

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

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11th BM@N collaboration meeting, 11/28/2023



# Outline



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

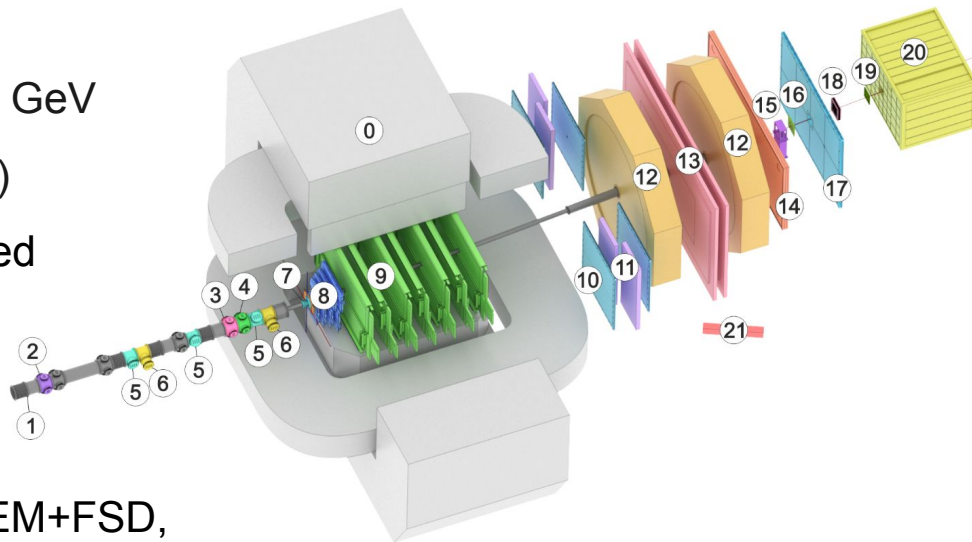
# The BM@N experiment

## Data:

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

## QA Run-by-Run:

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

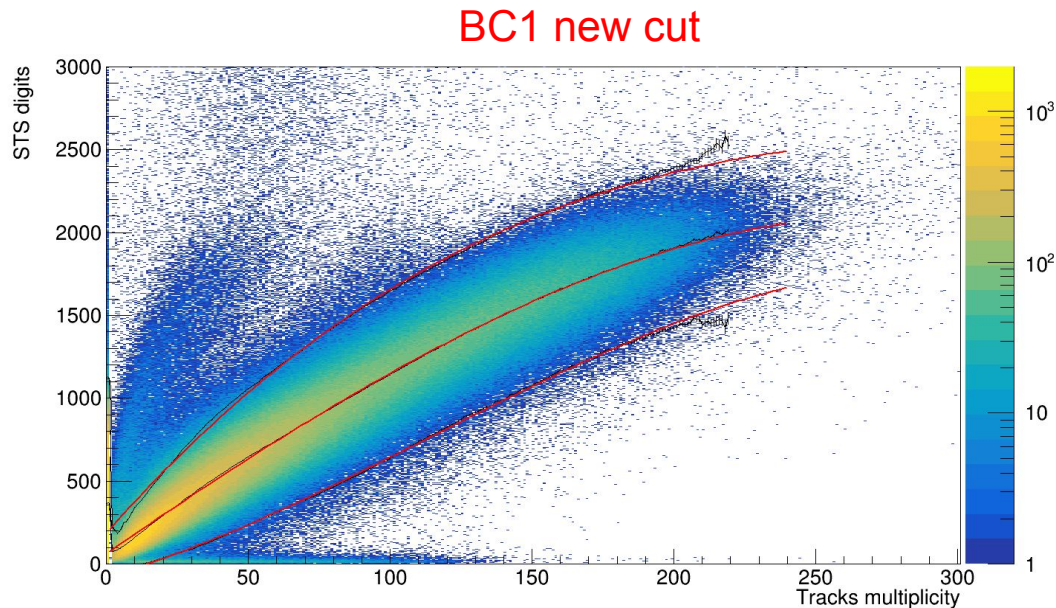
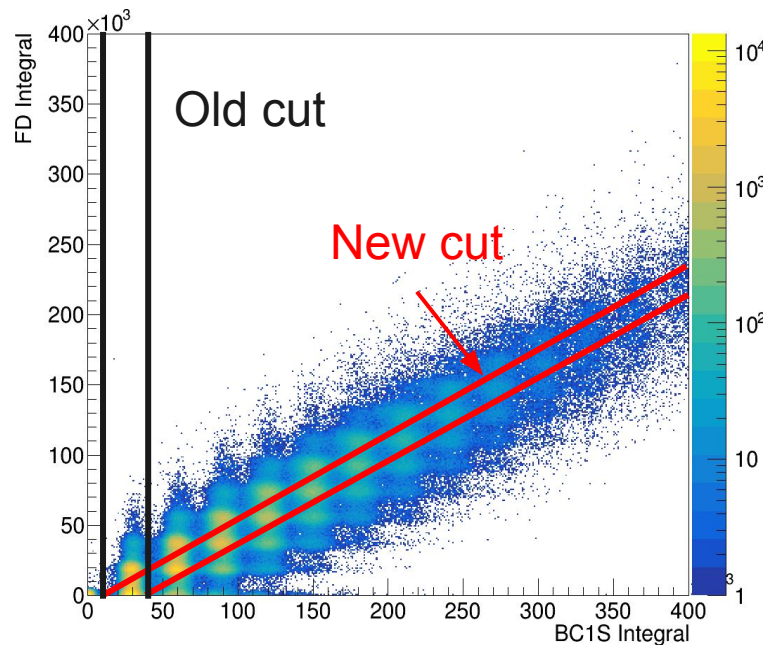


- Magnet SP-41 (0)
- Vacuum Beam Pipe (1)
- BC1, VC, BC2 (2-4)
- SiBT, SiProf (5, 6)
- Triggers: BD + SiMD (7)
- FSD, GEM (8, 9)
- CSC 1x1 m<sup>2</sup> (10)
- TOF 400 (11)
- DCH (12)
- TOF 700 (13)
- ScWall (14)
- FD (15)
- Small GEM (16)
- CSC 2x1.5 m<sup>2</sup> (17)
- Beam Profilometer (18)
- FQH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

