

Report on the QA and run-by-run systematics in the Xe+Cs(I) run

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BM@N meeting, 14/05/2024



Outline



1. BM@N Experiment
2. QA Run-by-Run:
 - a. Events
 - b. Tracks
3. Conclusions and plans

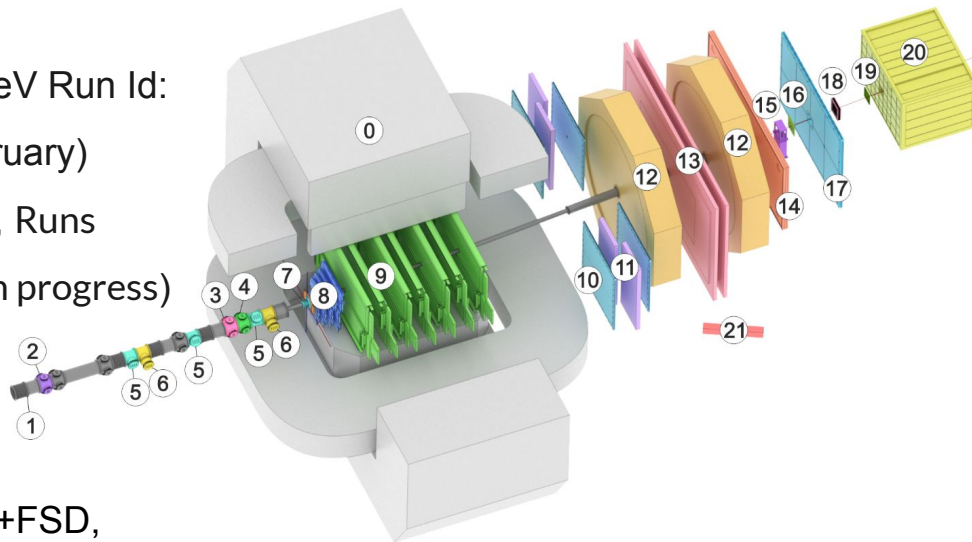
The BM@N experiment

Data:

- run8 Xe-Csl @3.8A GeV Run Id:
 - 6600-8300 (February)
 - 7200-8300 (May, Runs 6900-7200 are in progress)
- VF tracking was used

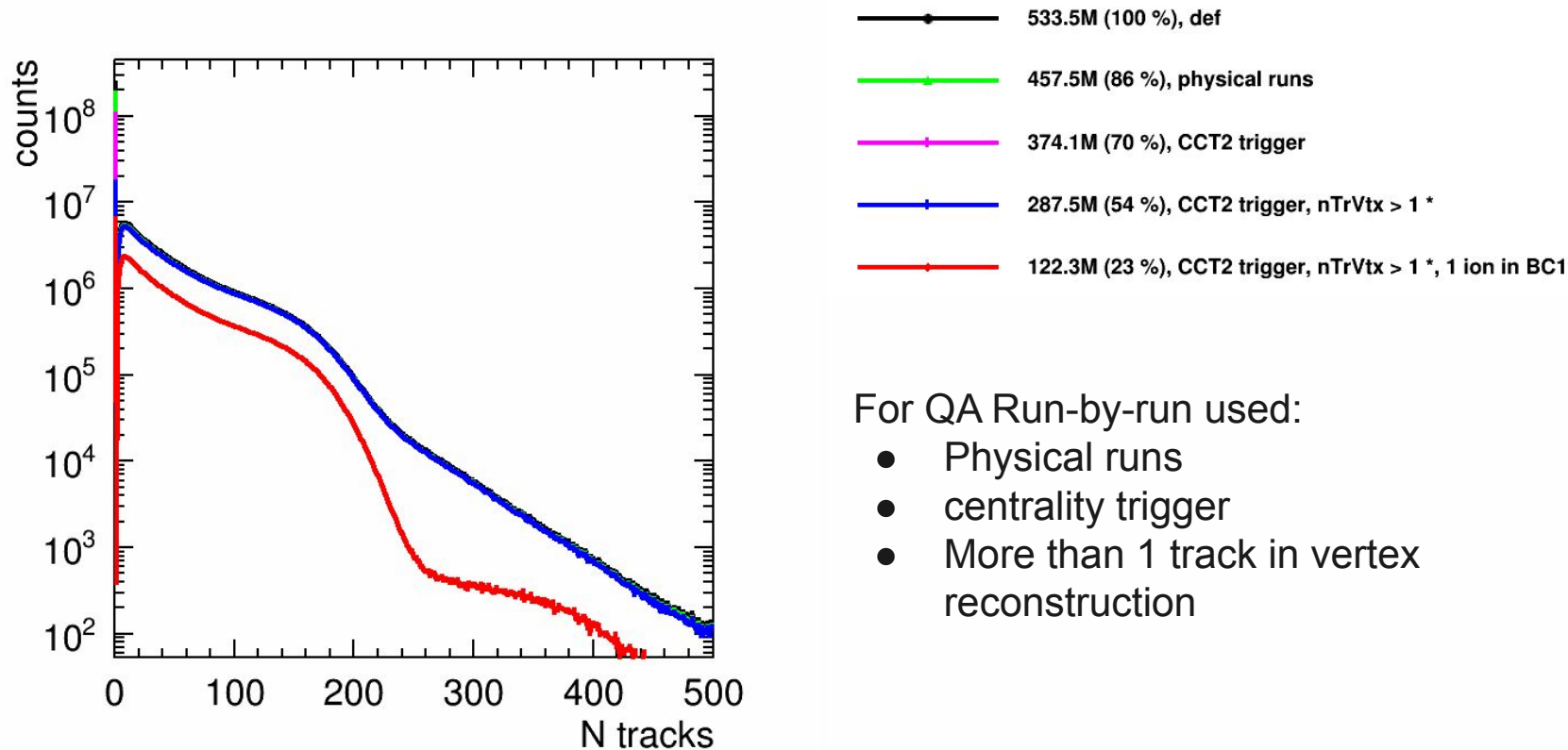
QA Run-by-Run:

- Tracking system GEM+FSD,
- BC, FD
- FHCal
- FQH
- TOF-400, TOF-700



- Magnet SP-41 (0)
- Vacuum Beam Pipe (1)
- BC1, VC, BC2 (2-4)
- SiBT, SiProf (5, 6)
- Triggers: BD + SiMD (7)
- FSD, GEM (8, 9)
- CSC 1x1 m² (10)
- TOF 400 (11)
- DCH (12)
- TOF 700 (13)
- ScWall (14)
- FD (15)
- Small GEM (16)
- CSC 2x1.5 m² (17)
- Beam Profilometer (18)
- FQH (19)
- FHCal (20)
- HGN (21)

Basic selection



For QA Run-by-run used:

- Physical runs
- centrality trigger
- More than 1 track in vertex reconstruction

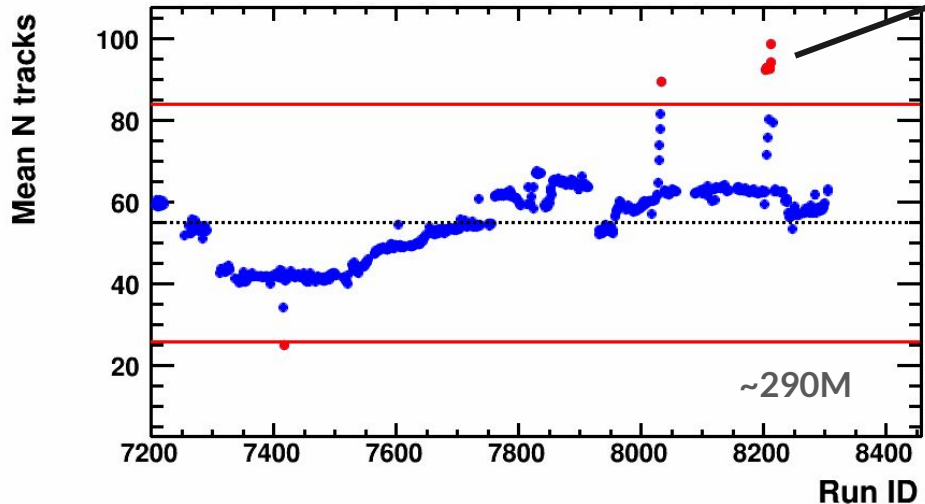
* nTrVtx>1: More than 1 track in vertex reconstruction

QA Run-by-Run: runs rejection

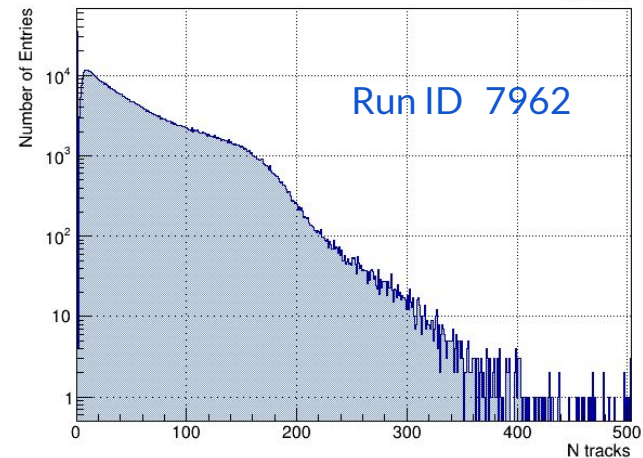
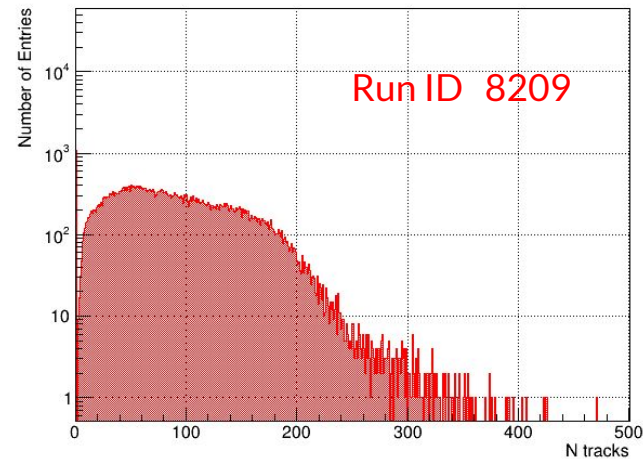
- CCT2
- More than 1 track in vertex reconstruction

Procedure: y_i – mean value by run ID

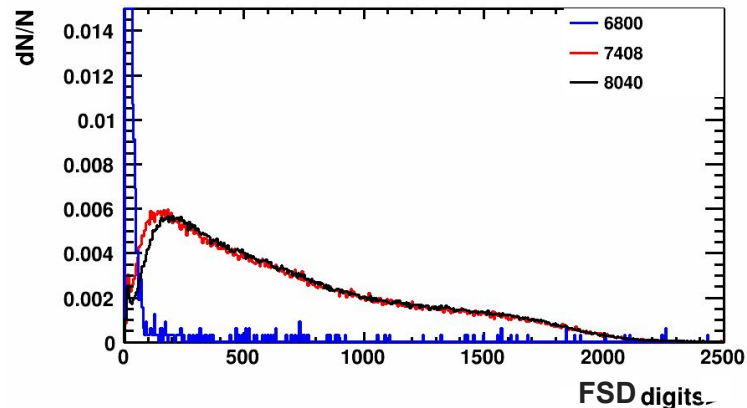
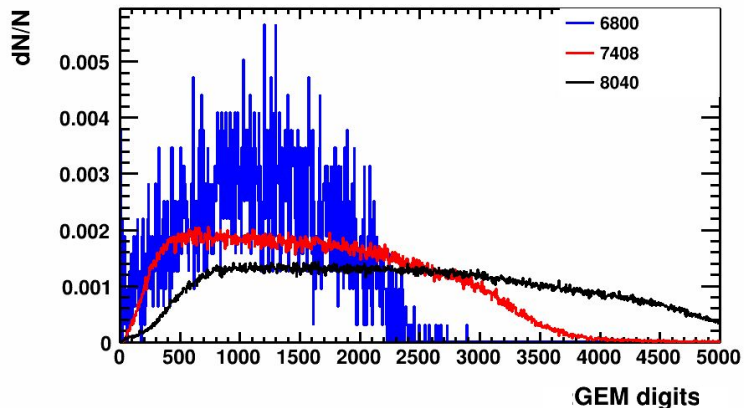
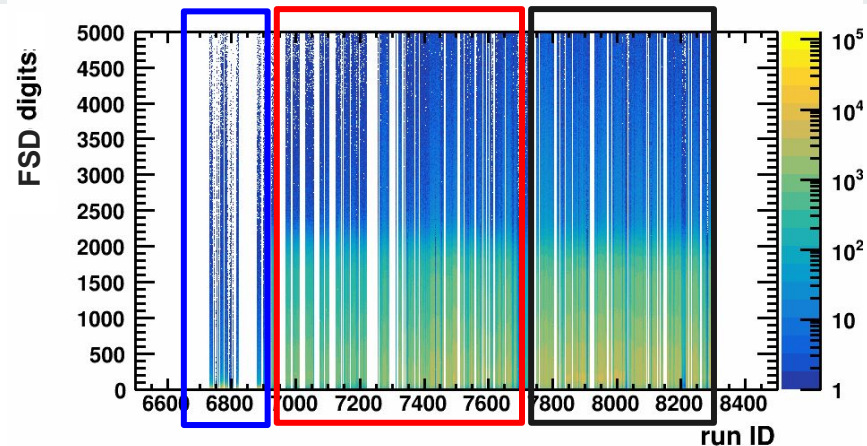
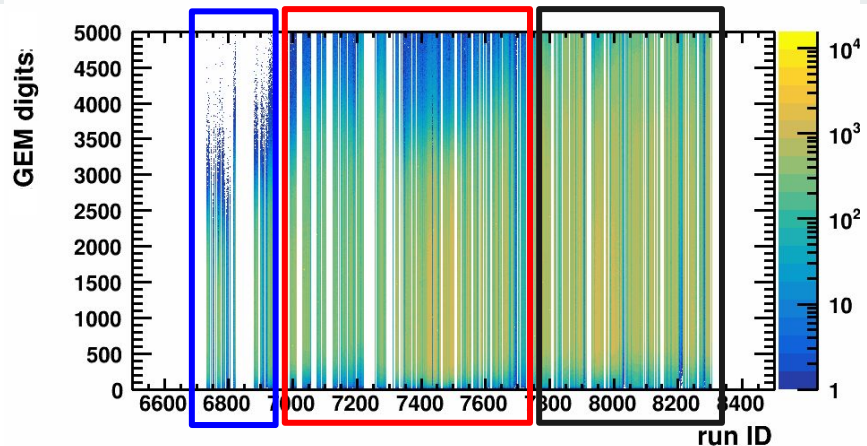
$$\mu = \frac{1}{N} \sum_{i=1}^N y_i \quad \sigma = \sqrt{\frac{\sum (y_i - \mu)^2}{N}}$$



