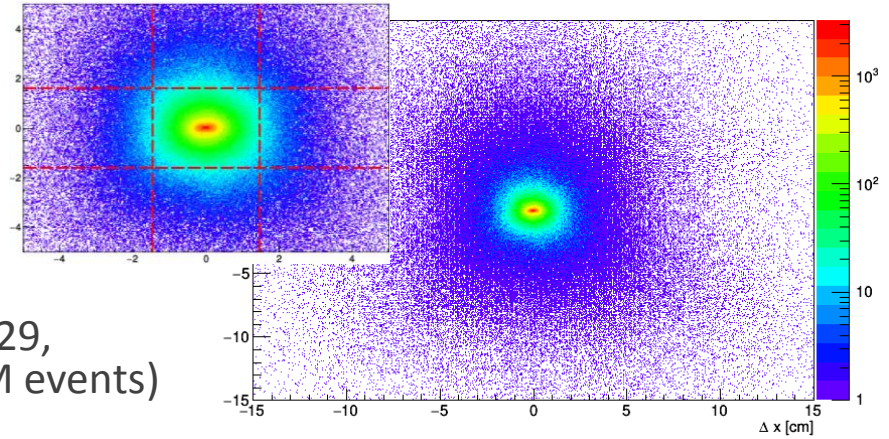
Cosmic event
B = 0 T





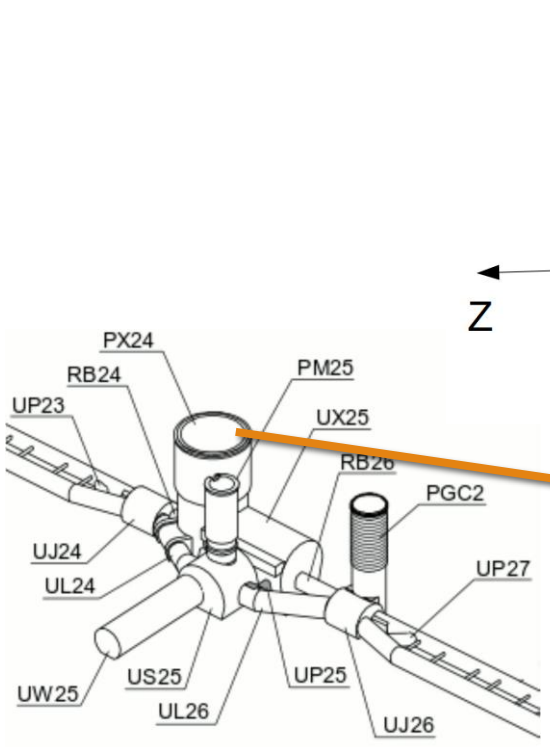
- TOF fired (trigger include OB3)
- Two tracks only
- Back-to-back tracks
  - 3 σ cuts on $\sum\theta$ and $\Delta\phi$, 3 σ cuts on Δx and Δy (from fitting the test run)
- Momentum cut (p > 2 GeV/c)
- Pseudorapidy cut ($|\eta| < 0.8$)
- Both hits at TOF