# BC1 Integral cut improvement

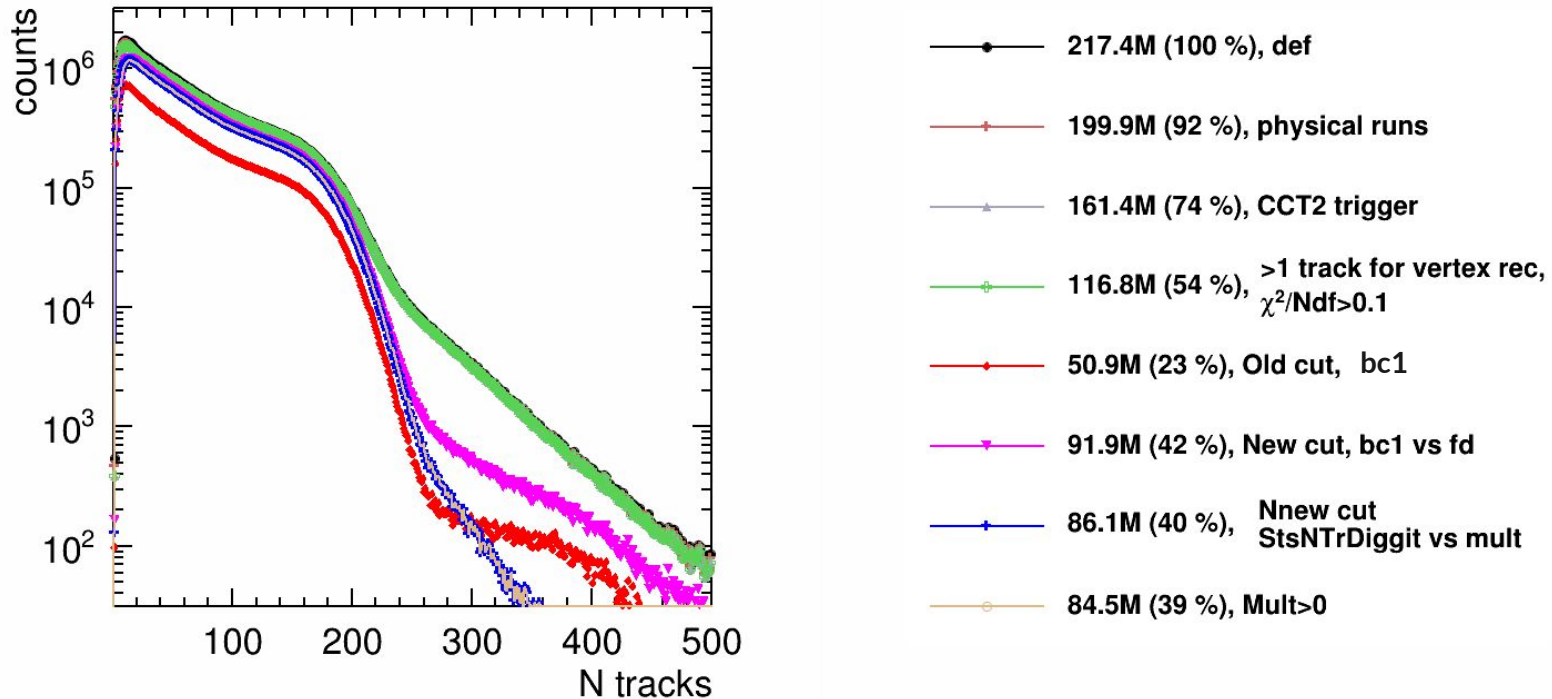
See the talk of I.Segal for details

- CCT2 trigger
- More than 1 track for vertex reconstruction



We have more events after the New cuts

# Basic selection



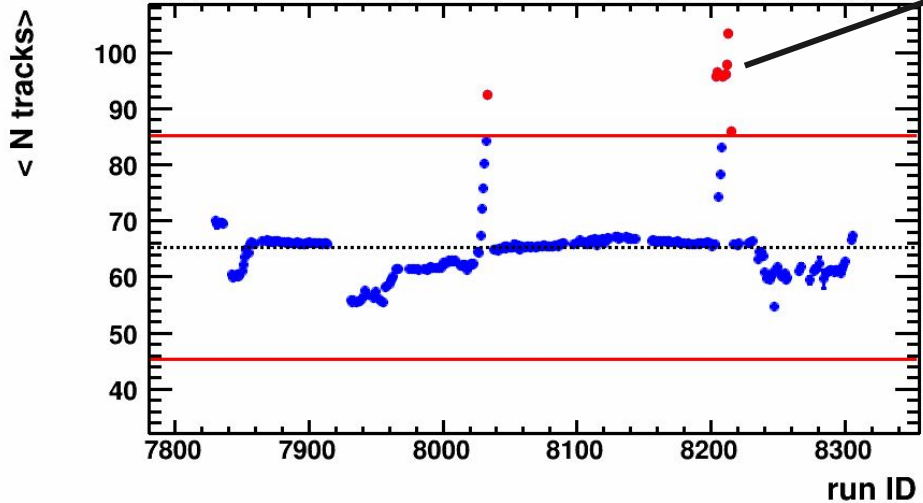
**Using the new pile-up cuts, we have twice as many events.**

For QA Run-by-run used: CCT2, new pile-up cuts, Mult>0, vertex quality

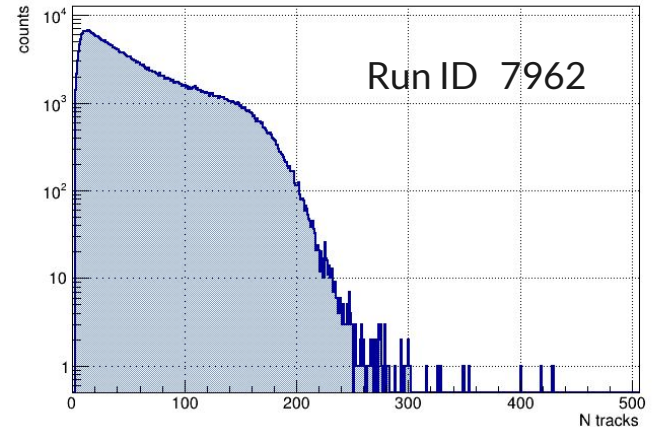
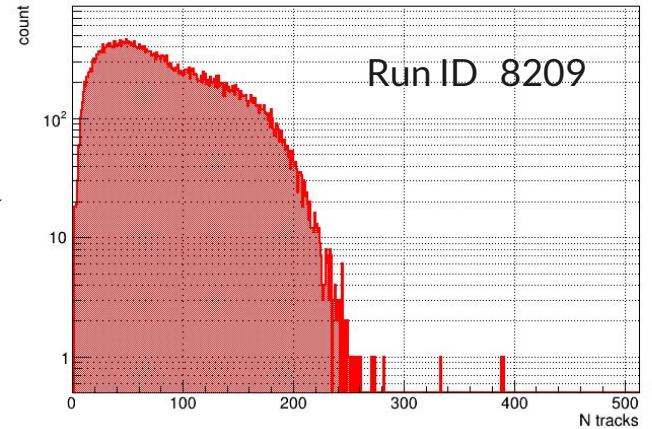
# QA Run-by-Run: runs rejection

Procedure:  $y_i$  – mean value by run ID

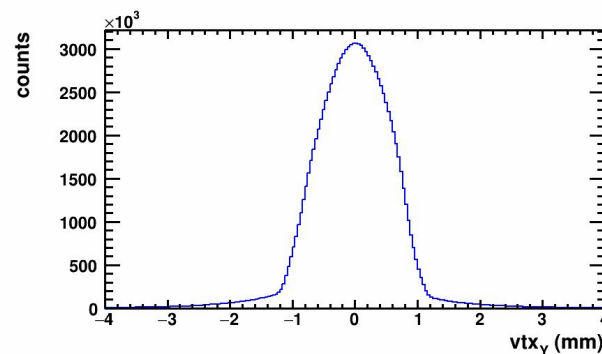
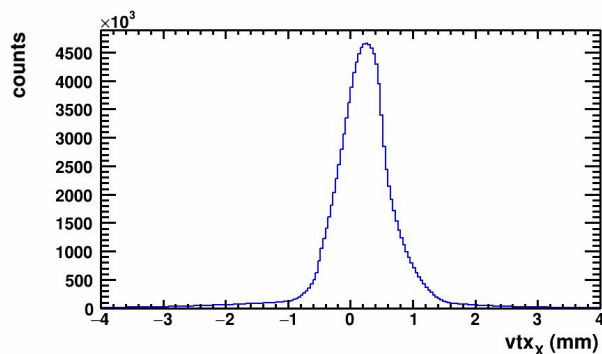
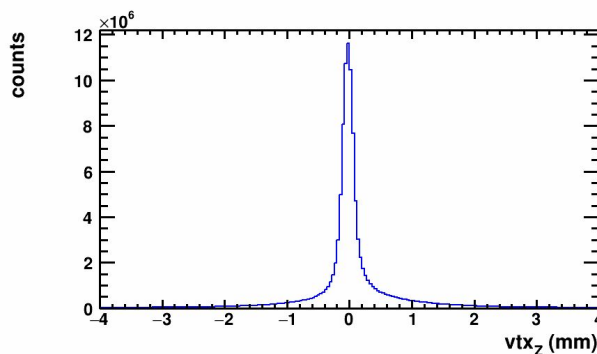
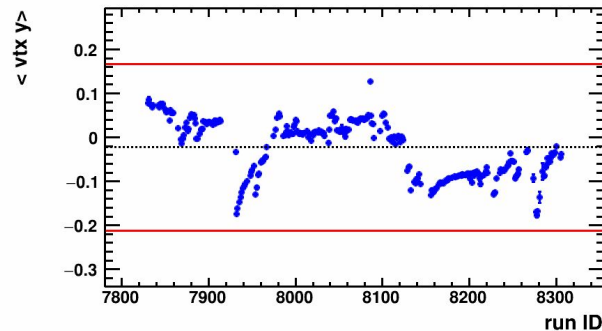
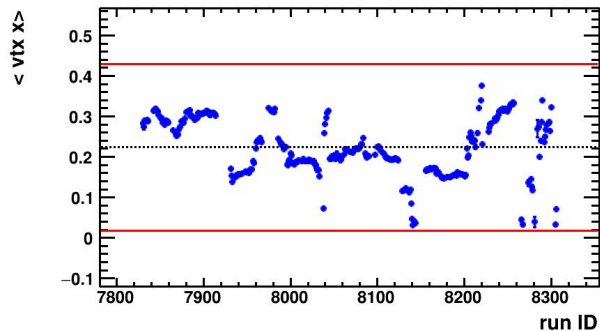
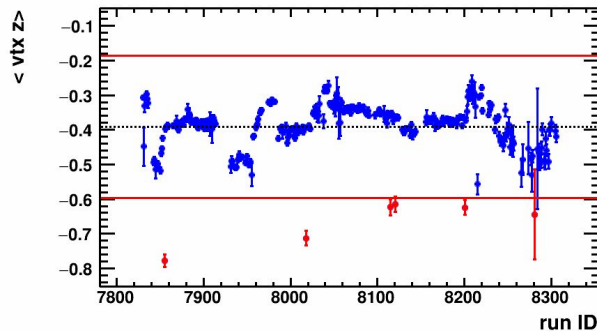
$$\mu = \frac{1}{N} \sum_{i=1}^N y_i \quad \sigma = \sqrt{\frac{\sum (y_i - \mu)^2}{N}}$$



Bad run ID (beyond  $\pm 3\sigma$ ): 8033, 8204, 8205, 8209, 8210, 8211, 8212, 8213, 8276