Bad run ID (beyond $\pm 3\sigma$): 7417, 8033, 8204, 8205, 8209, 8210, 8211, 8212, 8213

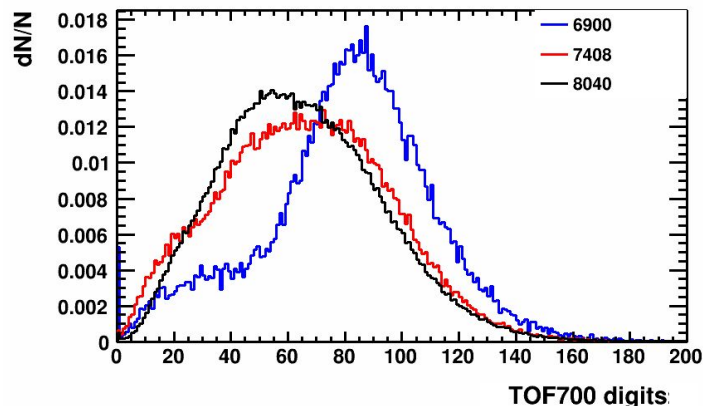
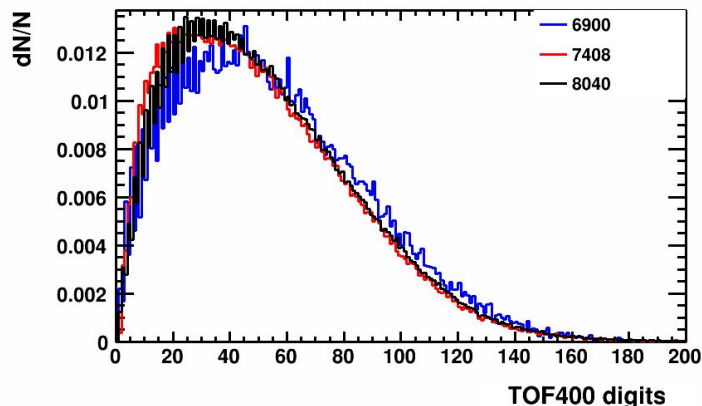
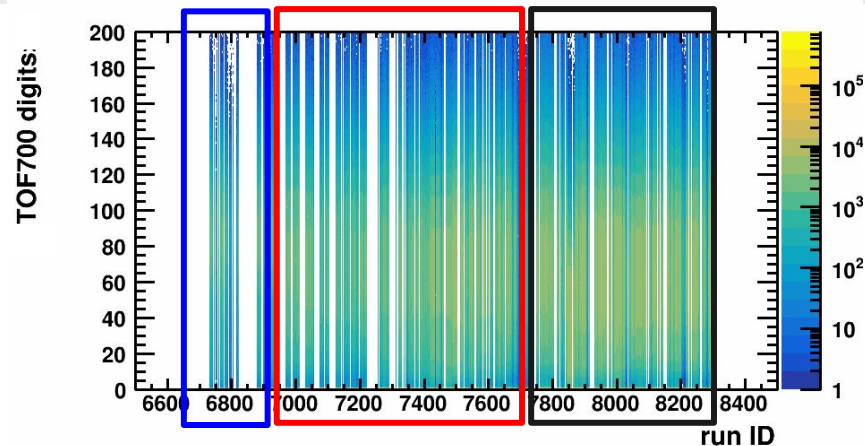
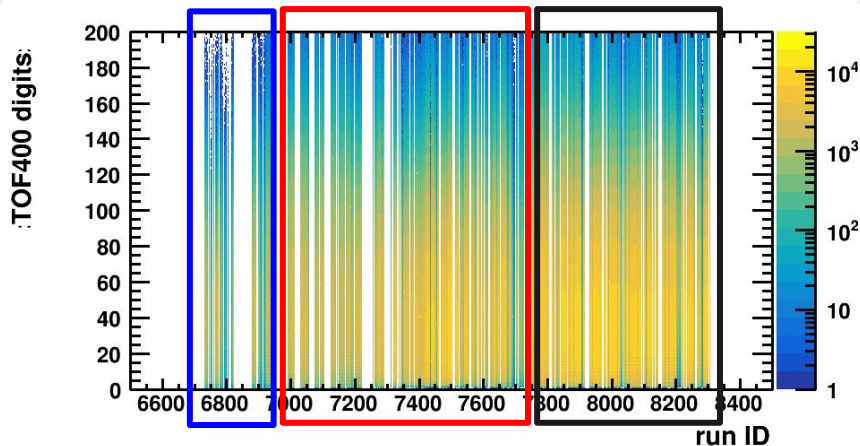


QA Run-by-Run: GEM+FSD (February prod.)



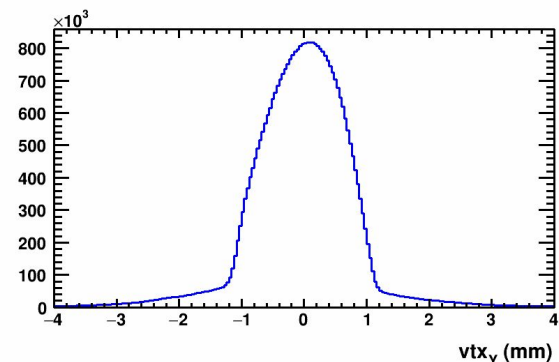
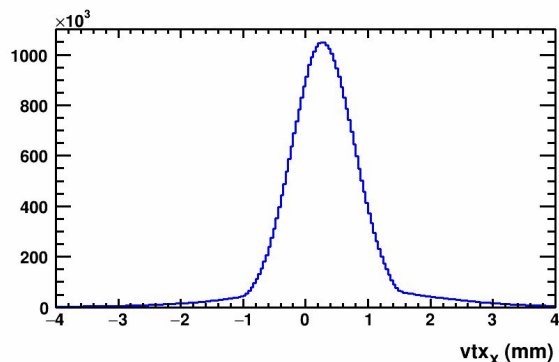
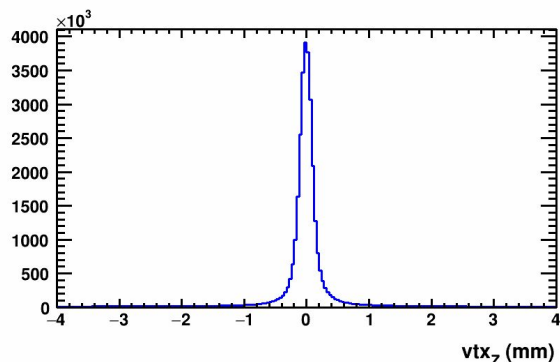
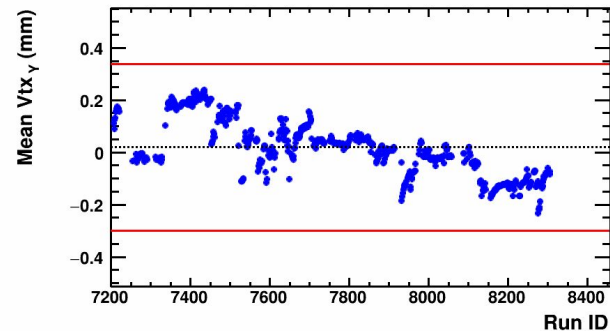
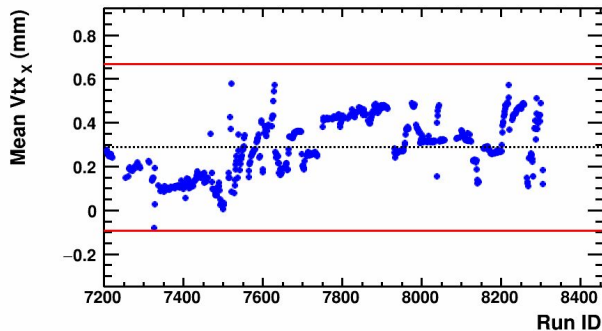
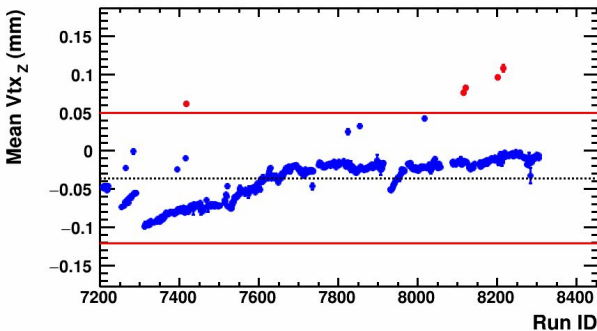
- Stable operation of the FSD detector (6924-8300)
- We don't consider Runs below 6924

QA Run-by-Run: TOF-400 and TOF-700 (February prod.)



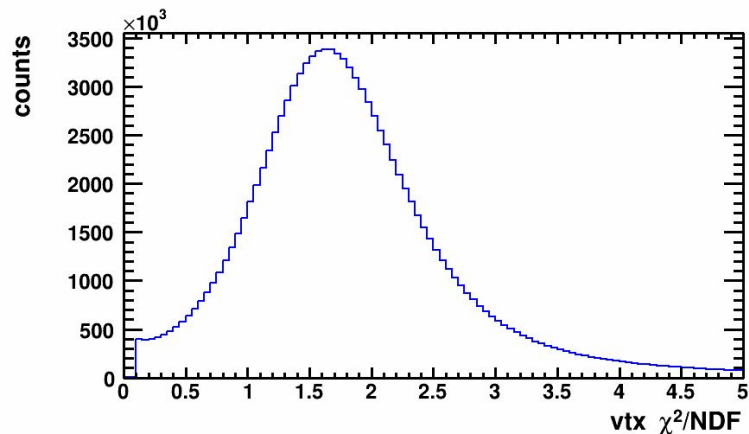
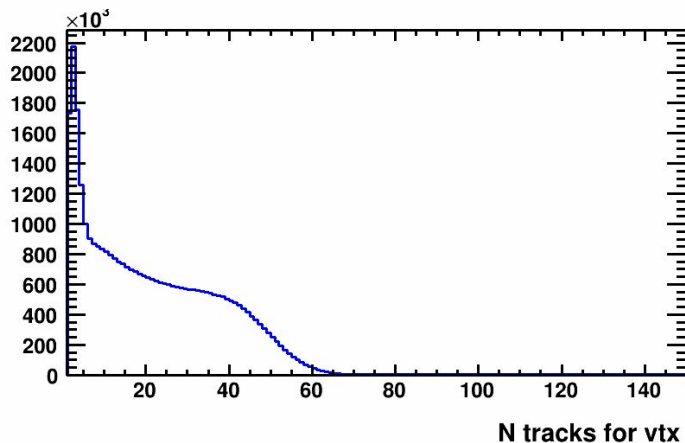
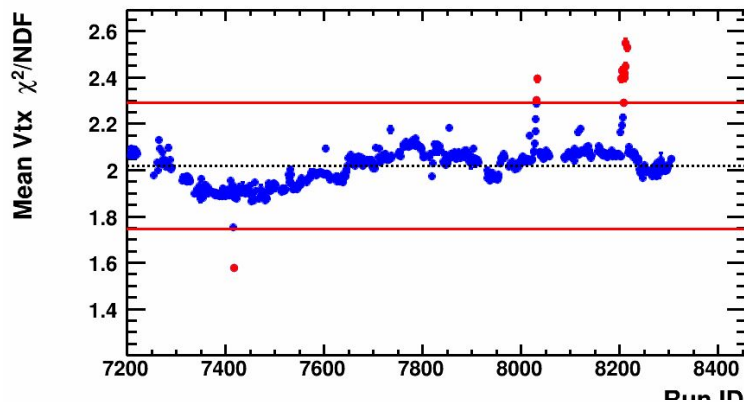
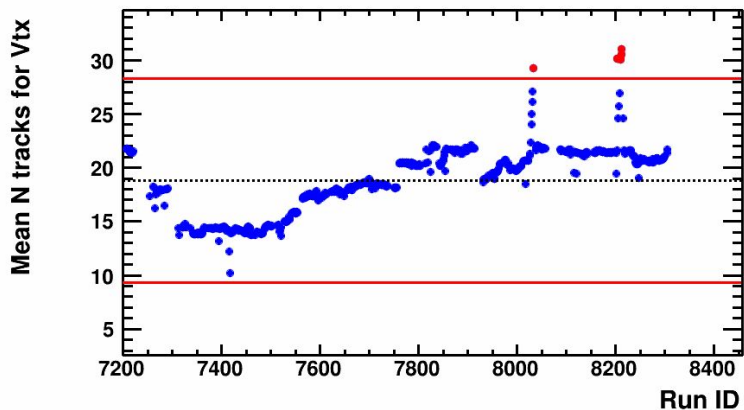
- Stable operation of the TOF-400 and TOF-700 detector (6924-8300)
- We don't consider Runs below 6924