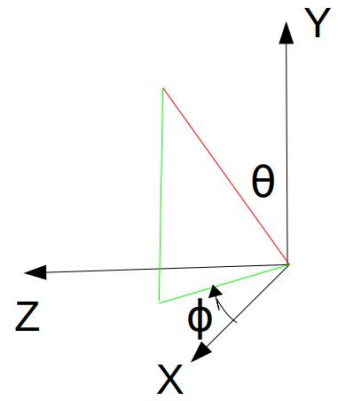




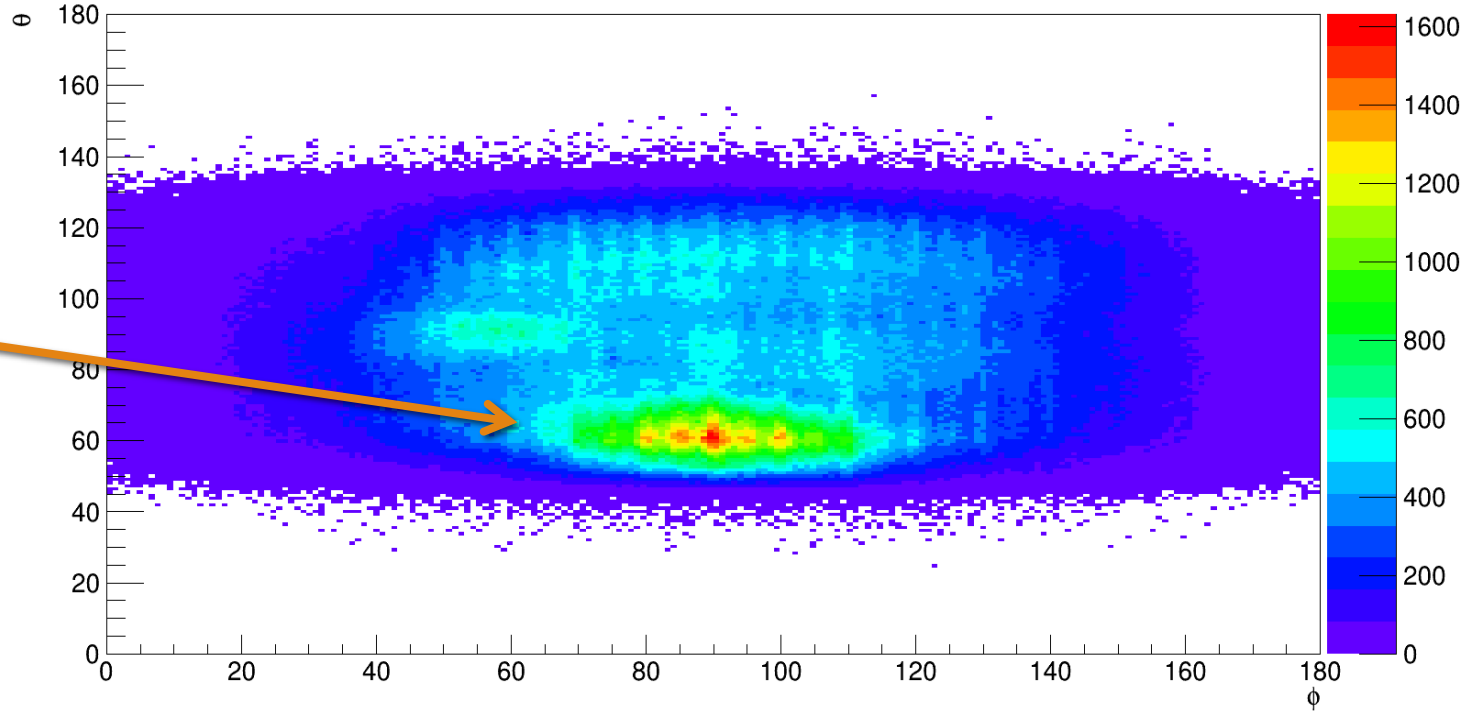
- Test run: 275878 (1.4M OB3 triggered events)
- All runs used in analysis: 246469, 273789, 273999, 274041, 274295, 274429, 275878, 276817, 276825, 276871, 276950, 279803, 279804, 281375 (7.6M events)