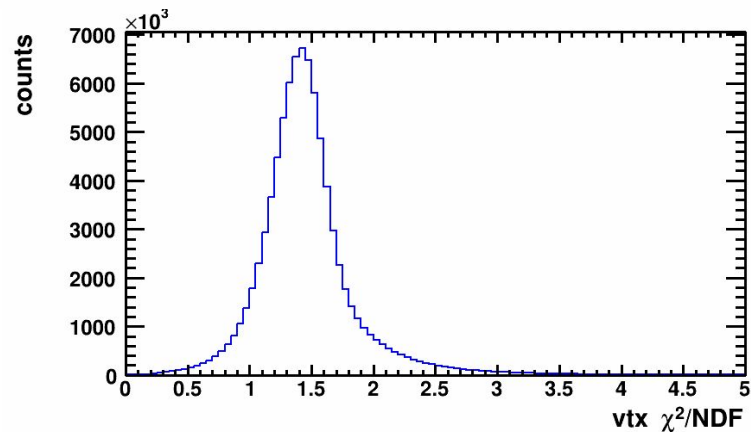
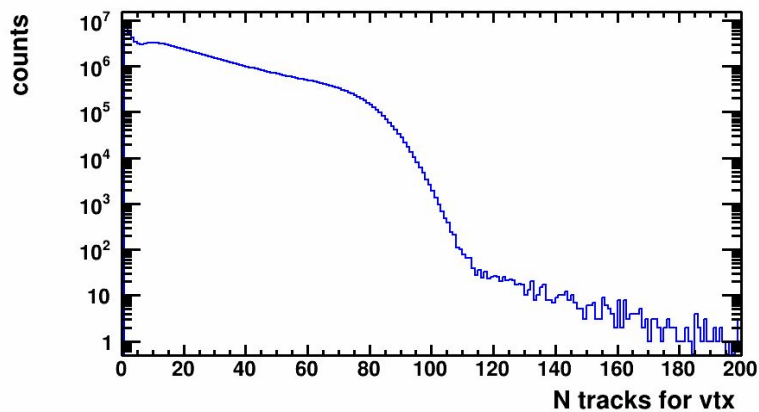
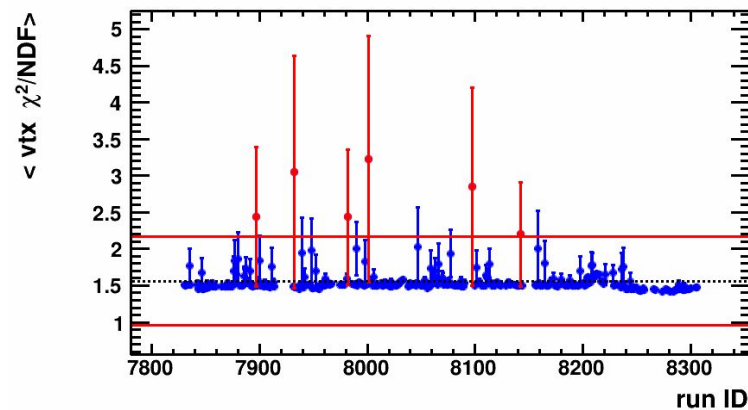
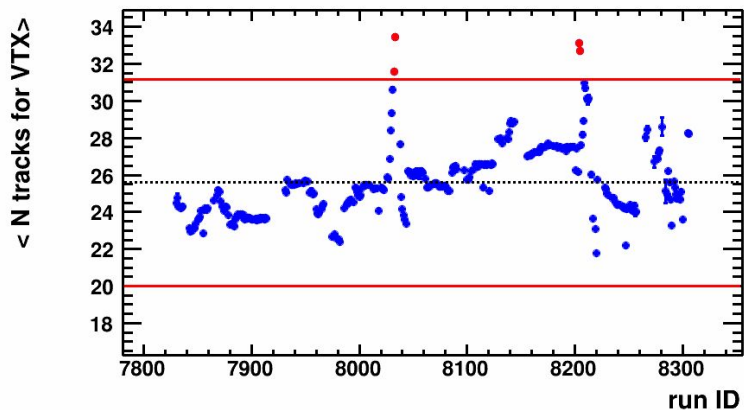


# QA Run-by-Run: vertex position



Bad Runs: 7855, 7986, 7996, 8018, 8121, 8201- ( $v_{tx} z$ ), 8276 ( $v_{tx} x$ ,  $v_{tx} y$ )

# QA Run-by-Run: vertex quality

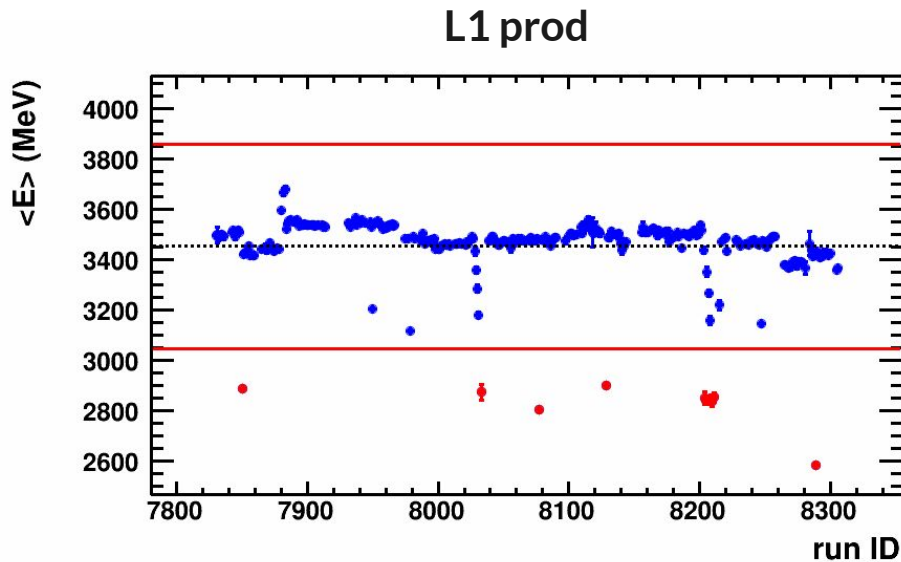
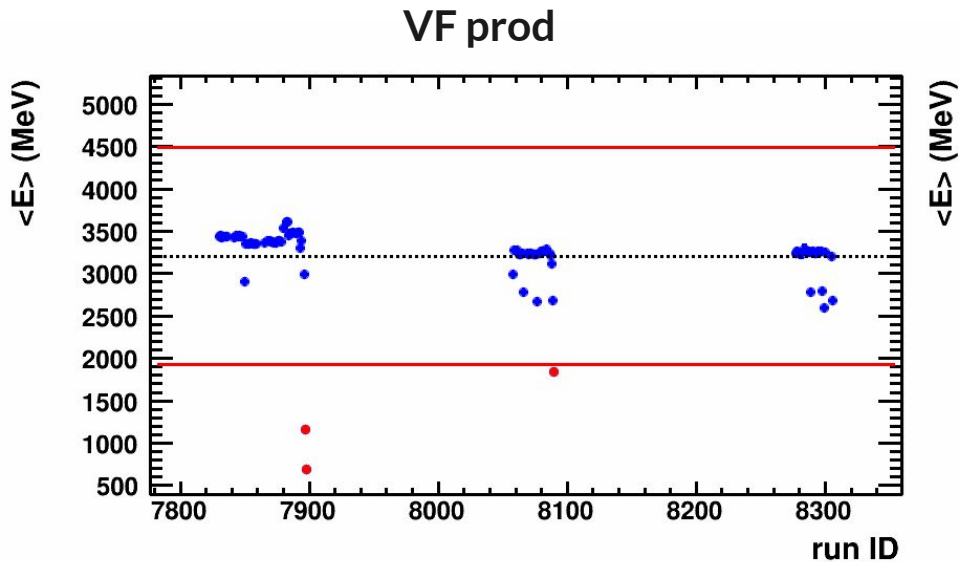


Bad Runs: 7897, 7932, 8001, 8097, 8142

Bad Runs: 8032, 8033, 8204, 8205



# QA Run-by-Run: FHCal

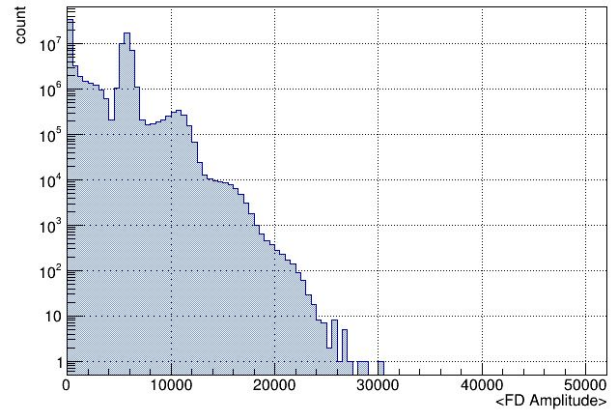
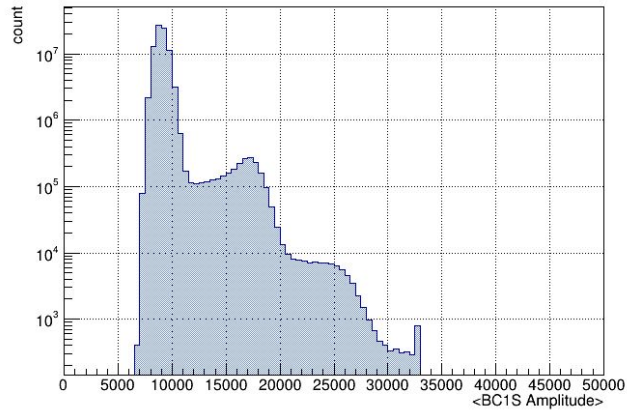
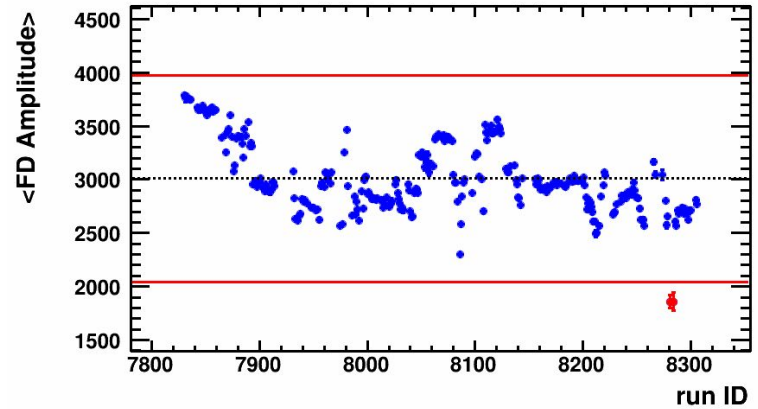
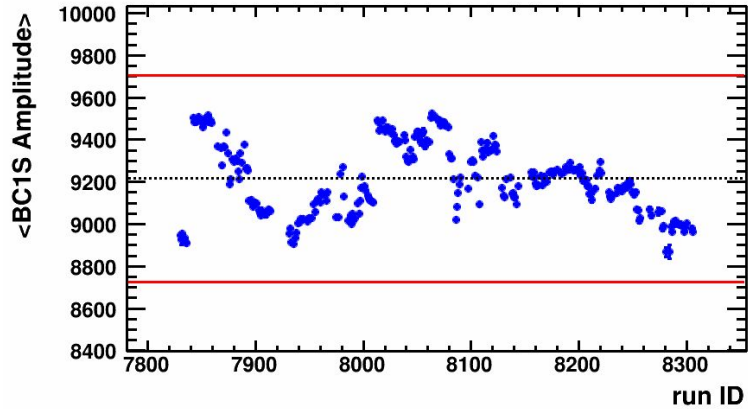