QA Run-by-Run: vertex position



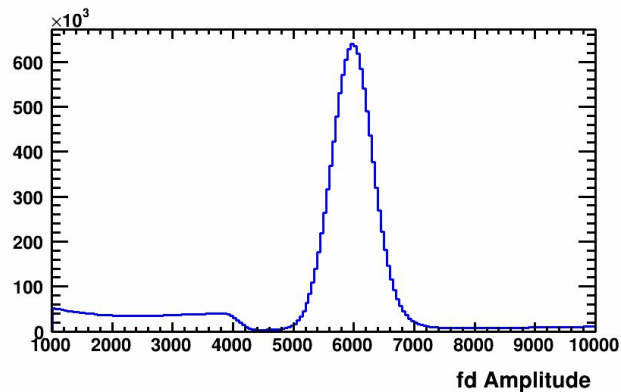
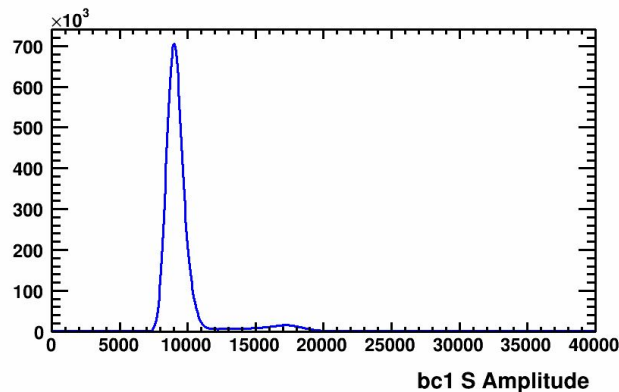
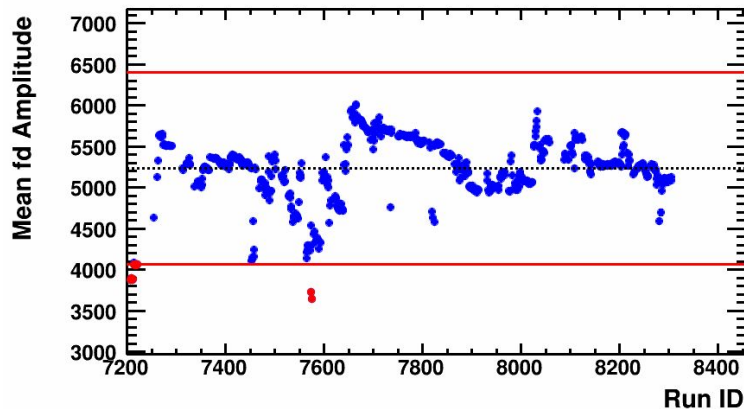
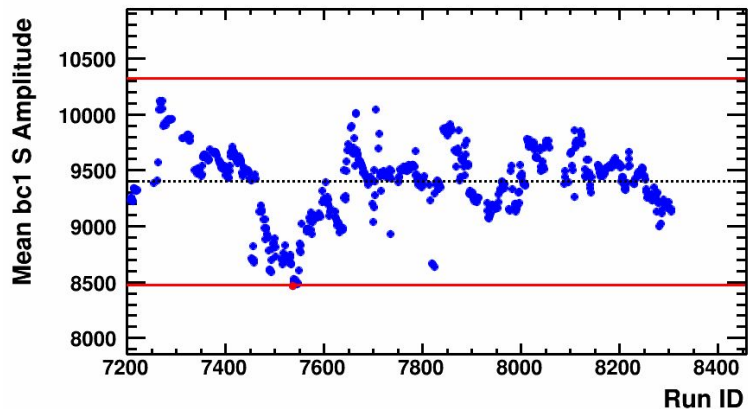
Bad Runs: 7417, 8115, 8121, 8201, 8215

QA Run-by-Run: vertex quality



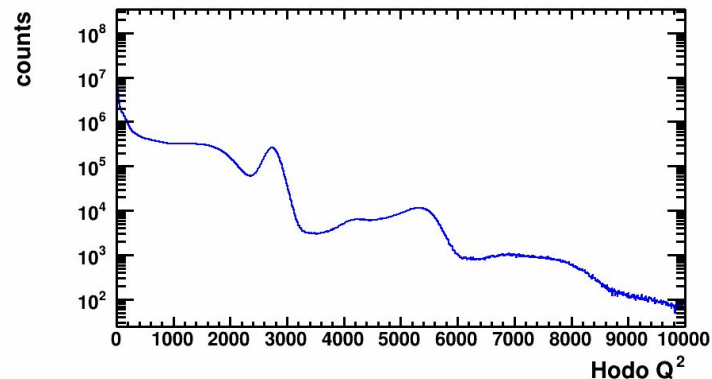
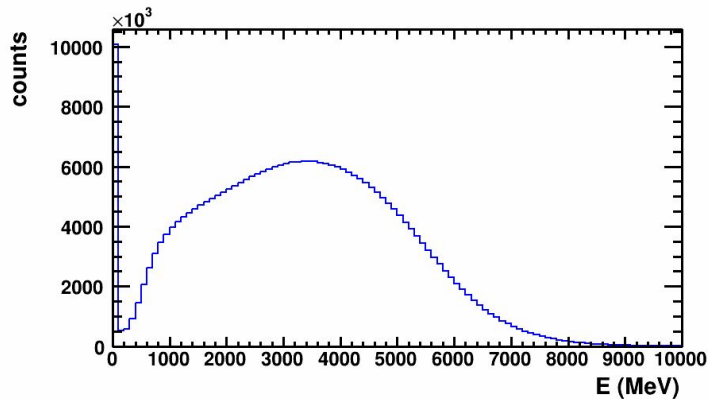
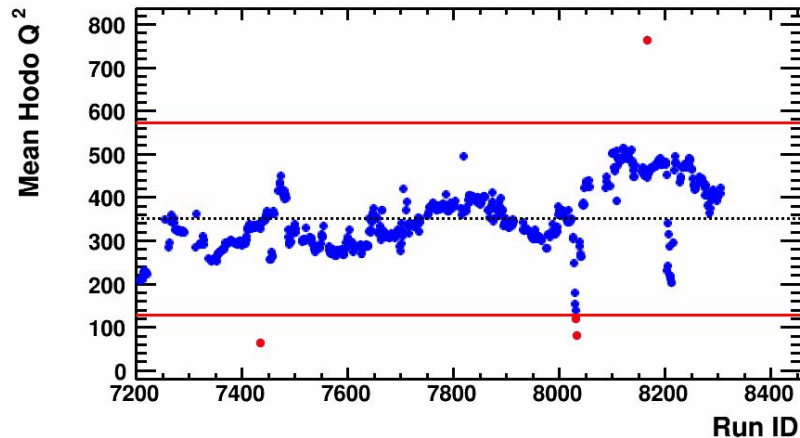
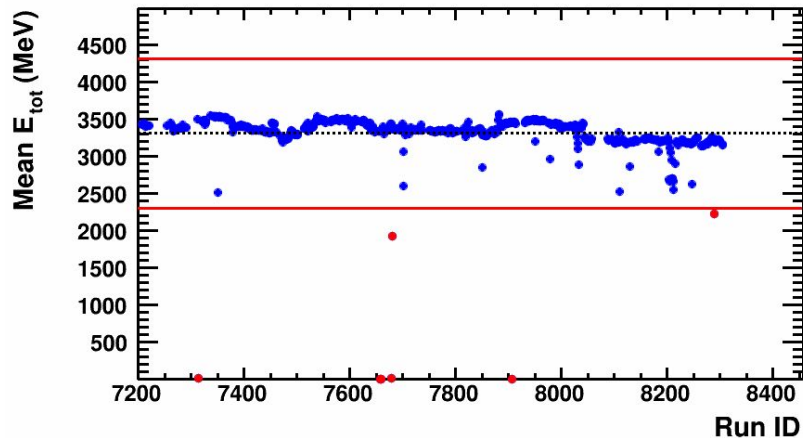
Bad Runs: 8033, 8204, 8205, 8209, 8210, 8211, 8212, 8213

QA Run-by-Run: BC1, FD



Plans on future: calibrate factor for each RunId

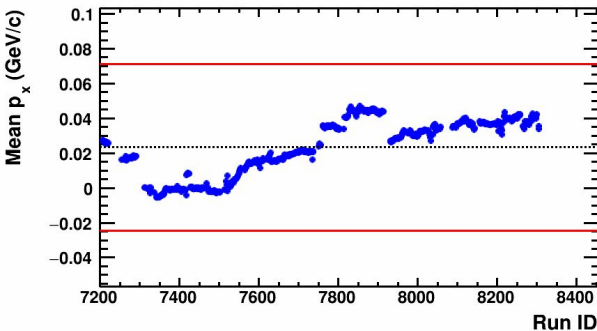
QA Run-by-Run: FHCAL and FQH



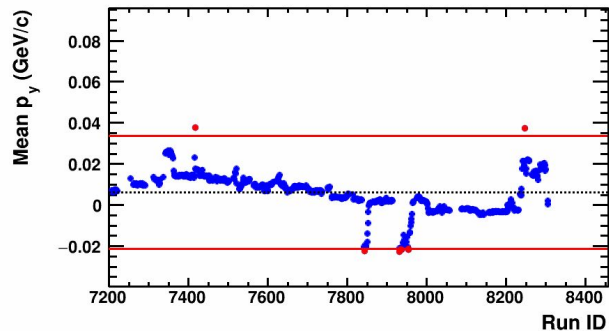
Bad Runs: 7313, 7657, 7659, 7679, 7681, 7907, 8289

QA Run-by-Run: Tracks

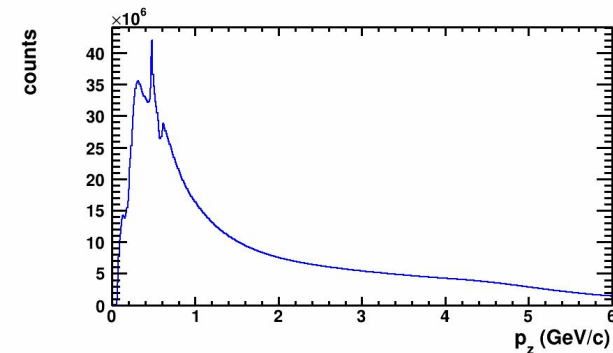
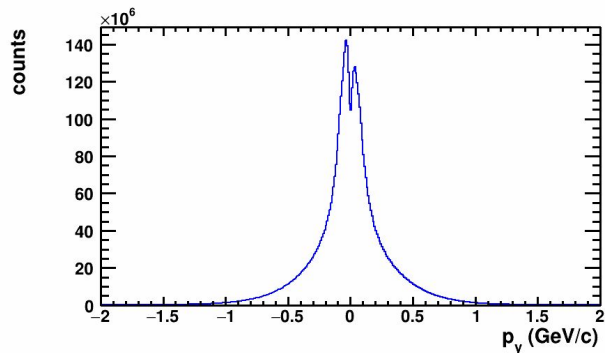
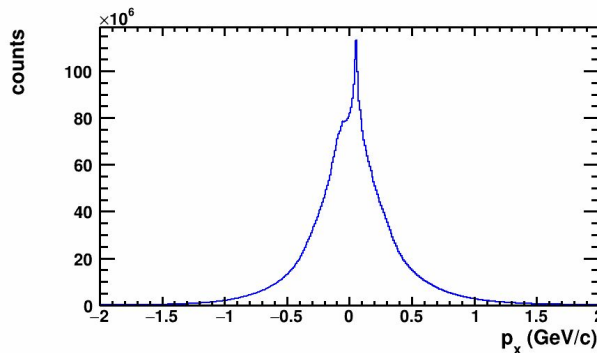
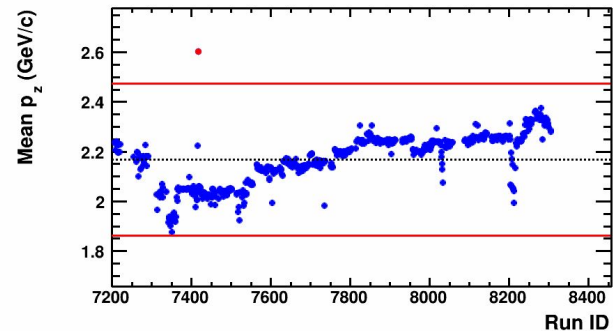
$\langle p_x \rangle$ GeV/c