Angular distribution of selected cosmics



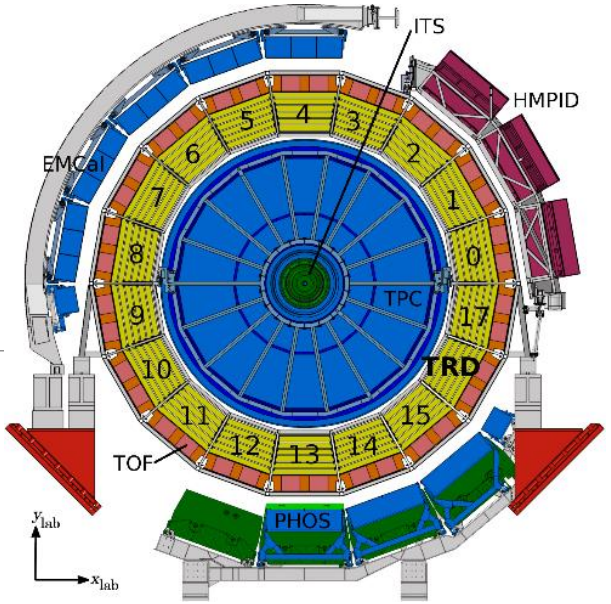


Visible structure of ALICE cavern

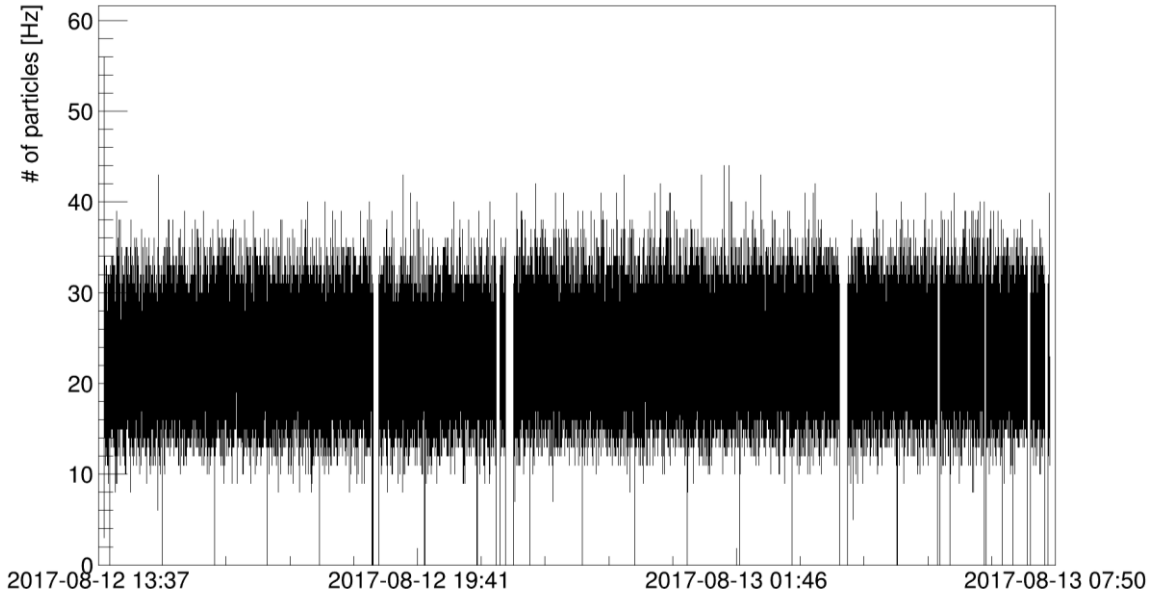


Triggered cosmics

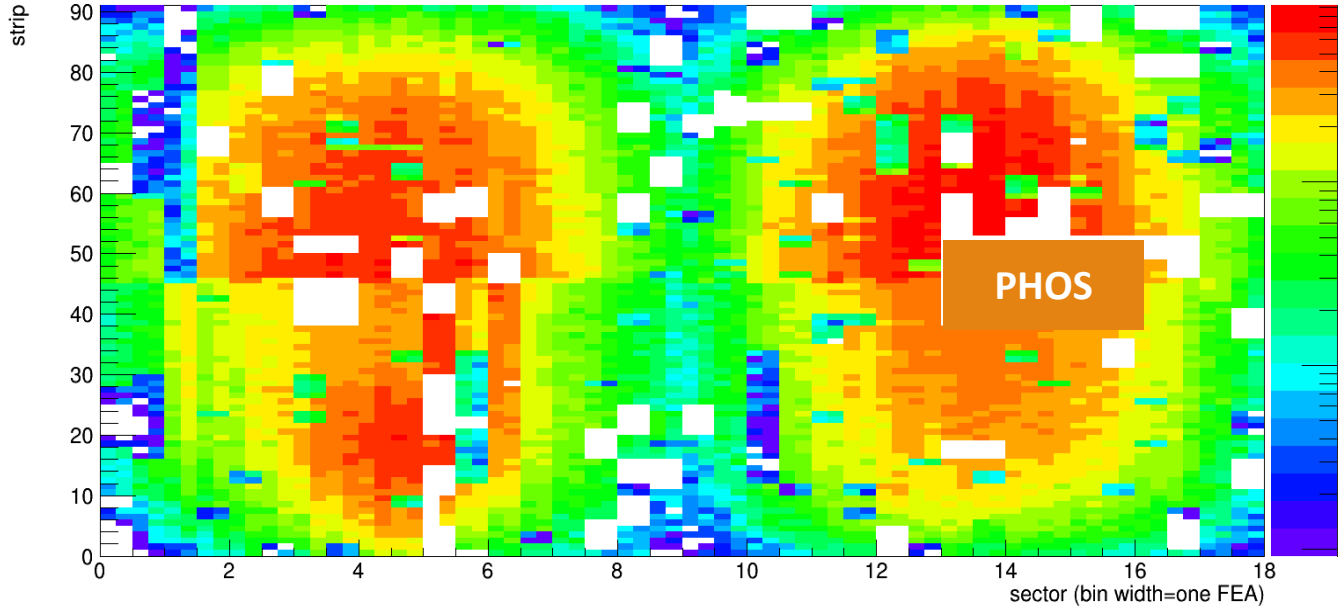
Very clean events



N/t for selected cosmics – test run (275878)