VF production made with different versions of BmnRoot:

- ~7800-7900, 8050-8100, 8070-8300 -> v23.08.0
- other runs -> later version (dev)
- Different versions are incompatible

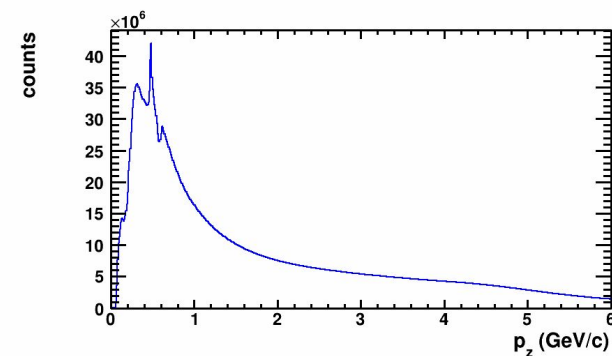
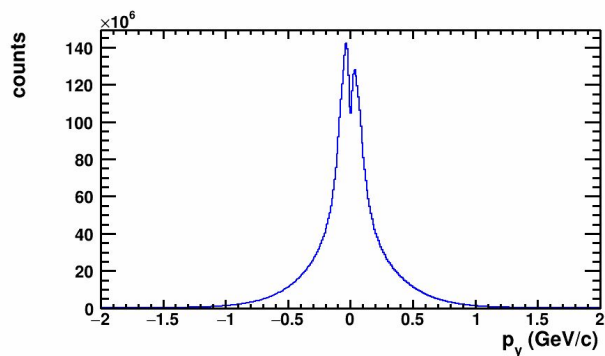
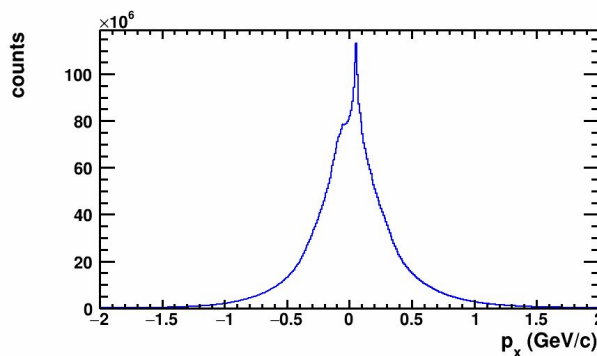
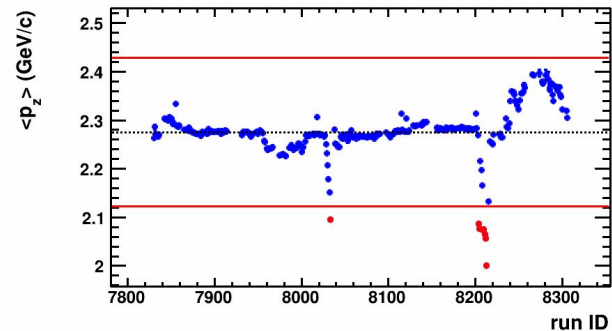
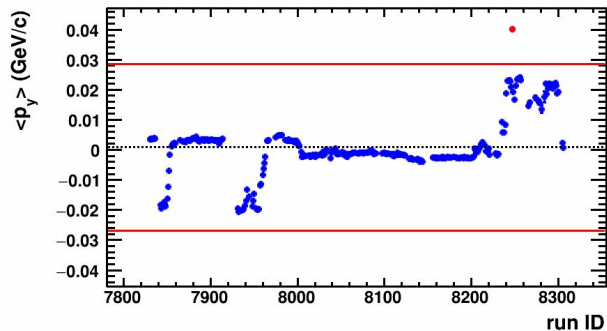
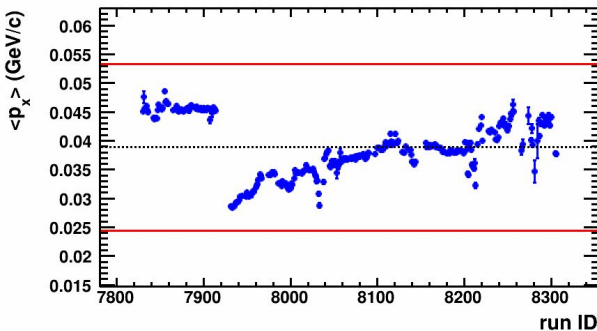


# QA Run-by-Run: BC1, FD



Plans on future: calibrate factor for each RunId

# QA Run-by-Run: Tracks



Bad Runs:

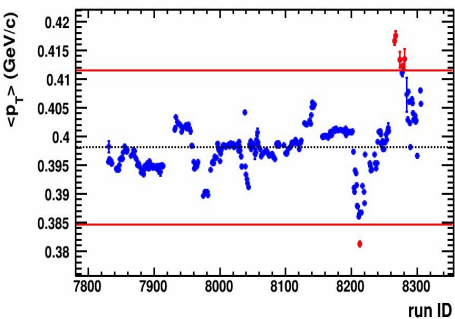
8247

Significant run Id dependence

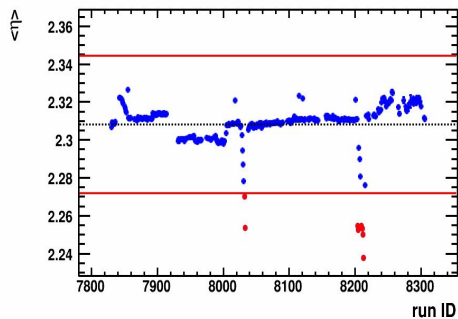
8033, 8204, 8205, 8209, 8210,  
8211, 8212, 8213

# QA Run-by-Run: Tracks

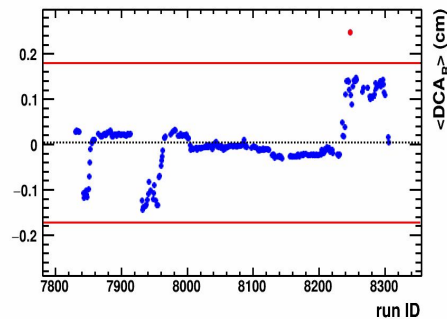
$\langle p_T \rangle$  GeV/c



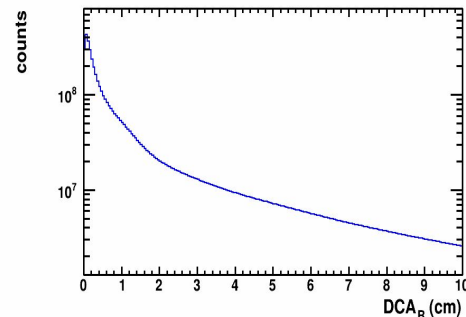
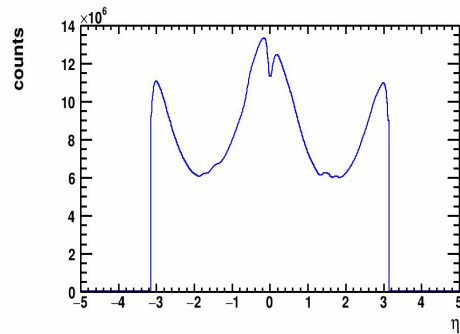
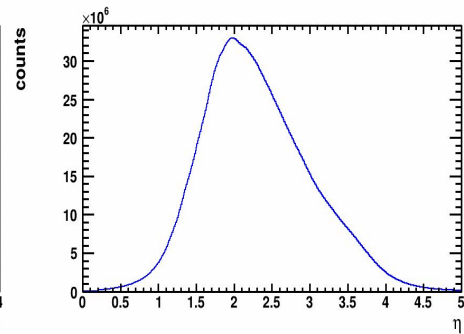
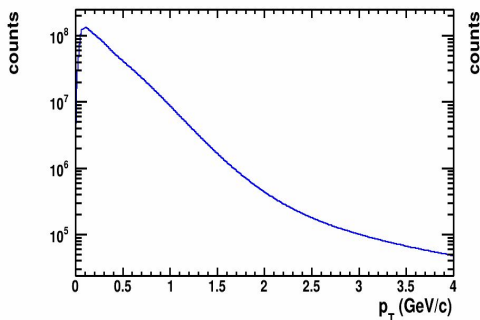
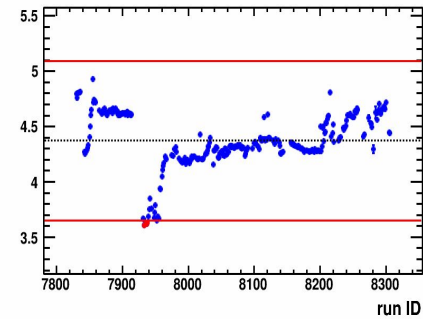
$\langle \eta \rangle$