$\langle p_y \rangle$ GeV/c



$\langle p_z \rangle$ GeV/c

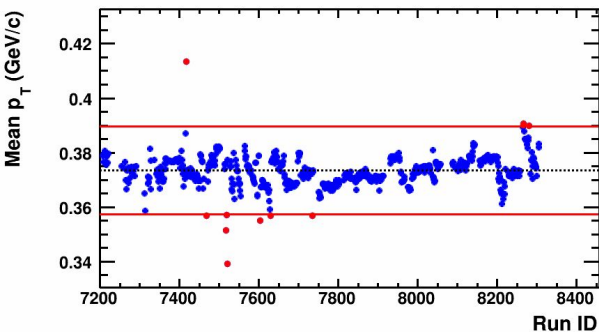


Bad Runs: 7843, 7932, 7933, 7935, 7937, 7954, 7955, 8247

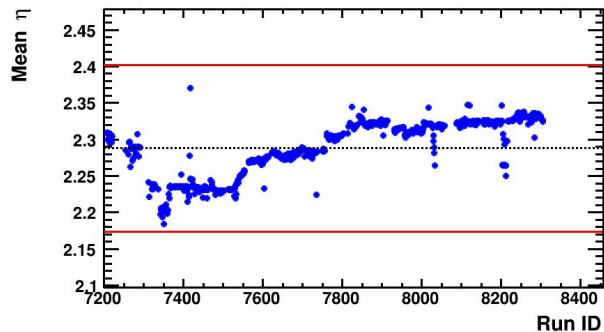
Significant run Id dependence

QA Run-by-Run: Tracks

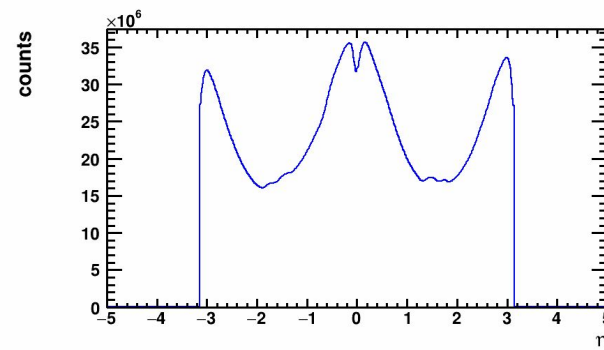
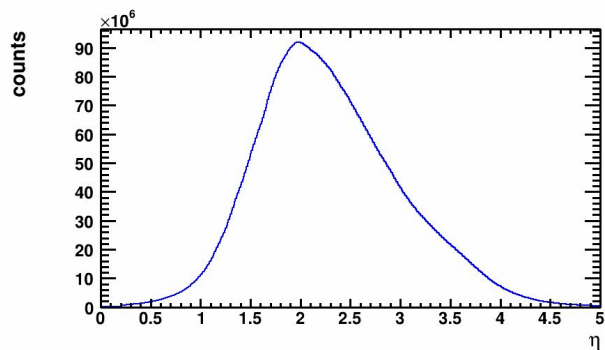
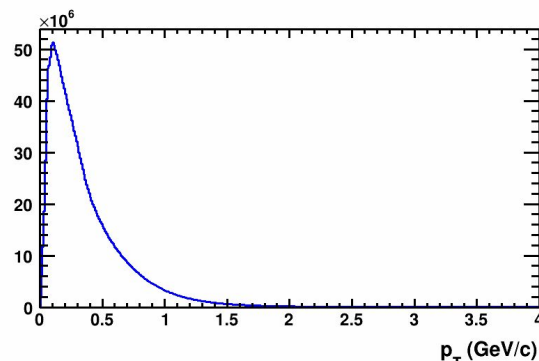
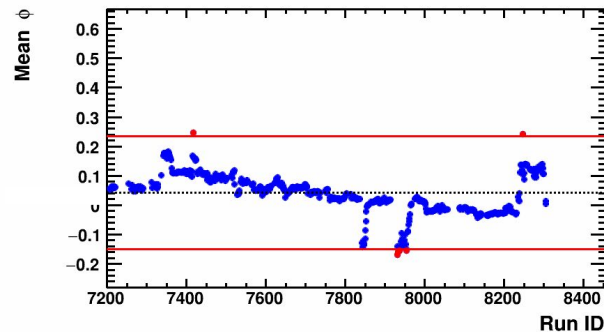
$\langle p_T \rangle$ GeV/c



$\langle \eta \rangle$



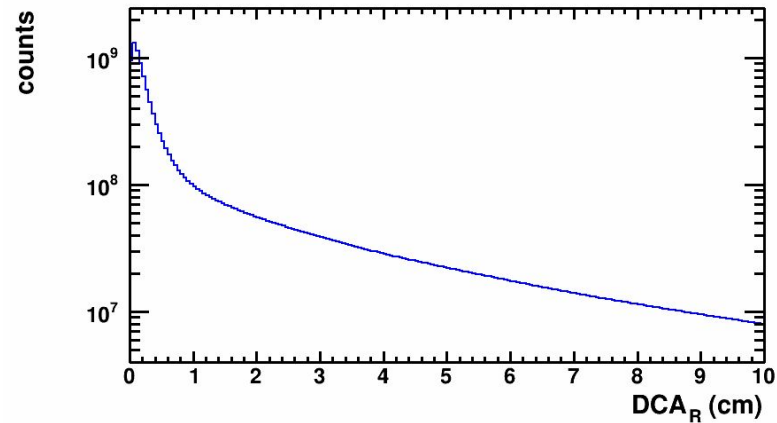
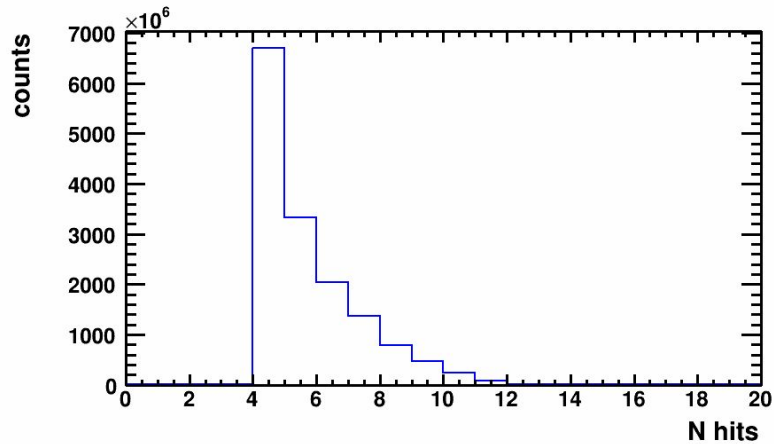
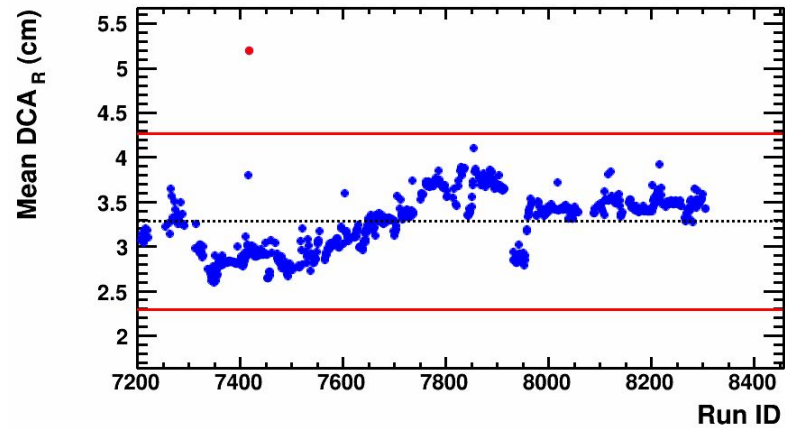
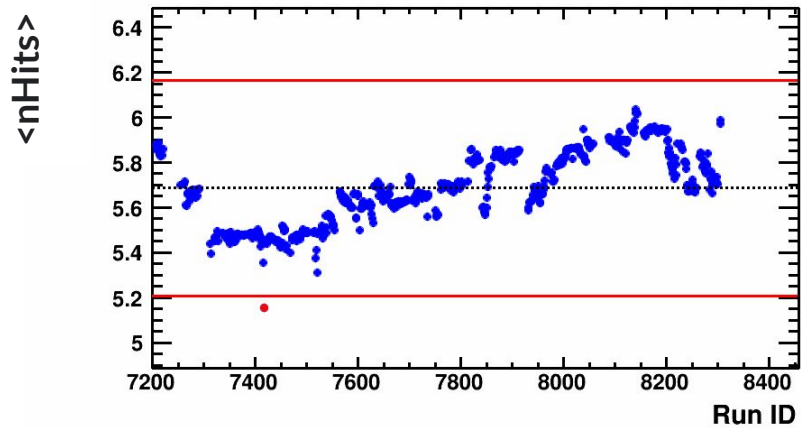
$\langle \phi \rangle$



Bad Runs: 6980, 6992, 7417, 7520

Significant run Id dependence

QA Run-by-Run: Tracks

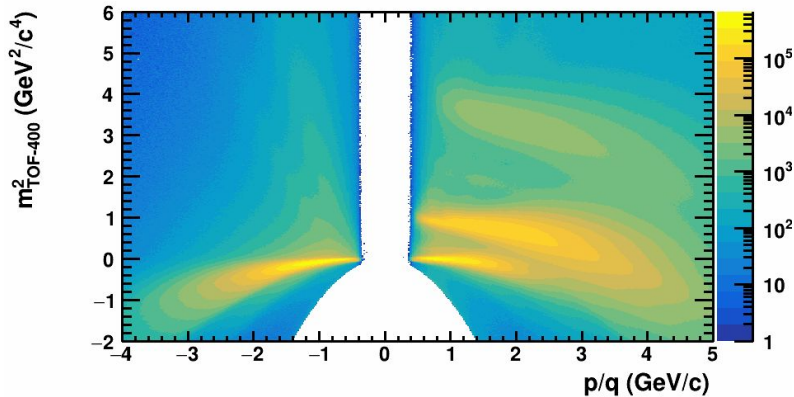


Square mass

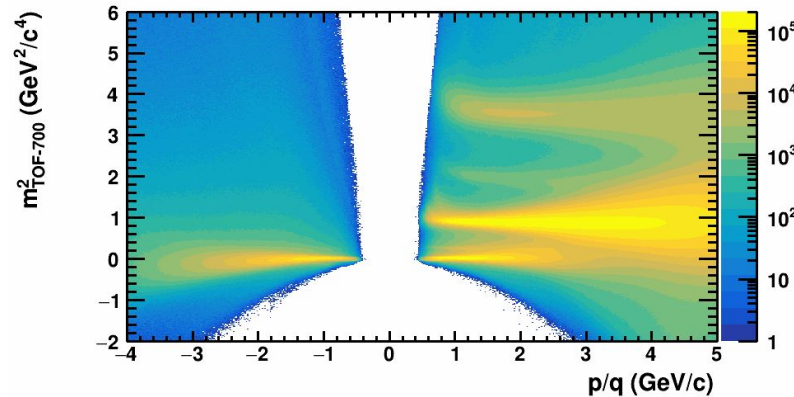
$$m^2 = \frac{(1 - \beta^2) * p^2}{\beta^2}$$

February prod.

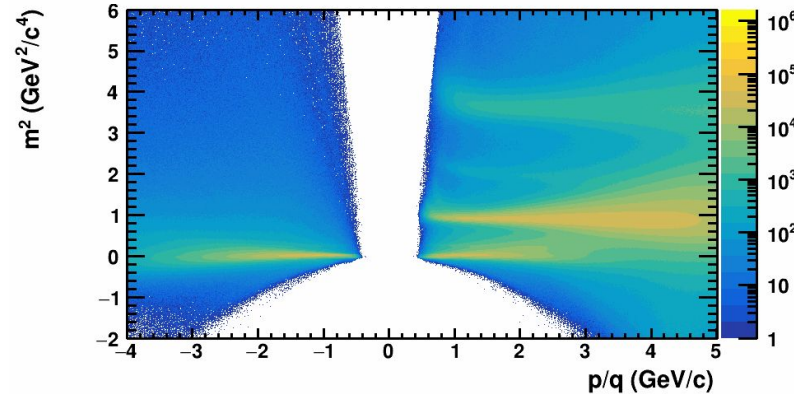
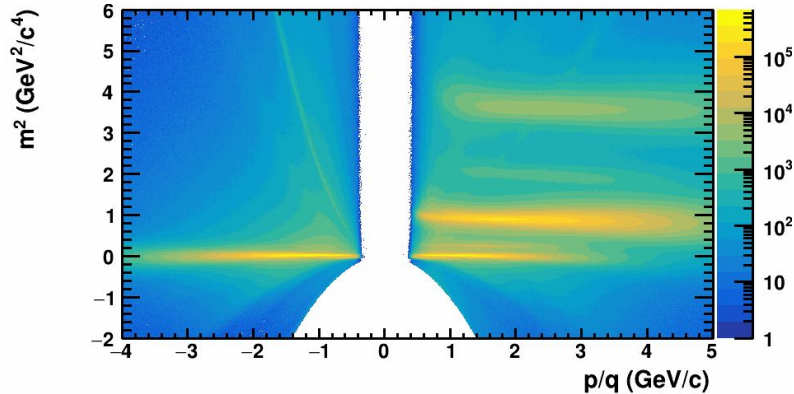
TOF-400



TOF-700



May prod. (last)



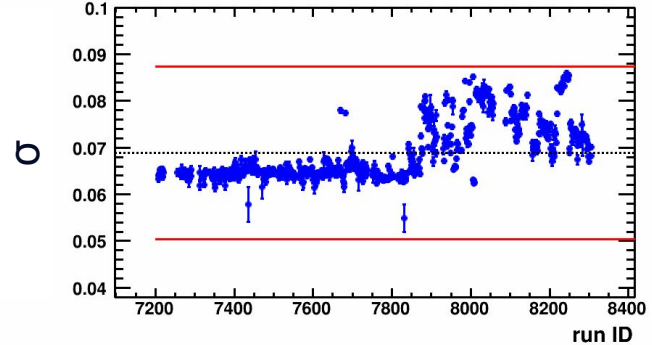
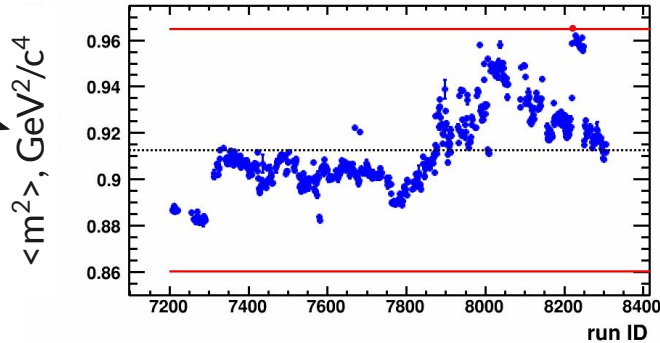
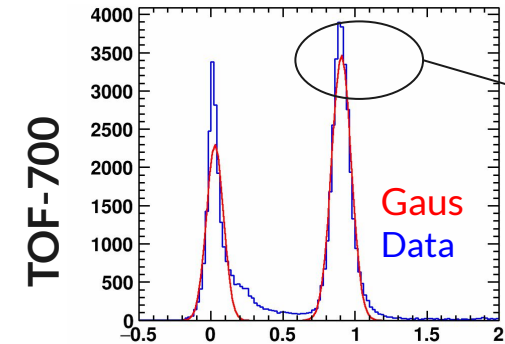
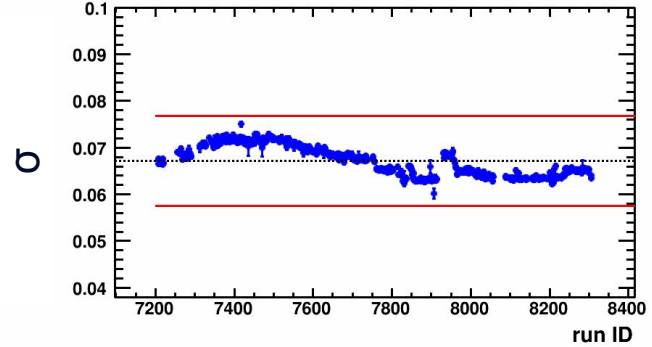
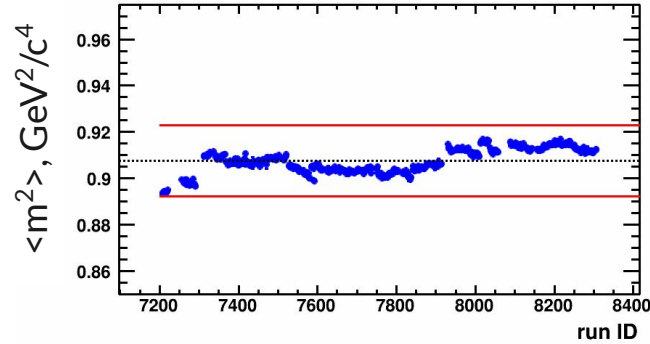
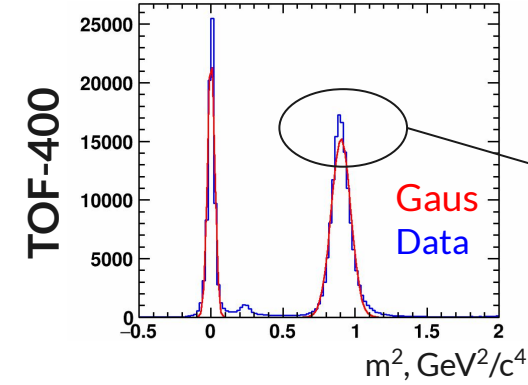
Calibration of TOF-400 and TOF-700 is completed.