Map of hits in TOF



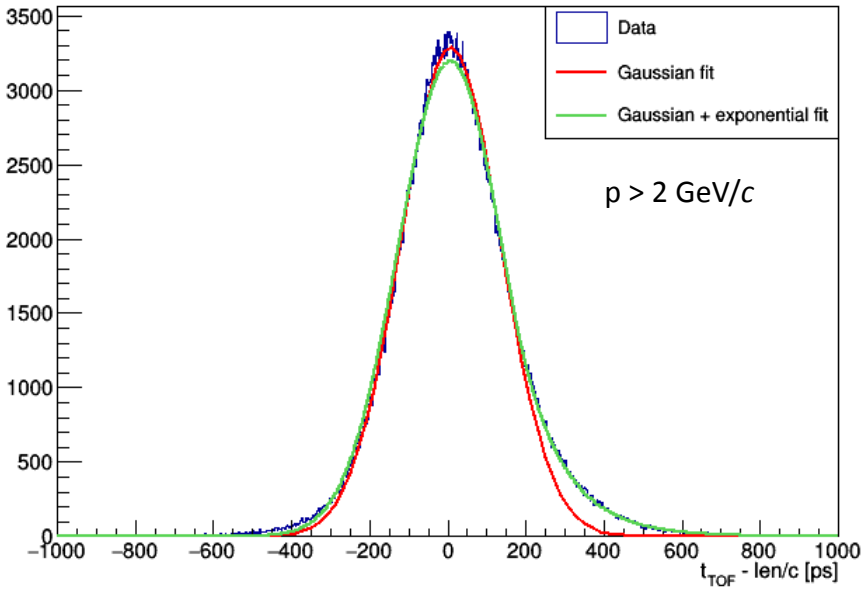
Time resolution

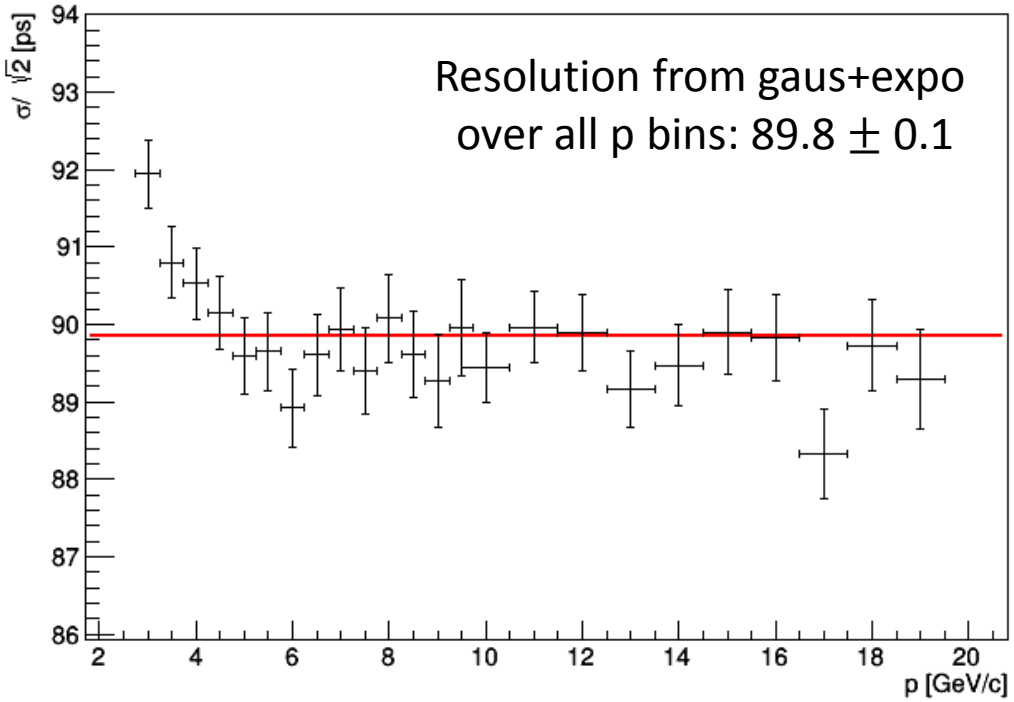
Gaus + expo:

$$\exp\left(-\frac{(x-\langle x\rangle)^2}{2\sigma^2}\right) \text{ for } x < \langle x\rangle + \tau\cdot\sigma$$

$$\exp\left(-(x-\langle x\rangle-\frac{\tau\cdot\sigma}{2}\right)\frac{\tau}{\sigma} \text{ for } x > \langle x\rangle + \tau\cdot\sigma$$

- **Resolution = $\sigma/\sqrt{2}$**
- Stable for different *p* bins

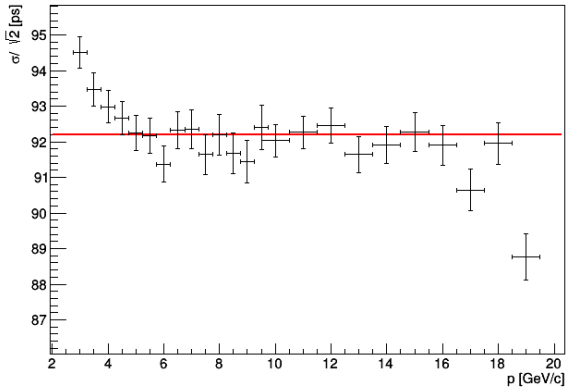




Fit parameters

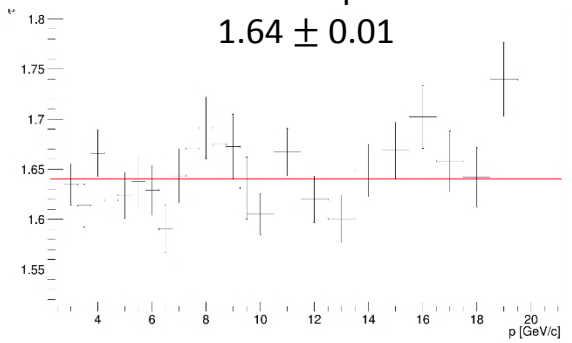
Gaussian: $\langle x\rangle = -3.8 \pm 0.2$, $\sigma = 120.6 \pm 0.3$

Gaussian + exponential: $\langle x\rangle = -5.9 \pm 0.2$, $\sigma = -127 \pm 0.2$, $\tau = -1.58 \pm 0.01$



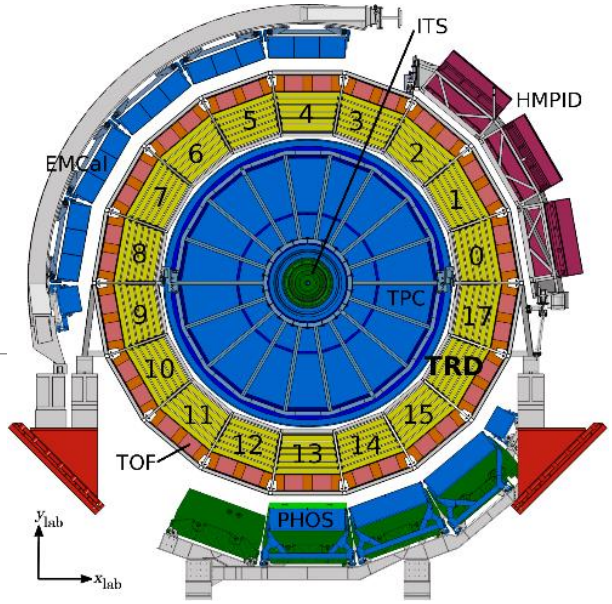
Resolution from gaus
over all p bins: 92.2 ± 0.1