$\langle \phi \rangle$



$\langle \text{DCA}_R \rangle$ , cm



Bad Runs: 8213, 8266,  
8267, 8274, 8279, 8281

8033, 8204, 8205,  
8209, 8210, 8211,  
8212, 8213

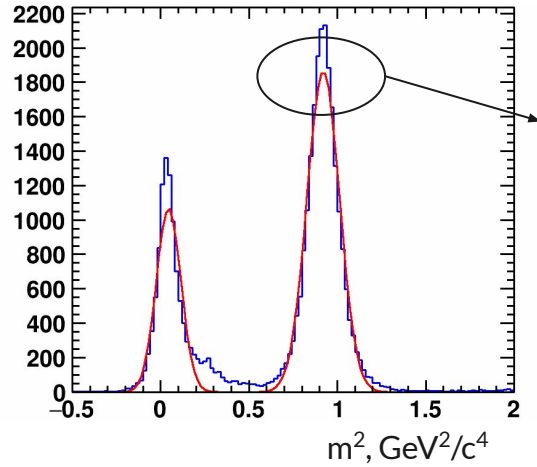
8247

7933, 7935, 7937,  
7938

Significant run Id dependence

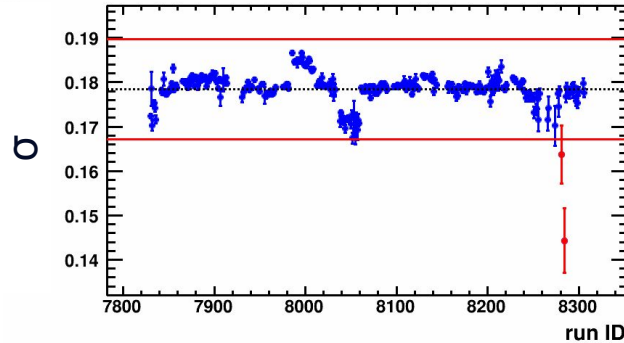
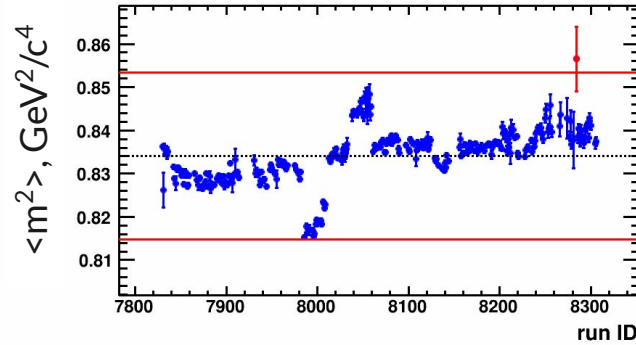
# QA Run-by-Run: proton

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

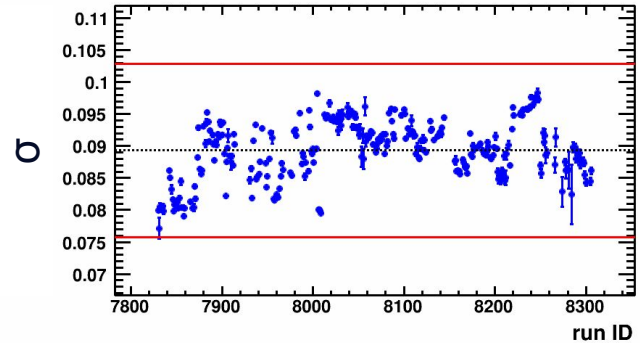
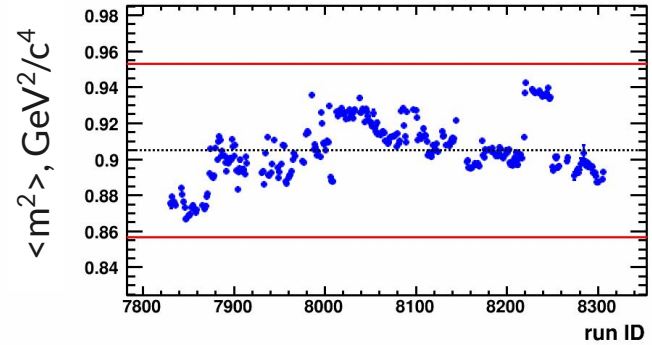


Fit of each run ID with Gaus

TOF-400



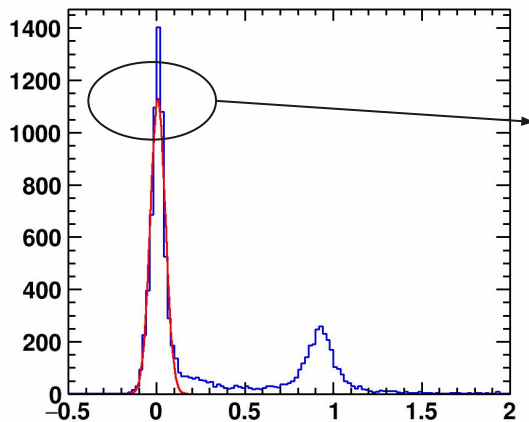
TOF-700



We have a room for improvement after TOF calibration

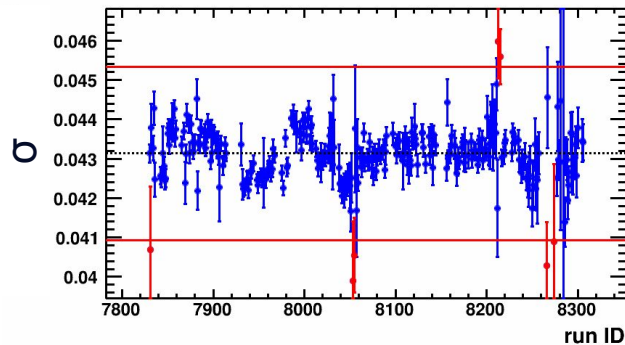
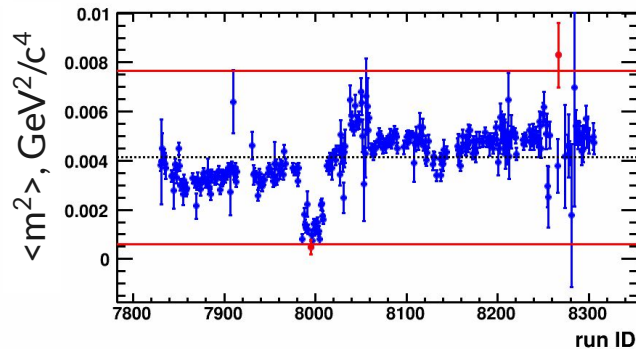
# QA Run-by-Run: $\pi^+$

$0.5 < p < 1.0 \text{ GeV}^2/c^4$

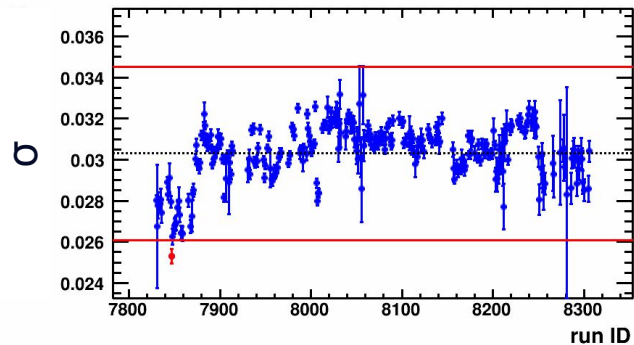
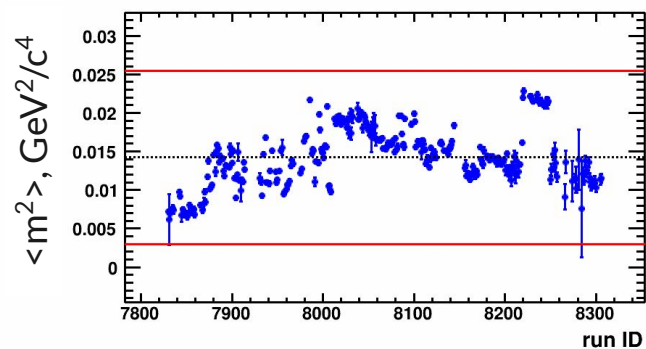


Fit of each run ID with Gaus

TOF-400



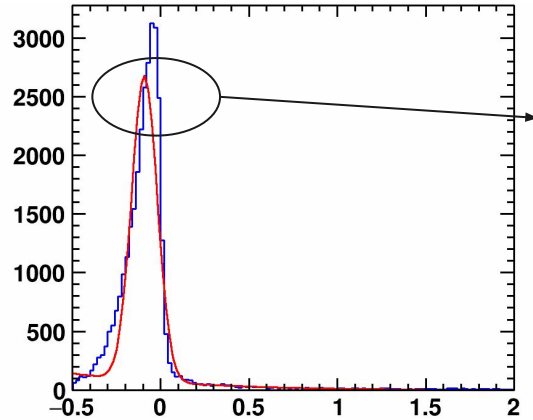
TOF-700



We have a room for improvement after TOF calibration

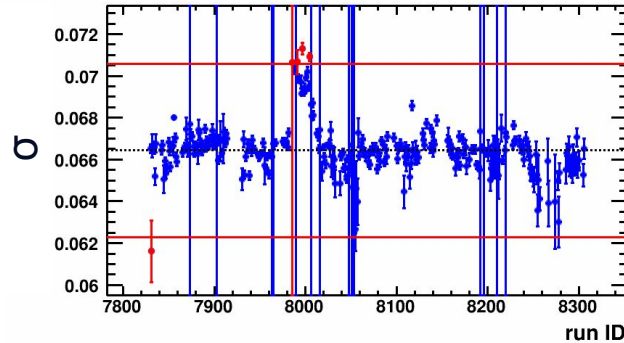
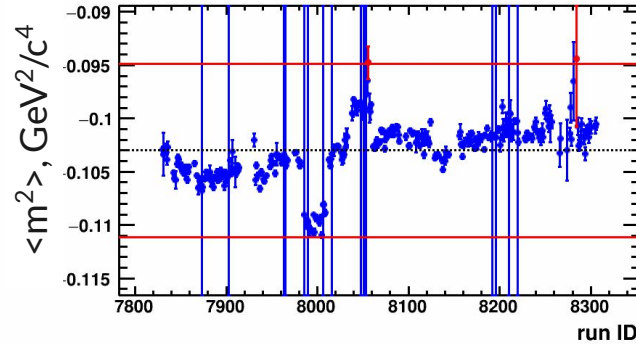
# QA Run-by-Run: $\pi^-$