QA Run-by-Run: proton

Fit of each run ID with Gaus

$0.5 < p < 2.0 \text{ GeV}^2/c^4$

Runs 6900-7200 are in progress...



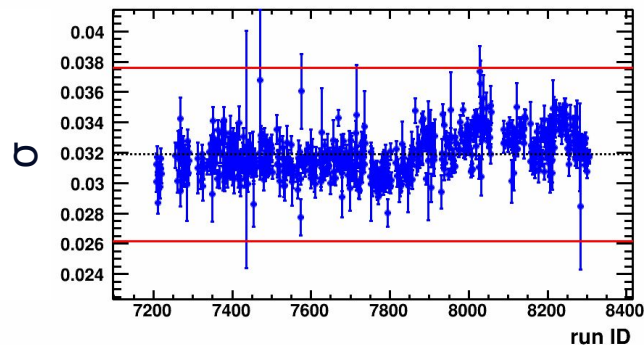
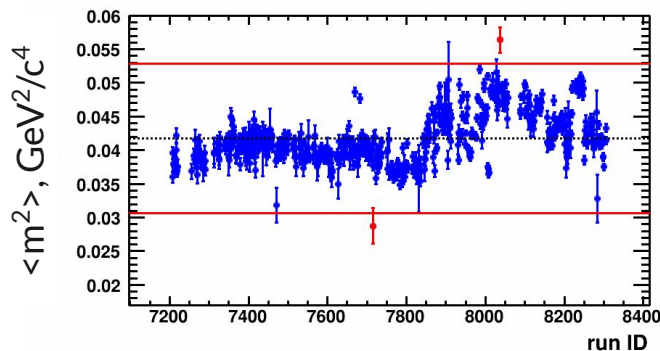
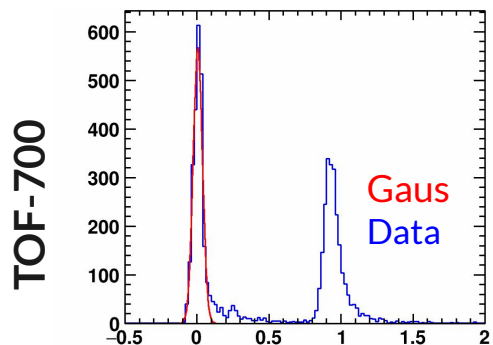
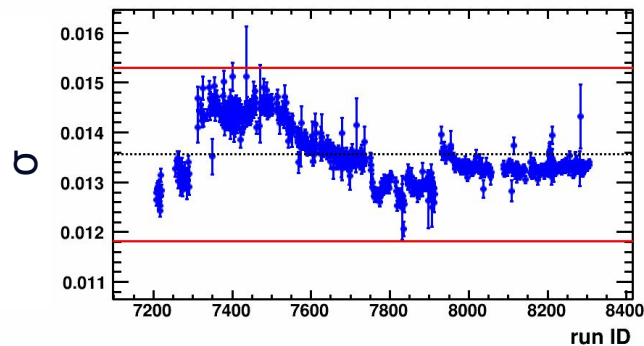
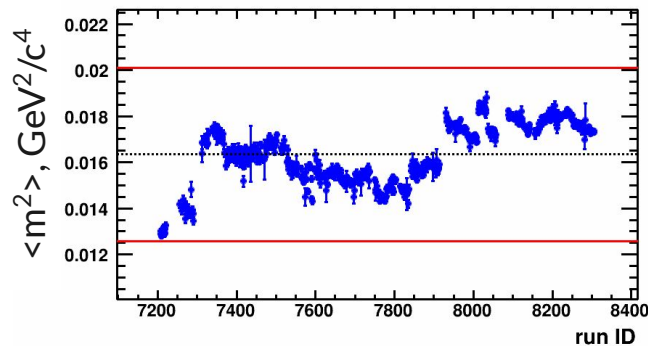
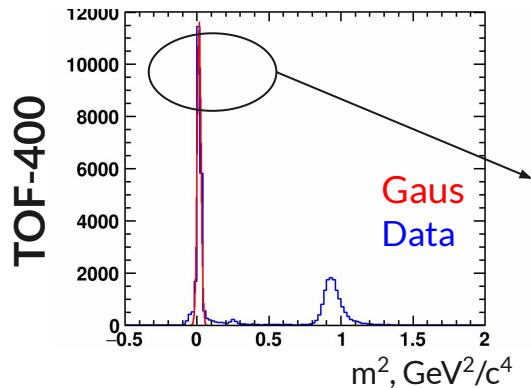
Good agreement $\langle m^2 \rangle$ and σ TOF-400 with TOF-700

QA Run-by-Run: π^+

Fit of each run ID with Gaus

$0.2 < p < 1.0 \text{ GeV}^2/c^4$

Runs 6900-7200 are in progress...



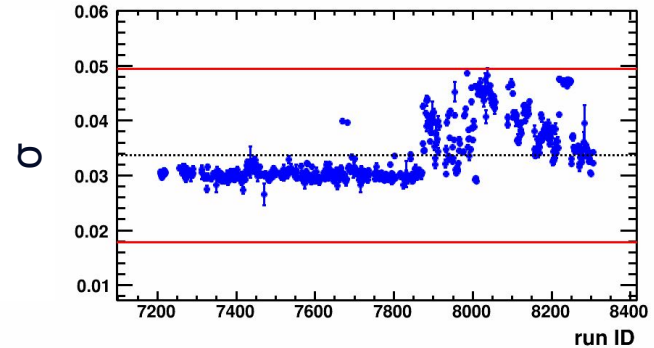
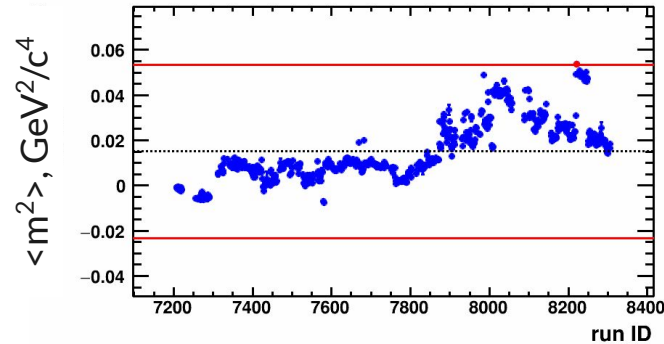
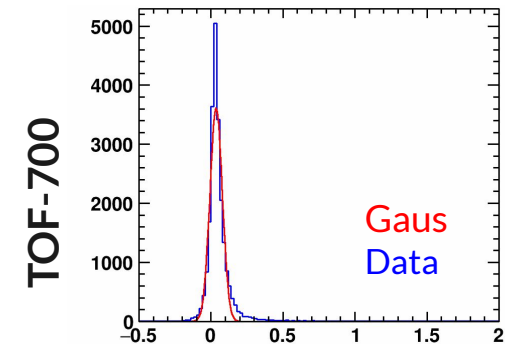
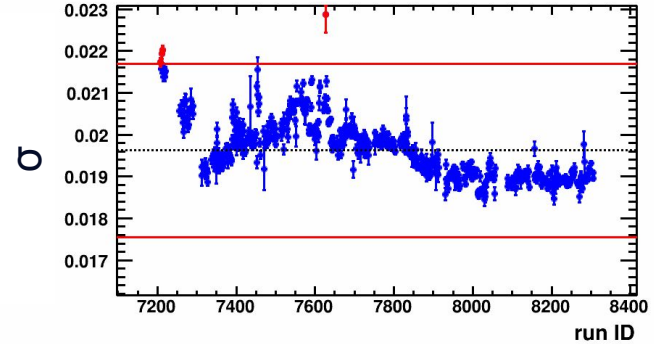
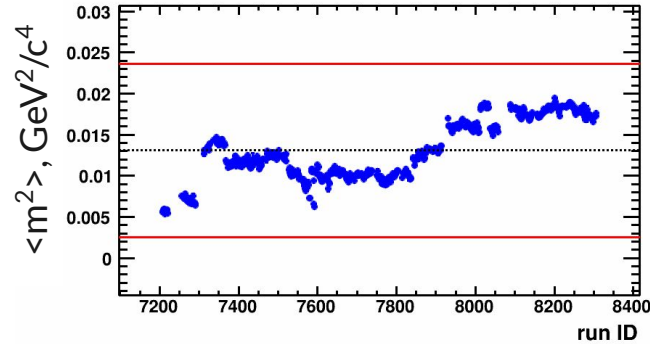
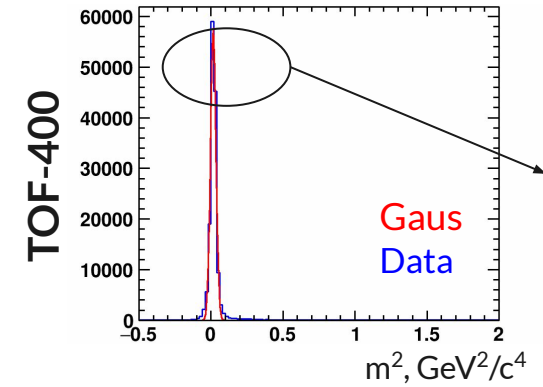
Differences in the position ($\langle m^2 \rangle$) and width (σ) of the peaks are observed.

QA Run-by-Run: π^-

Fit of each run ID with Gaus

$0.2 < p < 2.0 \text{ GeV}^2/c^4$

Runs 6900-7200 are in progress...



Differences in peak widths (σ) are observed

Conclusions

- We decided to use RunId > 6924
- A list of “outlier” runs has been compiled
 - 14M events rejected ~ 5% of all statistics (290M)
- Updated data for TOF-400 and TOF-700 in the latest production

- Outlook:
 - look at data from SiBT
 - Improve pile-up rejection procedure
 - look at Run 8 XeCsl 3.0A GeV

Thank you for your attention!



backup

Bad Runs

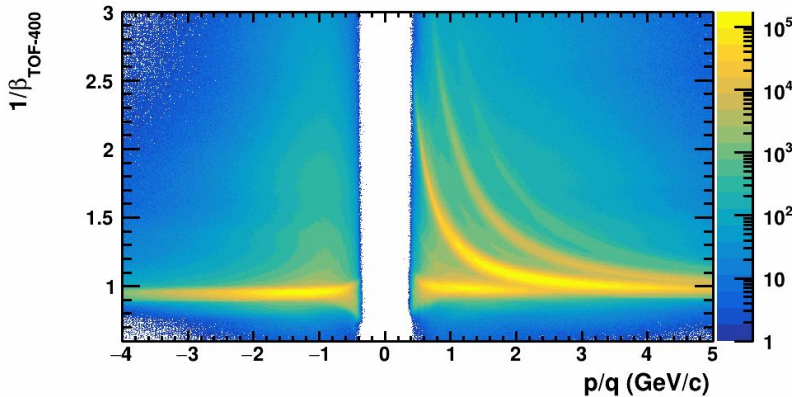
RunId: 7313, 7415, 7417, 7435, 7469, 7517, 7519, 7520, 7537, 7575, 7604, 7630, 7657,
7659, 7679, 7681, 7705, 7735, 7843, 7847, 7848, 7850, 7851, 7852, 7853, 7855, 7856, 7857,
7858, 7859, 7865, 7868, 7907, 7931, 7932, 7933, 7935, 7937, 7938, 7939, 7954, 7955, 8031,
8032, 8033, 8115, 8121, 8167, 8201, 8204, 8205, 8208, 8209, 8210, 8211, 8212, 8213, 8215,
8247, 8265, 8266, 8267, 8281, 8289

Square mass

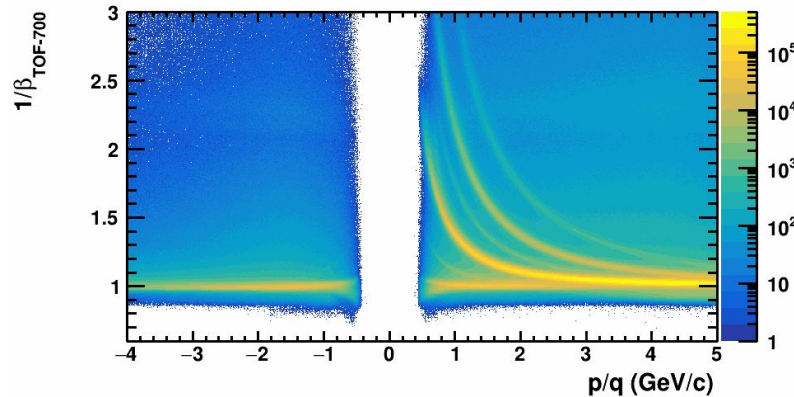
$$m^2 = \frac{(1 - \beta^2) * p^2}{\beta^2}$$

February prod.