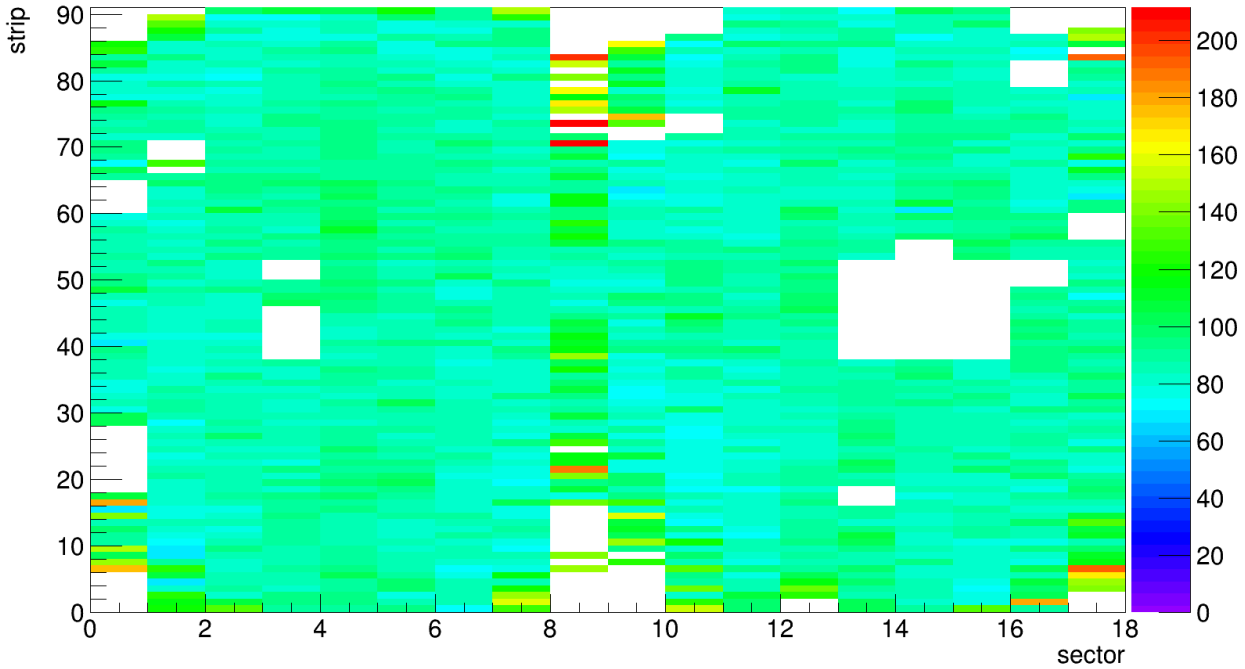
Tau over all p bins:
1.64 ± 0.01

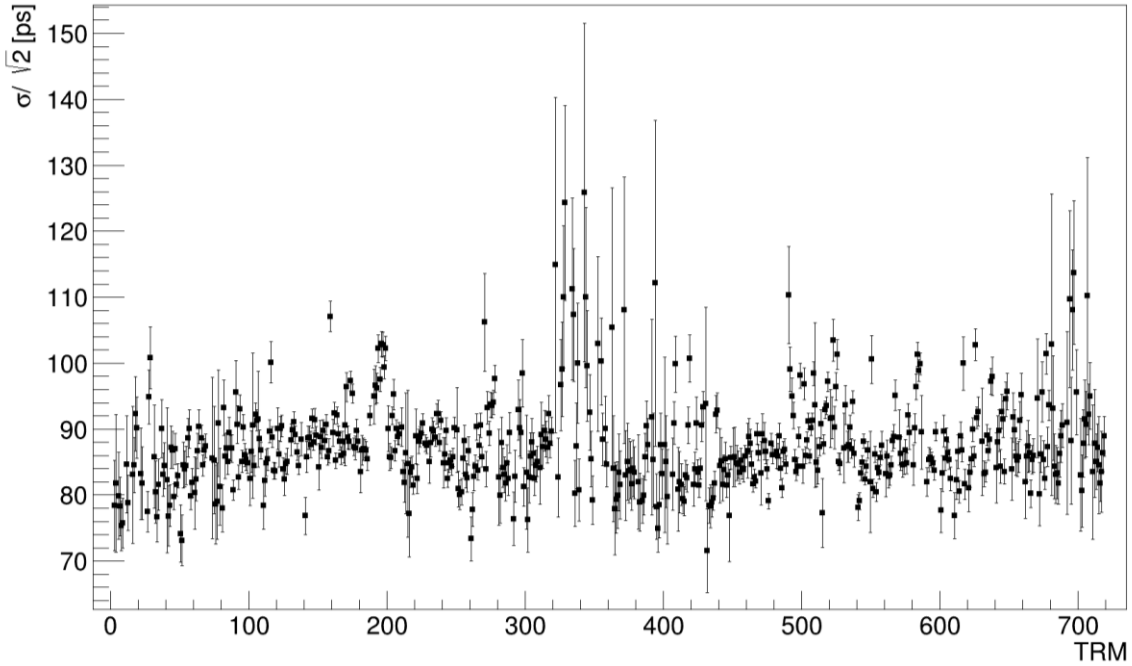


Time resolution

- Stable for all levels of granularity (with sufficient statistics)
  - sectors x strips
  - TRM (TDC readout module)