$0.5 < p < 1.5 \text{ GeV}^2/c^4$

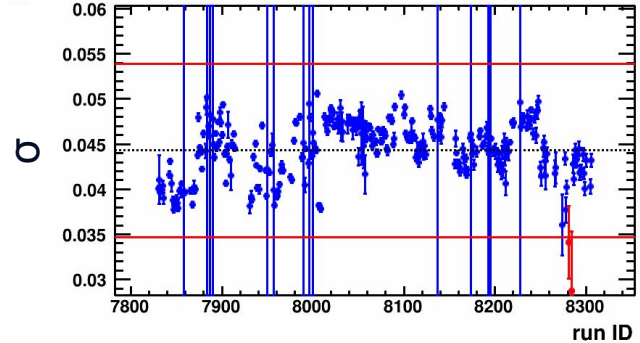
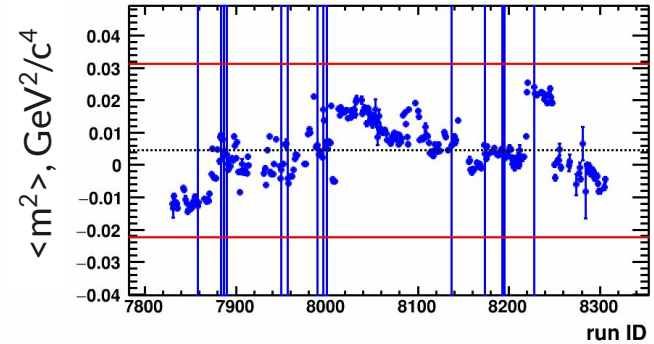


Fit of each run ID with Gaus

TOF-400



TOF-700



We have a room for improvement after TOF calibration

# Conclusions

- First implementation of the pile-up rejection was done
- Run-by-run systematics:
  - List of “outlier” runs
  - There are problems with the FHCAL data when using the VF production
- Outlook:
  - The comparison with results using L1 tracking
  - Improve pile-up rejection procedure

**Thank you for your attention!**

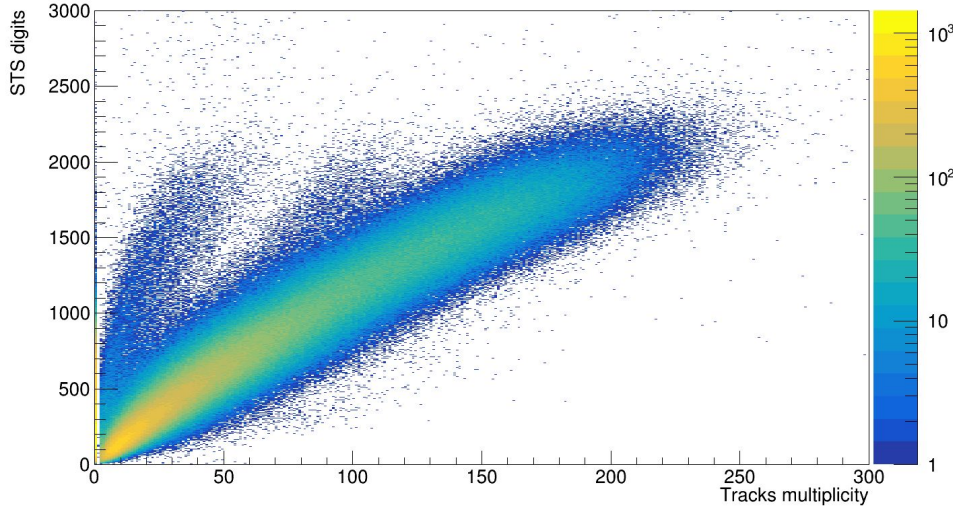




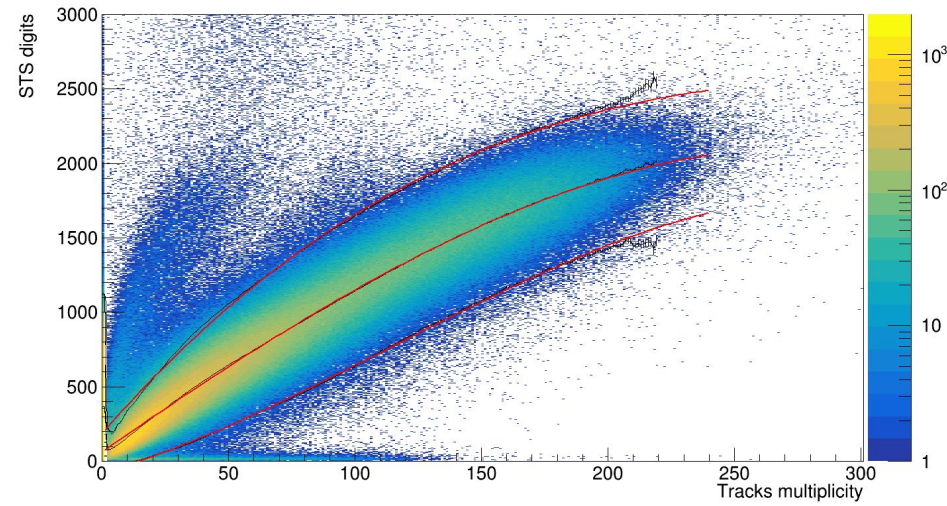
# backup

# Additional pileup graphic cut

BC1 old cut



BC1 new cut



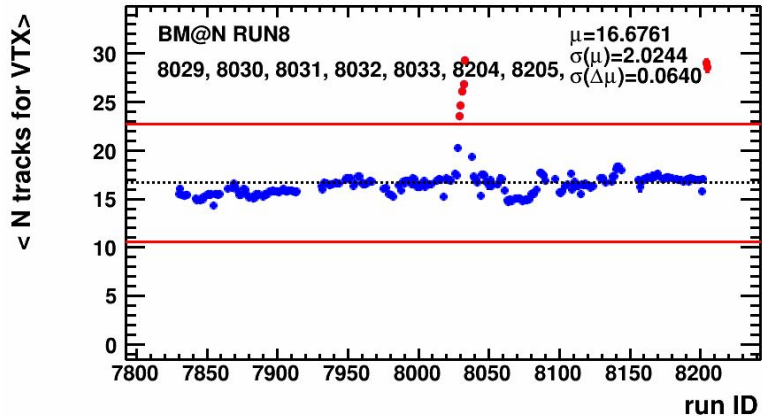
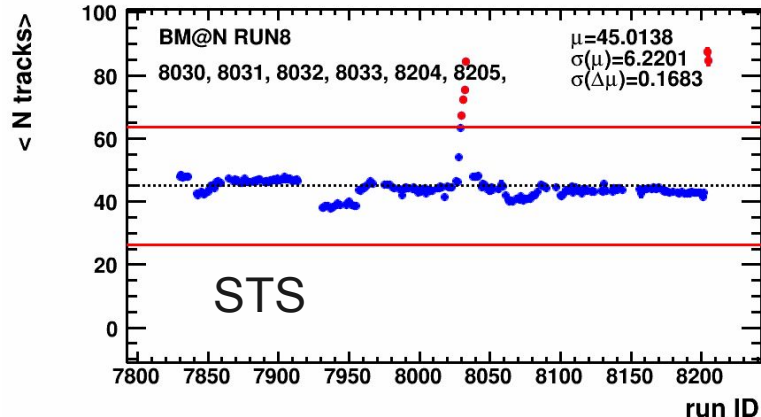
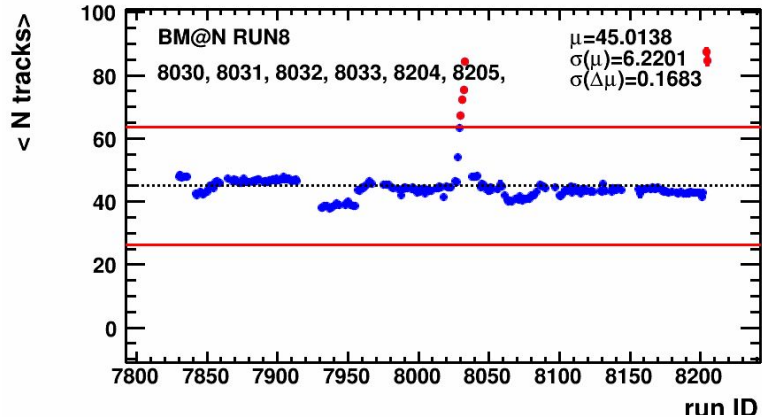
- Graphic cut was performed to throw out all event unusual behaviour:

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

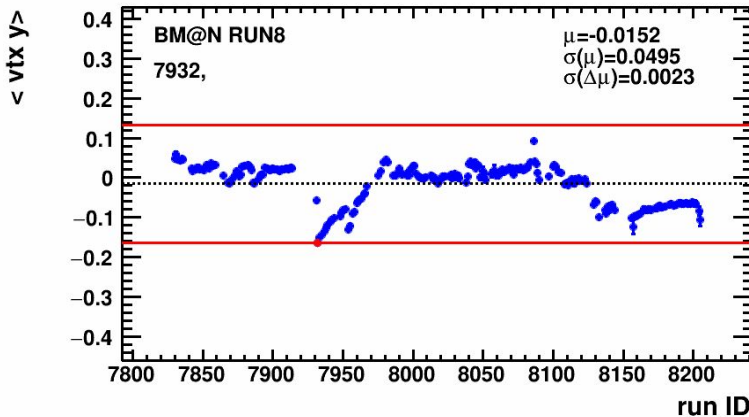
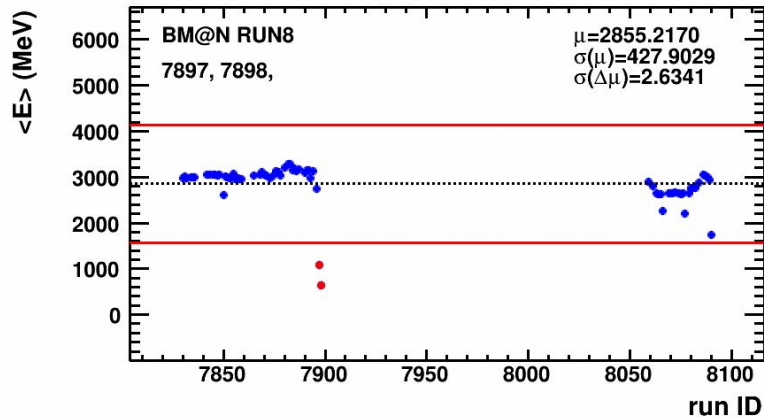
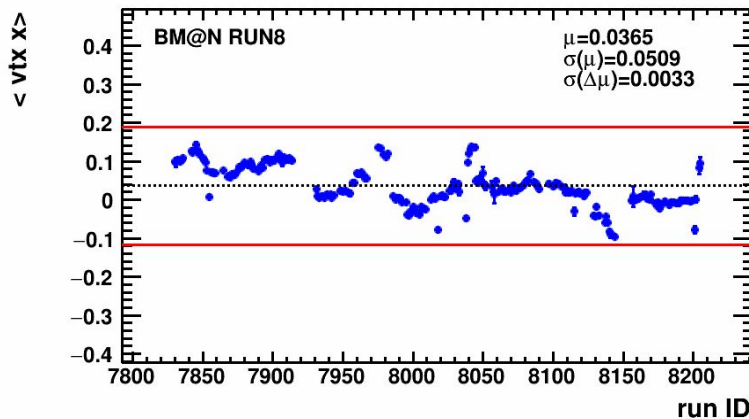
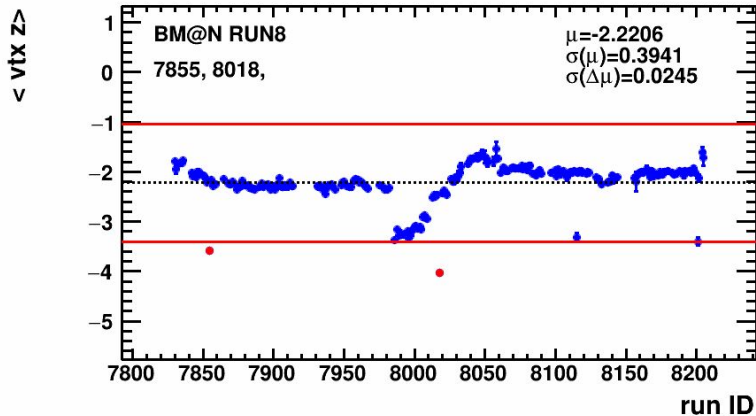
$$STS_{\min}(N_{\text{tracks}}) = -9.62078e-05 * N^3 + 0.0332792 * N^2 + 4.81632 * N - 74.0087$$

- Difference:

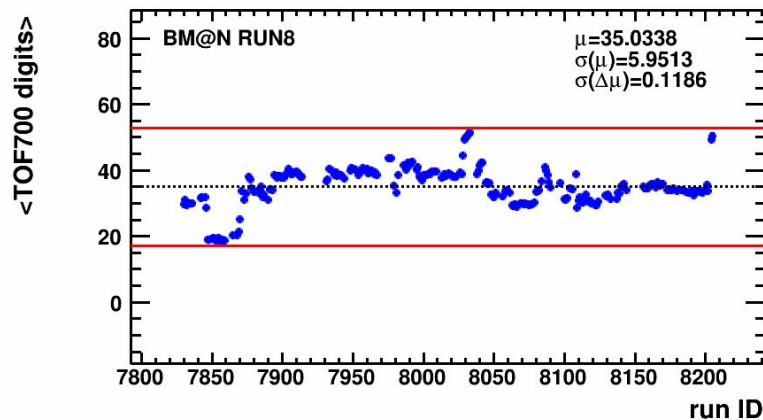
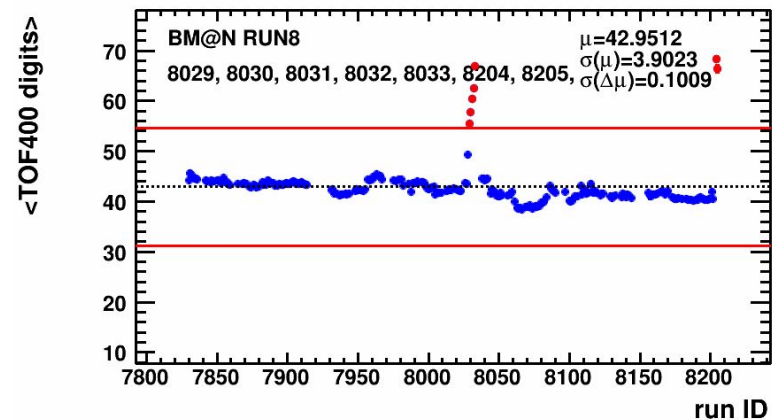
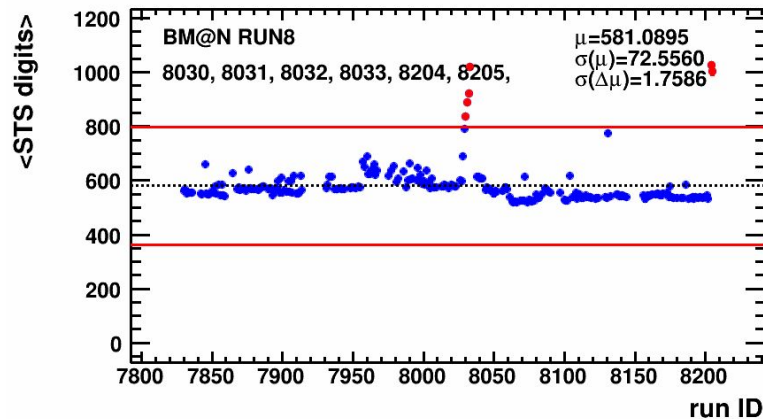
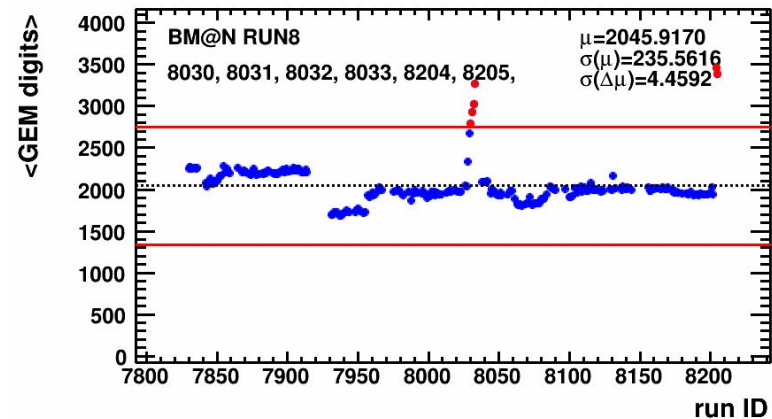
# QA Run-by-Run (Event)