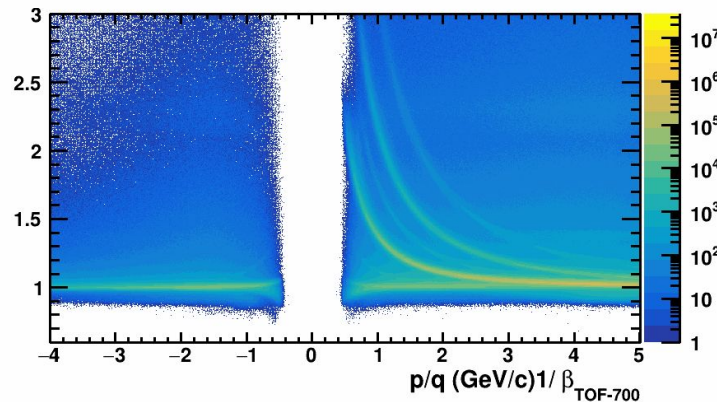
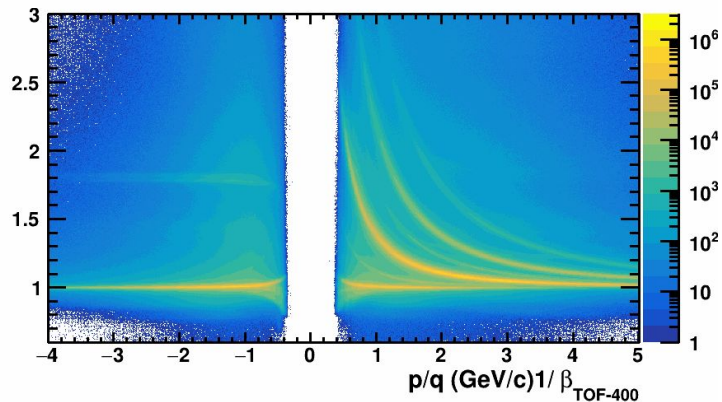
TOF-400



TOF-700



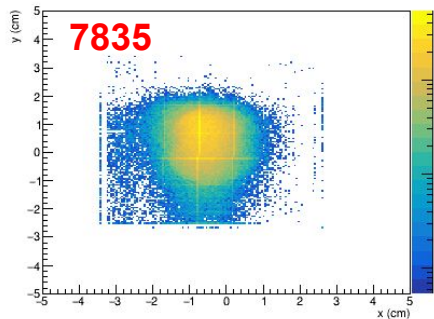
May prod.



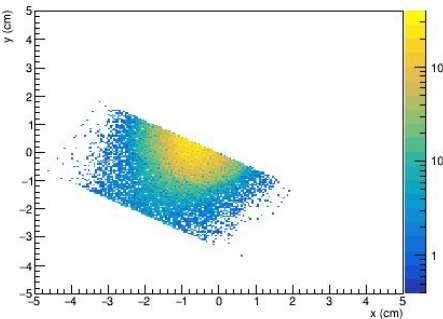
Calibration of TOF-400 and TOF-700 is completed.

QA Run-by-Run: SiBT

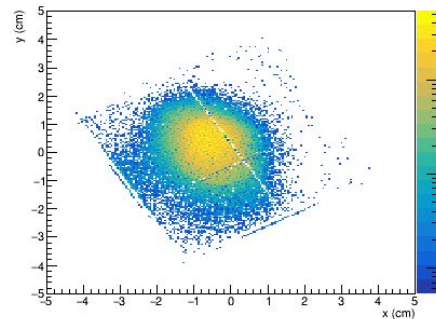
Station 1



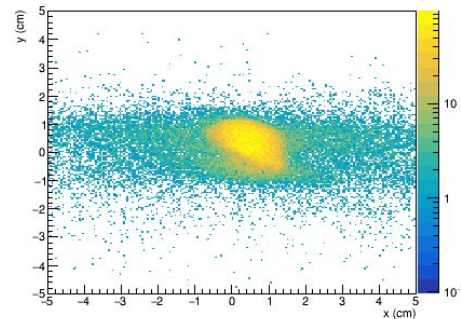
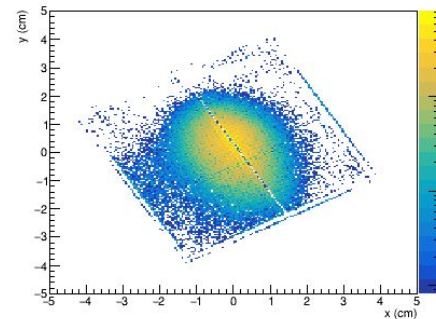
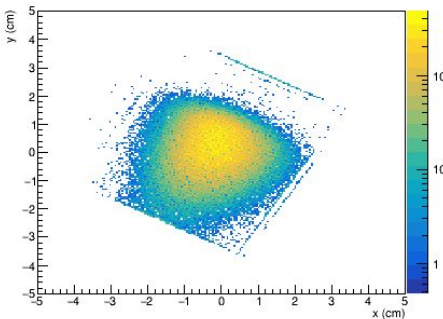
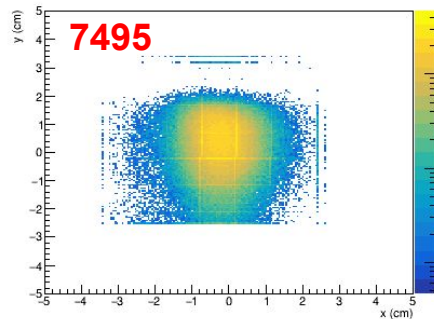
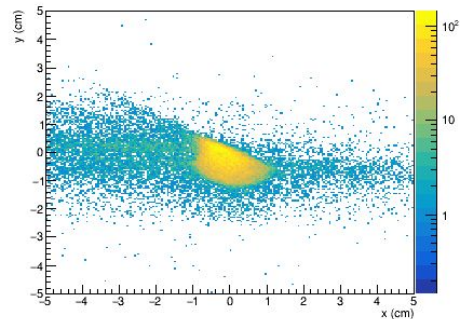
Station 2



Station 3



beam tracks (x,y)



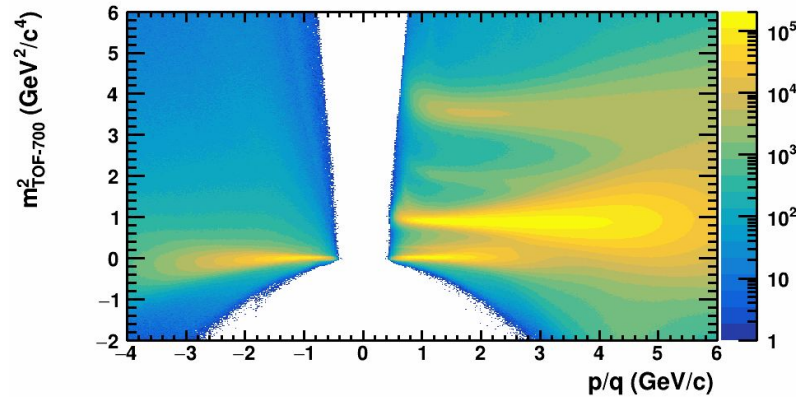
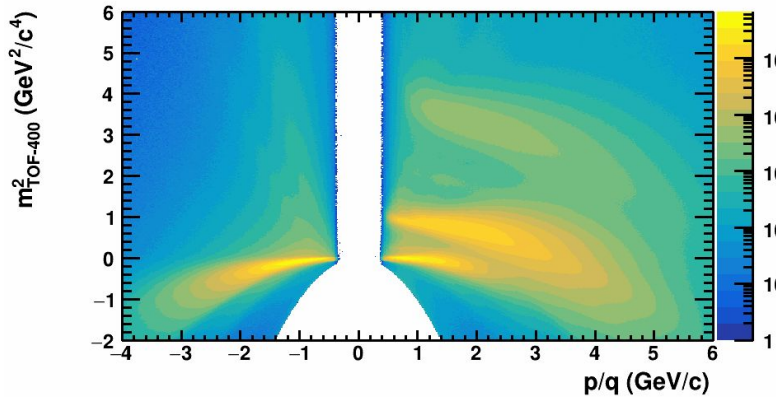
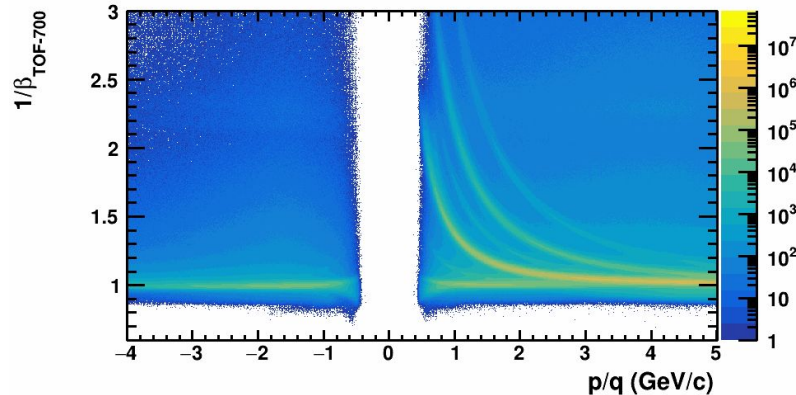
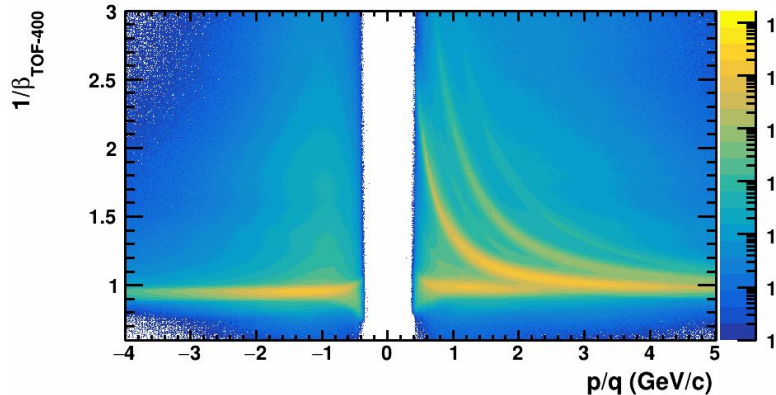
- QA run-by-run the SiBT are in progress

Square mass

TOF-400

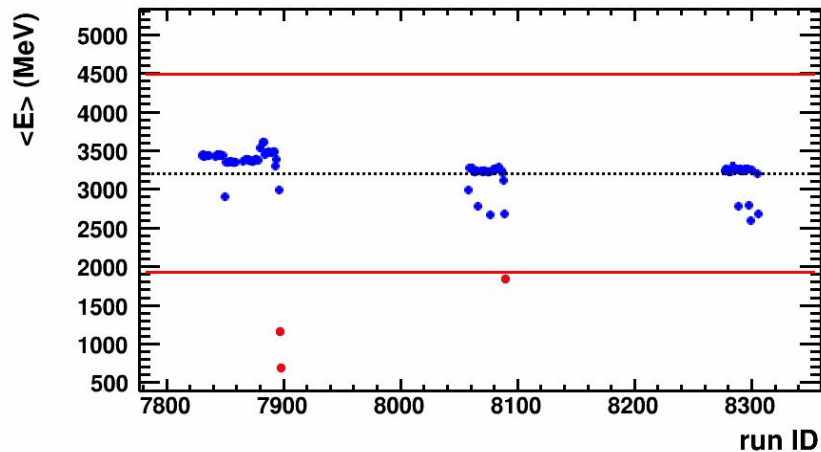
$$m^2 = \frac{(1 - \beta^2) * p^2}{\beta^2}$$

TOF-700

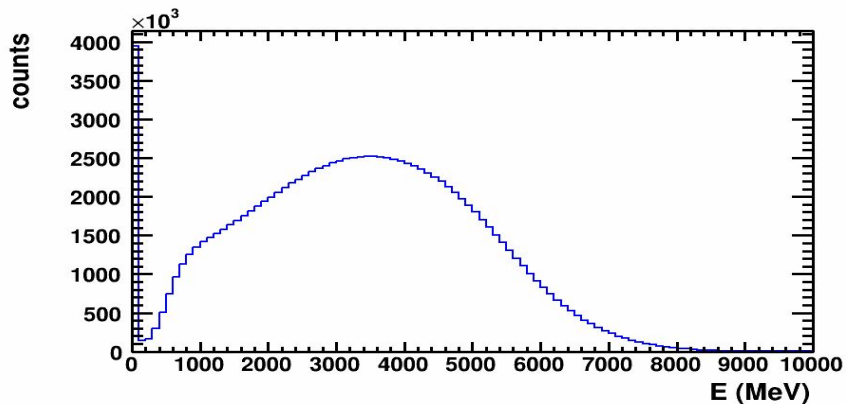
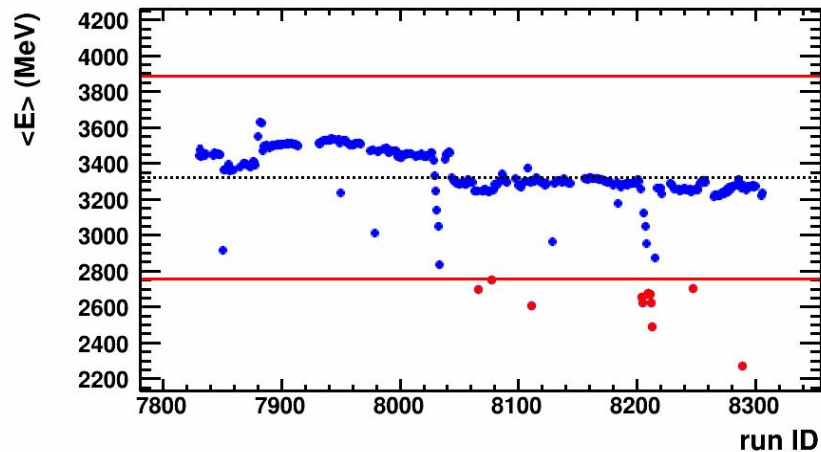