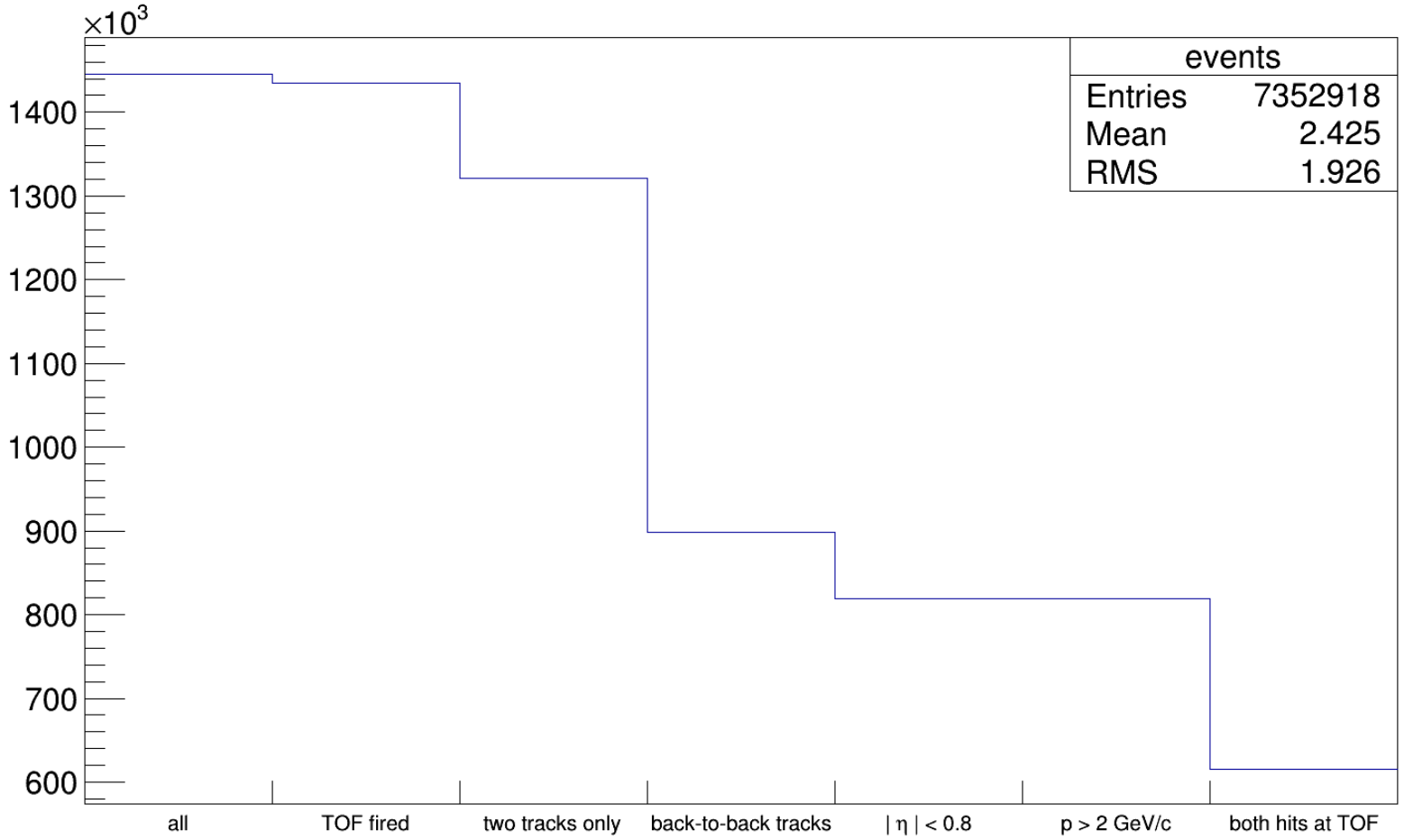
Conclusion and outlook

- Selected cosmic events are very clear
- Resolution of TOF from cosmic analysis ~ 90 ps
  - Just preliminary number!
- Uniformity across strips and TRMs checked