Difference between productions: FHCal (7800-8300)

Old prod (VF)

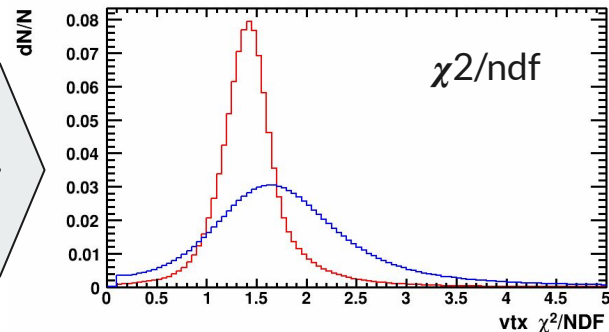
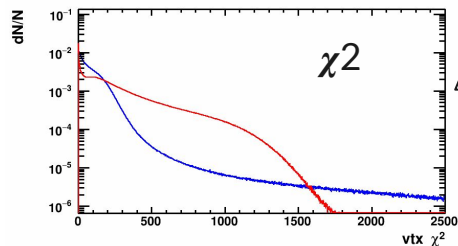
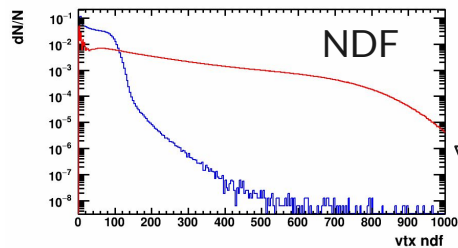
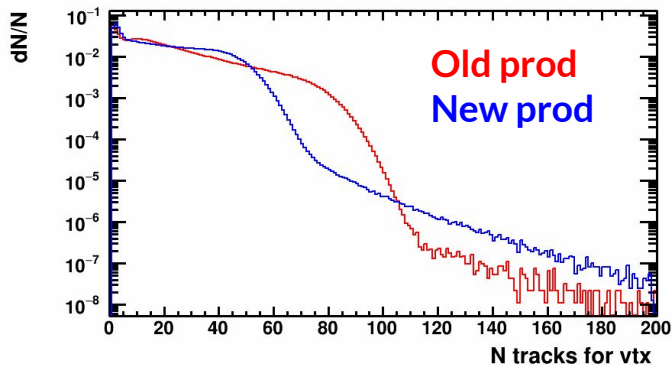
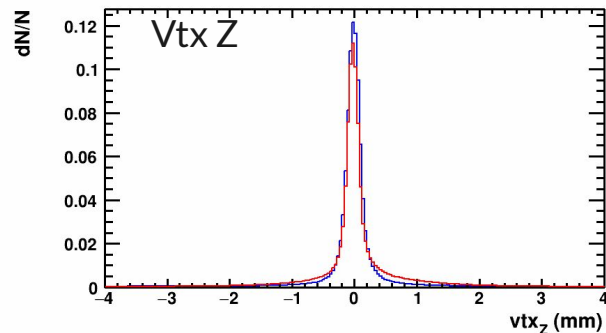
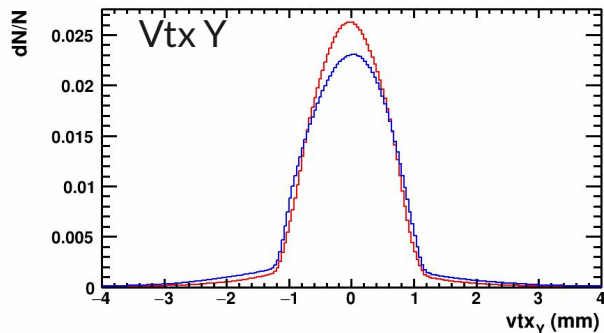
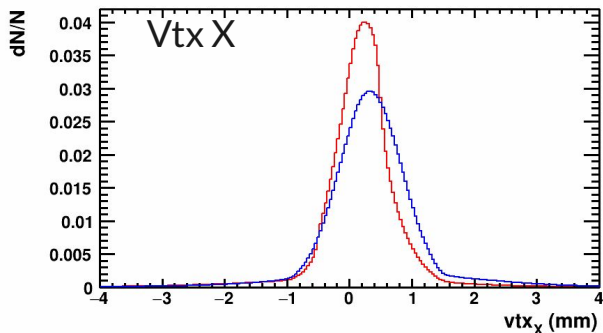


New prod (VF)



There are problems with the FHCal data when using the VF production - Solved!

Difference between productions: vertex reconstruction (7800-8300)



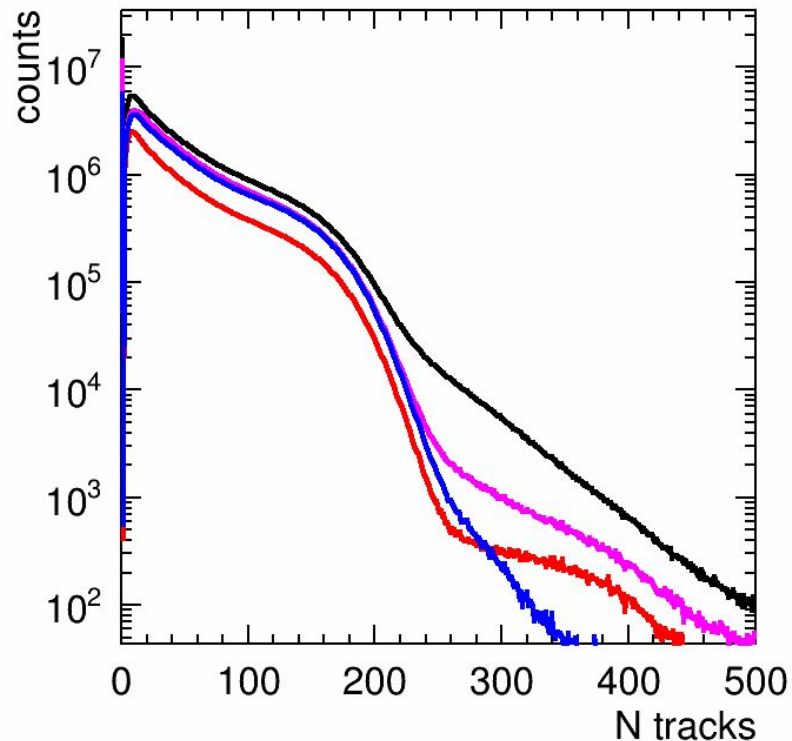
Changes in tracking?

Production information

Run8 Xe-CsI @3.8A GeV

- dev (old):
 - /eos/nica/bmn/exp/dst/run8/dev_vf
 - ~14000 files (7800-8300)
- 24.02.0 (new):
 - /eos/nica/bmn/exp/dst/run8/24.02.0
 - ~29000 files (6600-8300)

Basic selection

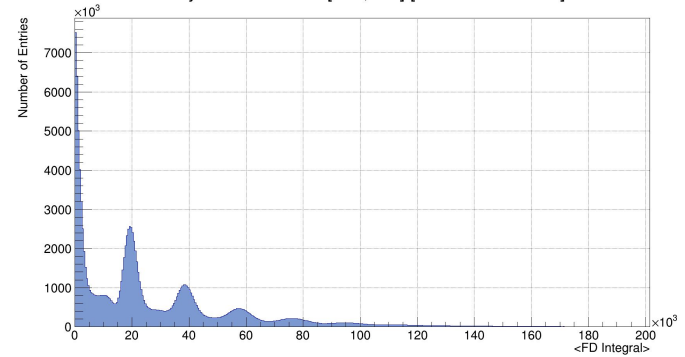
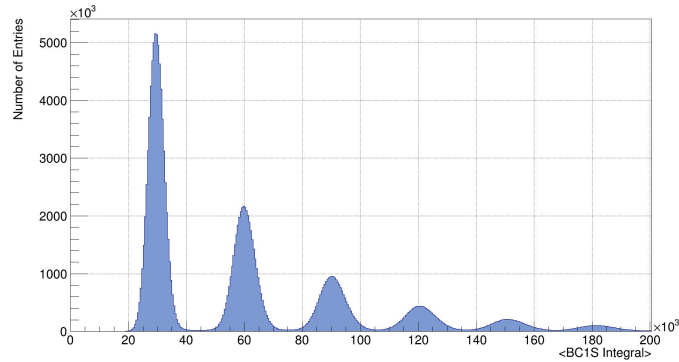
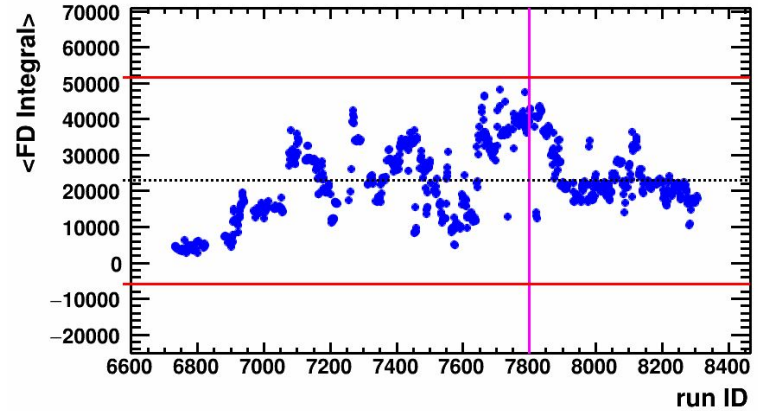
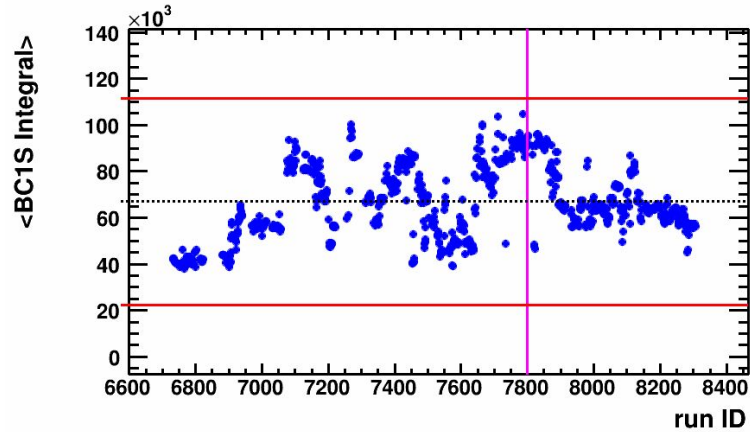


- 297.5M (62 %), CCT2 trigger, nTrVtx > 0
- 128.2M (27 %), 1 ion in BC1 (old)
- 228.4M (48 %), diff between BC1 and FD =1 (new)
- 202.5M (42 %), Add cut: StsNTrDiggit vs mult

For QA Run-by-run used:

- CCT2
- More than 1 track in vertex reconstruction

QA Run-by-Run: BC1, FD

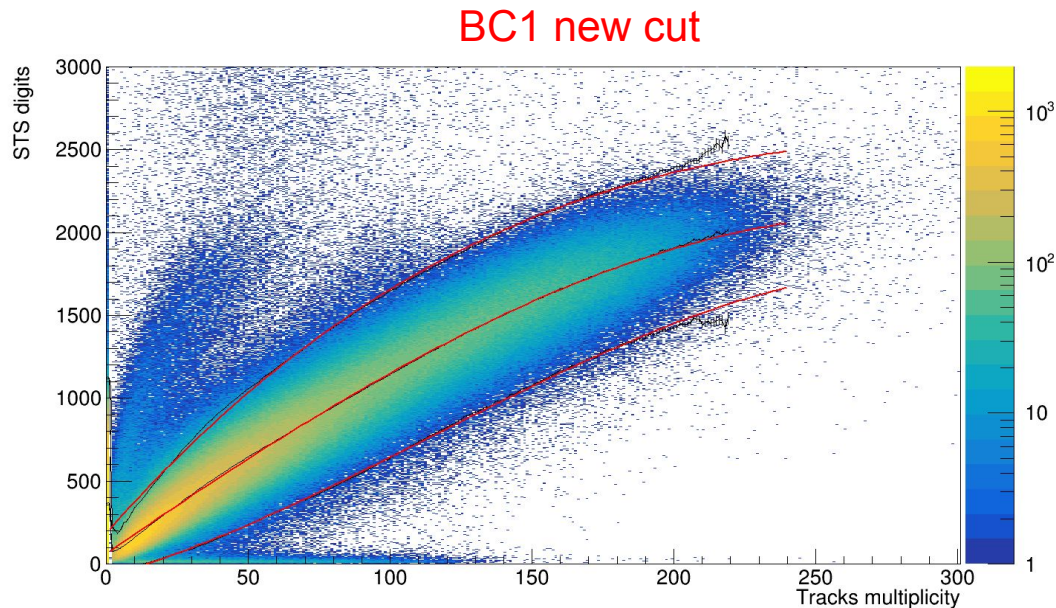
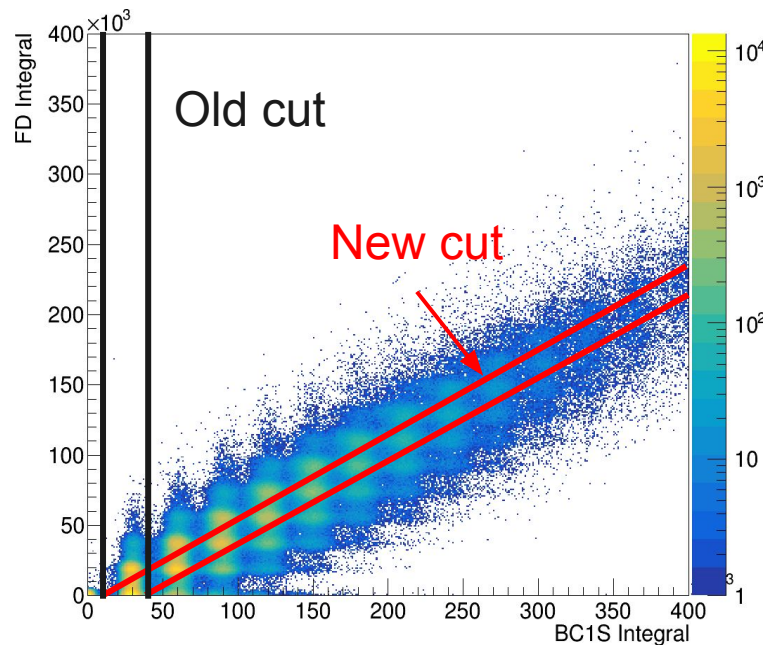


Plans on future: calibrate factor for each RunId

BC1 Integral cut improvement

See the talk of I.Segal for details

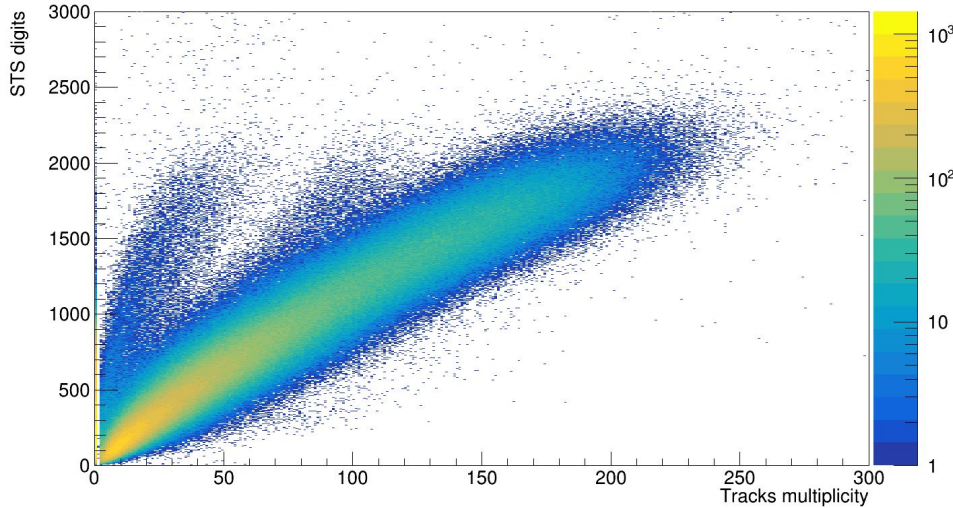
- CCT2 trigger
- More than 1 track for vertex reconstruction



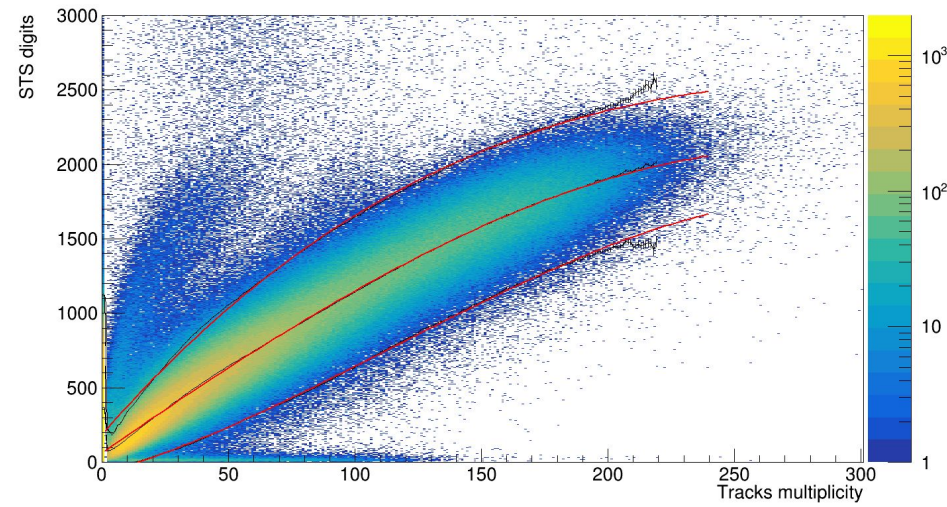
We have more events after the New cuts

Additional pileup graphic cut

BC1 old cut



BC1 new cut



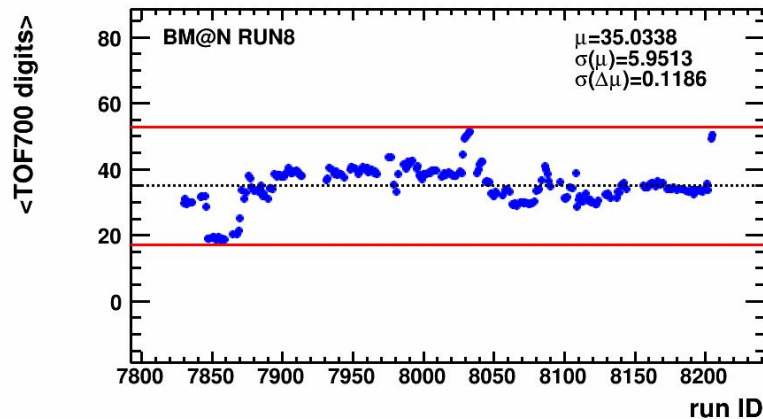
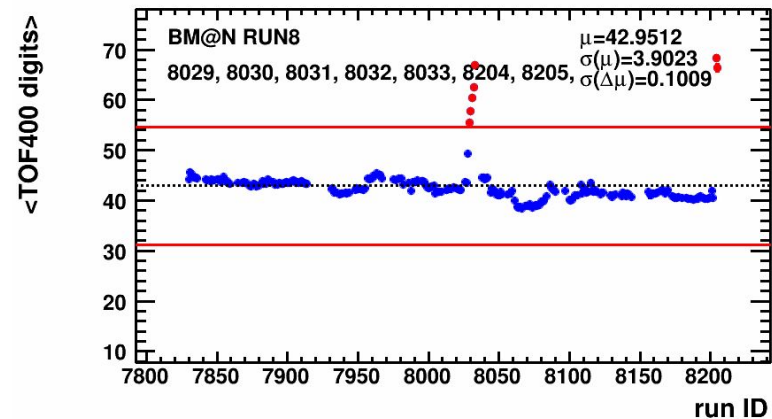
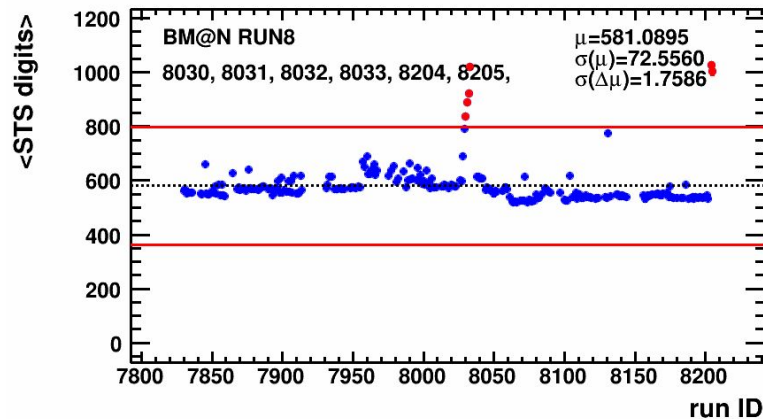
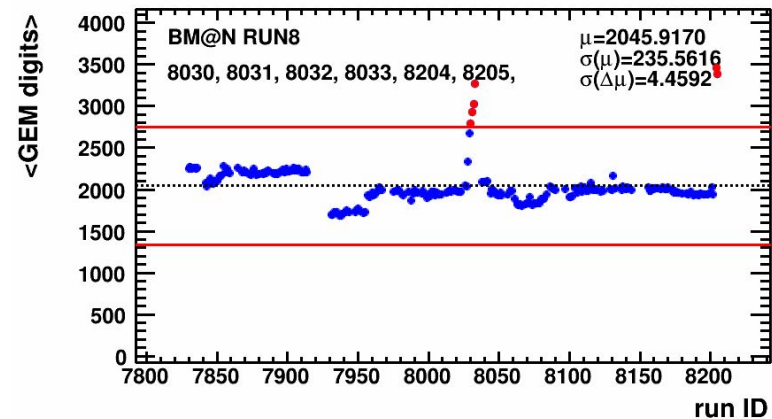
- Graphic cut was performed to throw out all event unusual behaviour:

$$STS_{\max}(N_{\text{tracks}}) = 4.56033e-05 * N^3 - 0.0518774 * N^2 + 19.4203 * N + 188.248$$

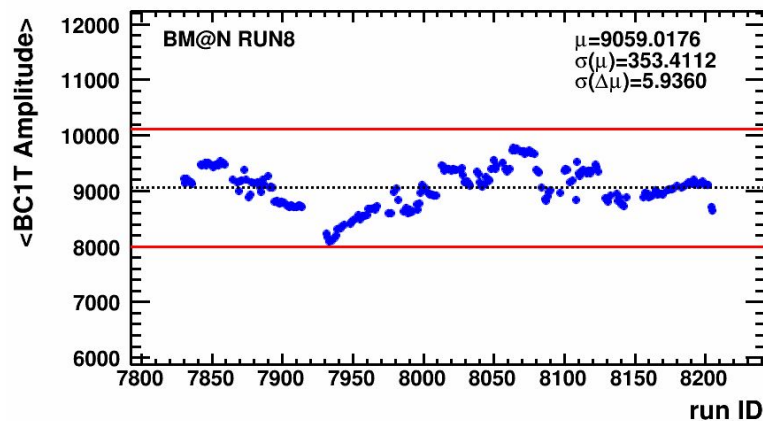
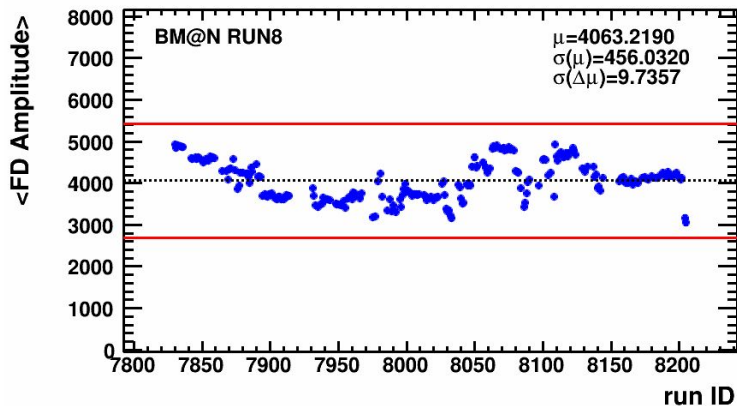
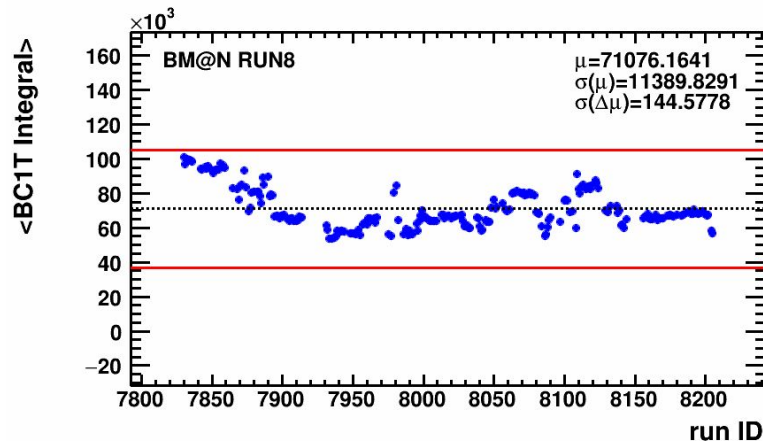
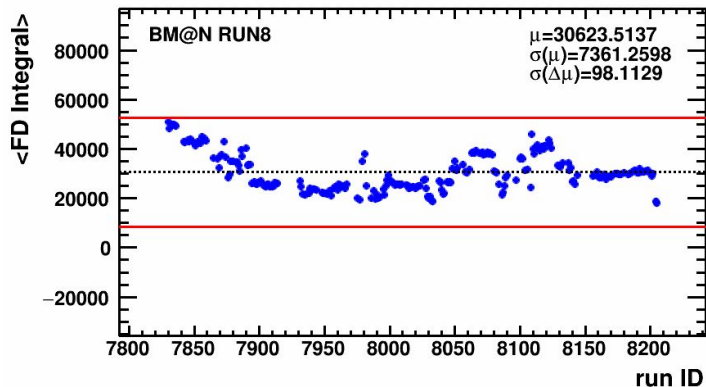
$$STS_{\min}(N_{\text{tracks}}) = -9.62078e-05 * N^3 + 0.0332792 * N^2 + 4.81632 * N - 74.0087$$

- Difference:

QA Run-by-Run (Event)



QA Run-by-Run (Event)



The BM@N experiment and motivation

Data:

- run8 Xe-CsI @3.8A GeV
(Run Id: 7800-8300)
- VF tracking was used