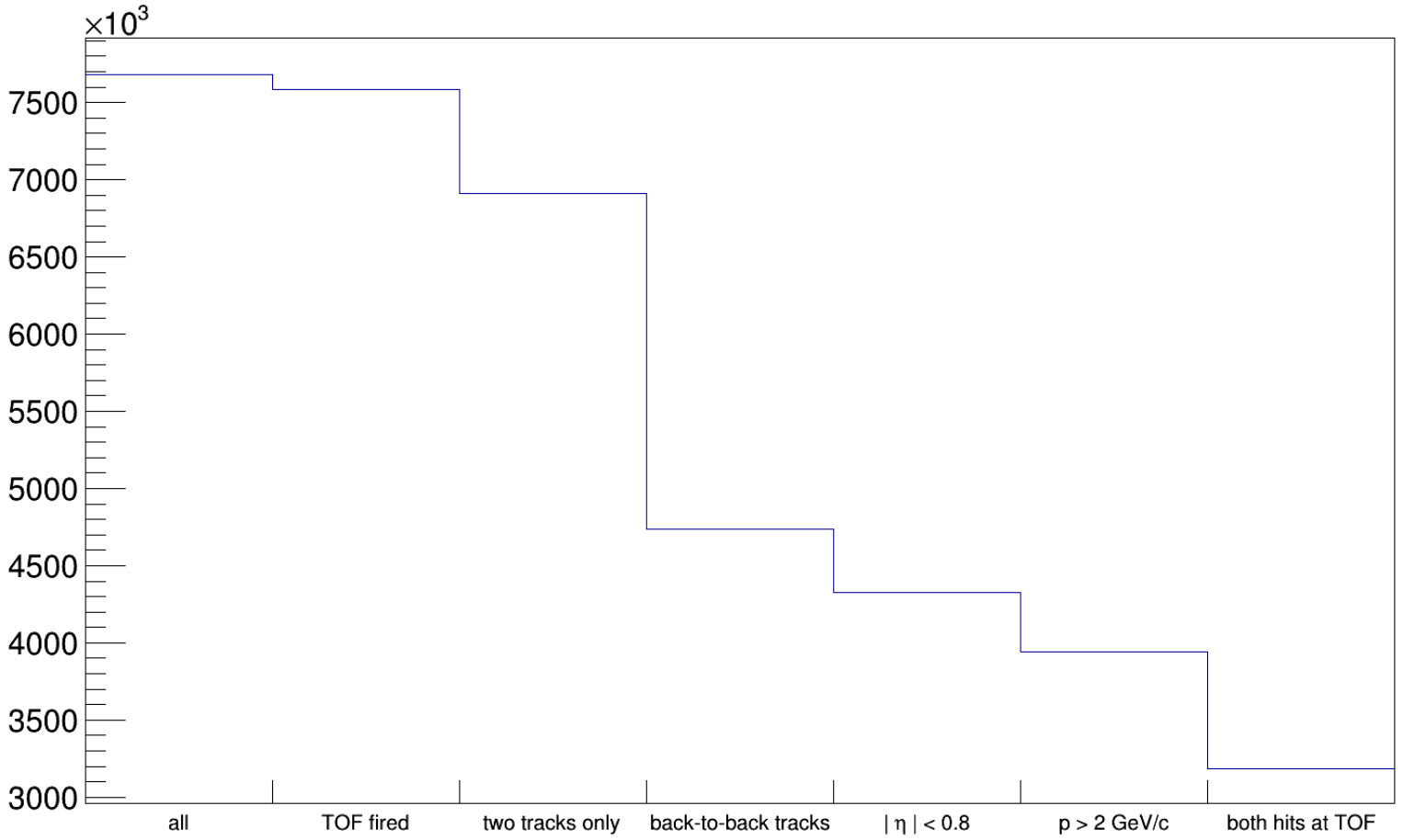
- **TO DO**:
  - Increase statistics to increase the granularity reached by the present study (down to the single channel)
  - Compare with pp data

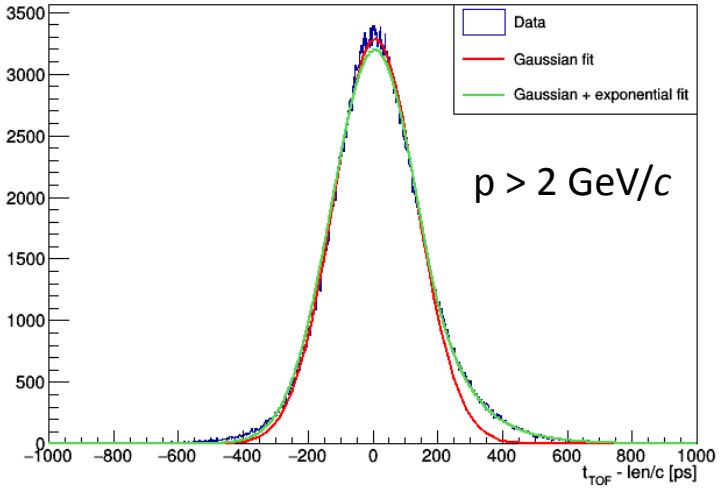
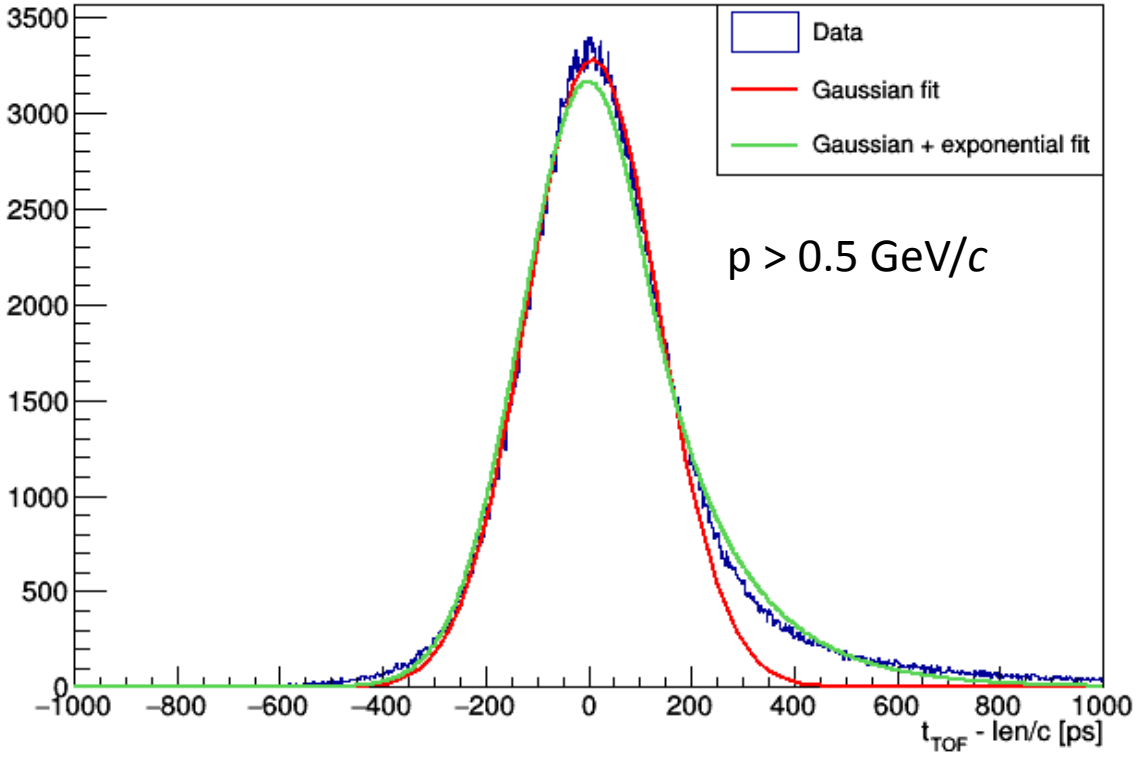
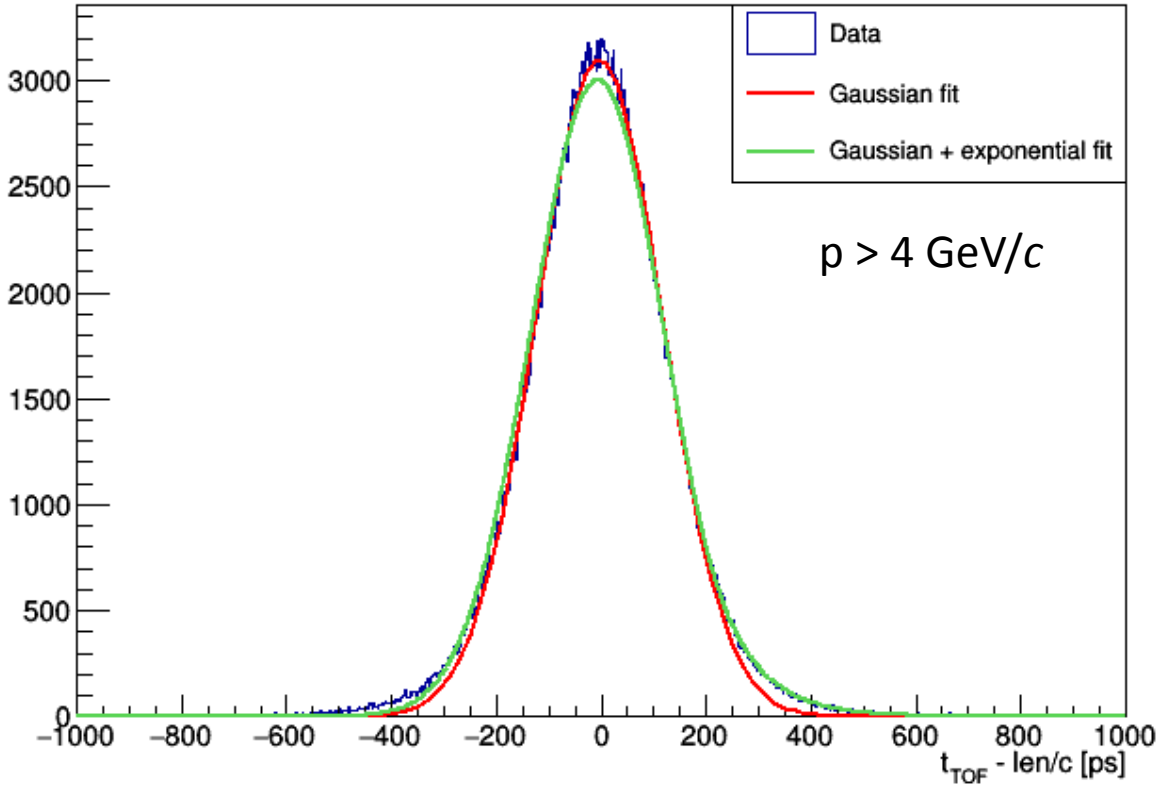
Back up

Event selection statistics – test run



Event selection statistics – all data



Time resolution

No need to use gaussian + exponential in higher momentum bins (p > 2 GeV/*c*)