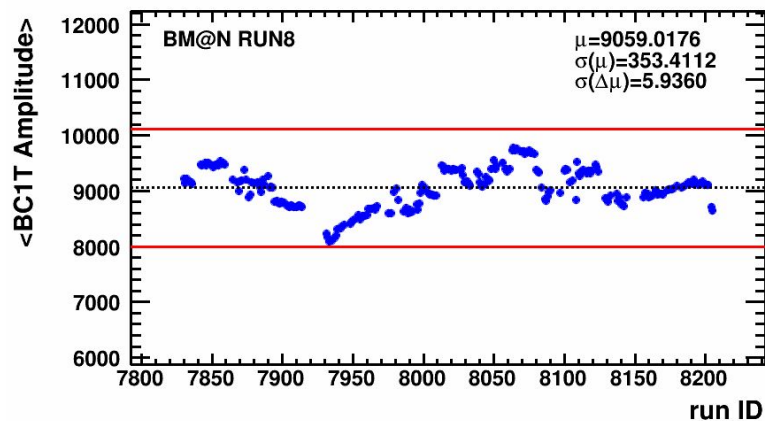
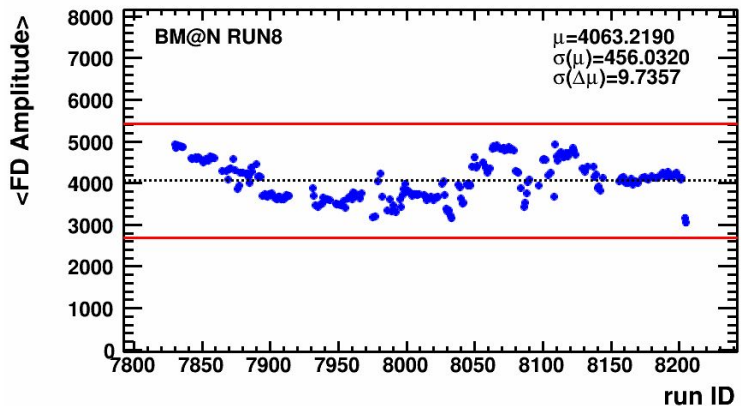
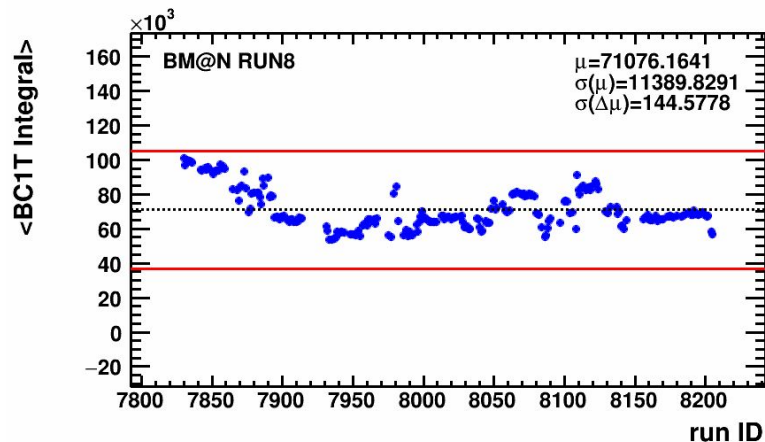
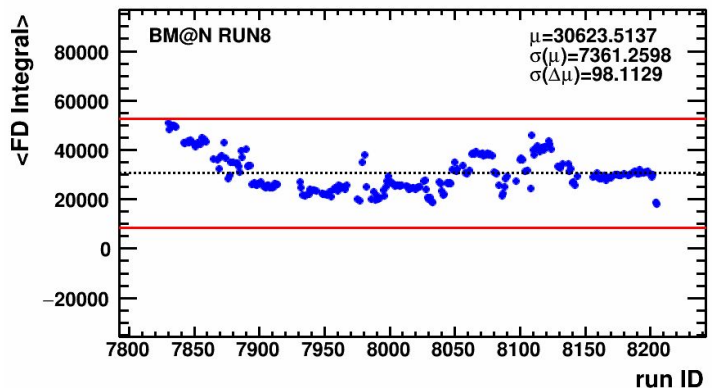
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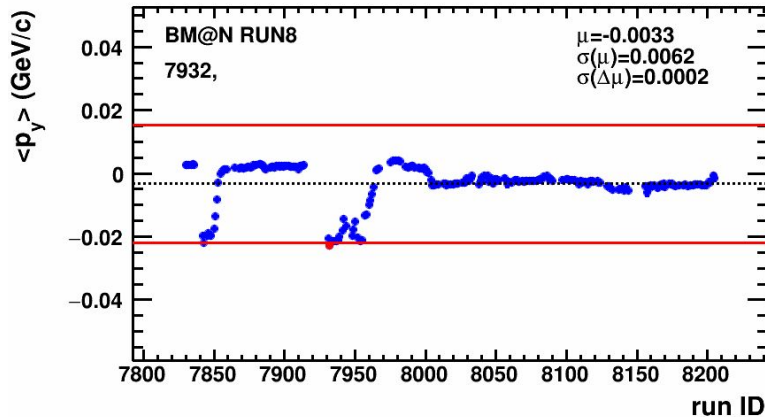
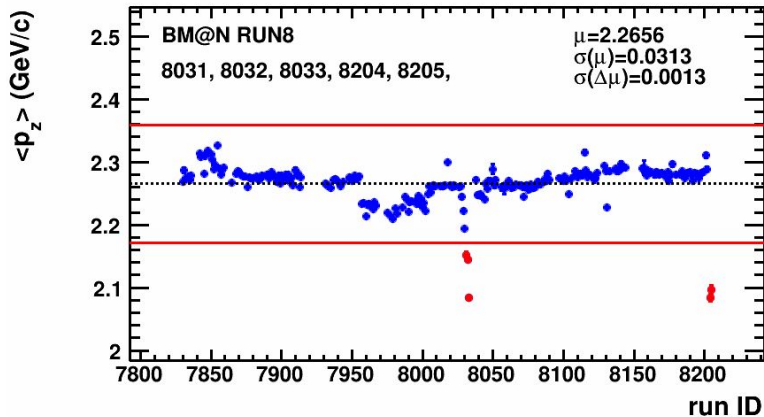
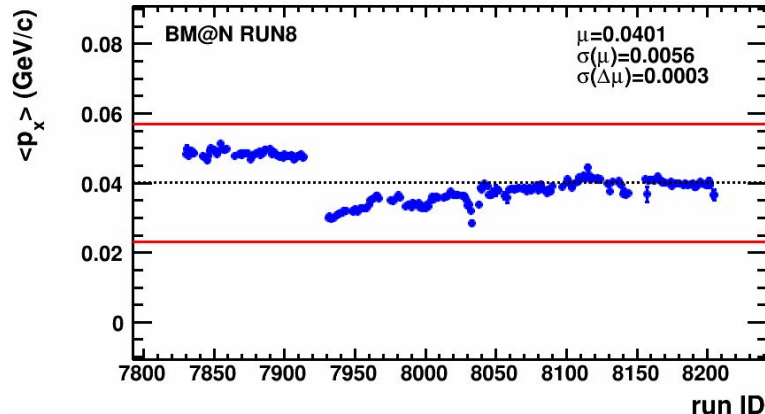
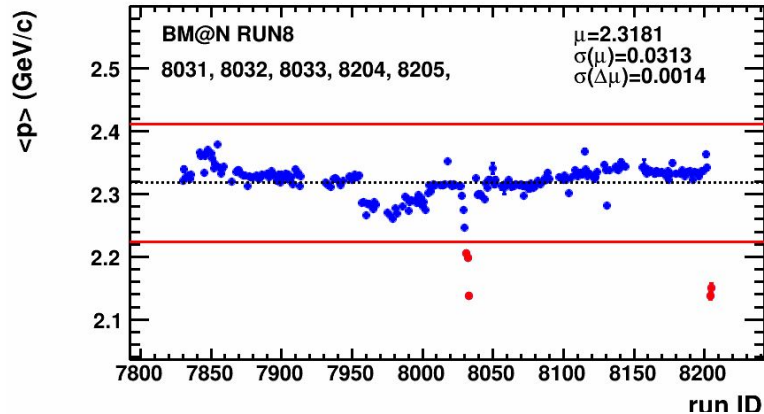
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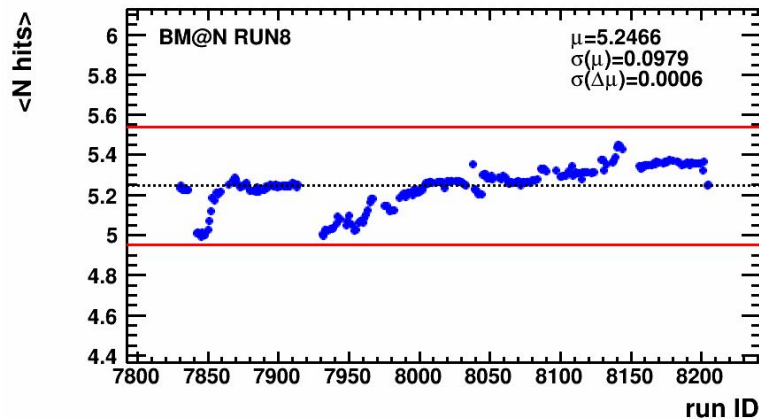
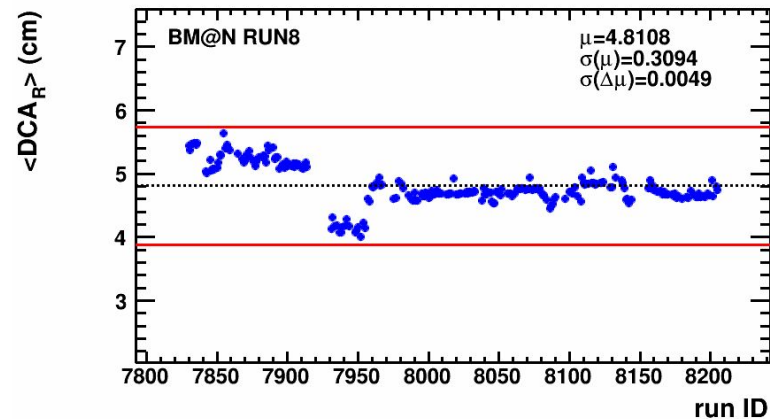
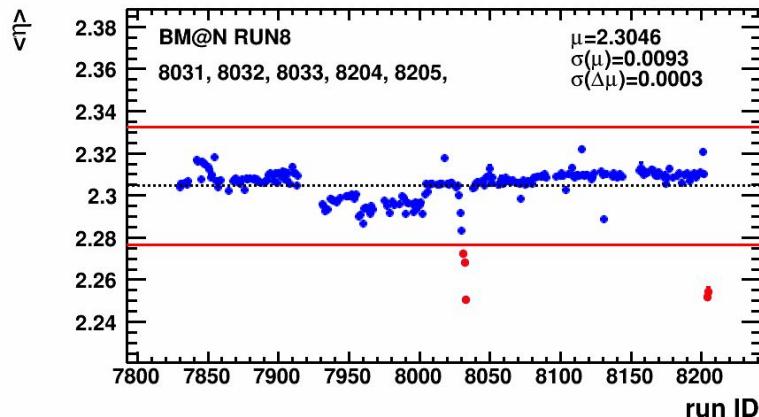
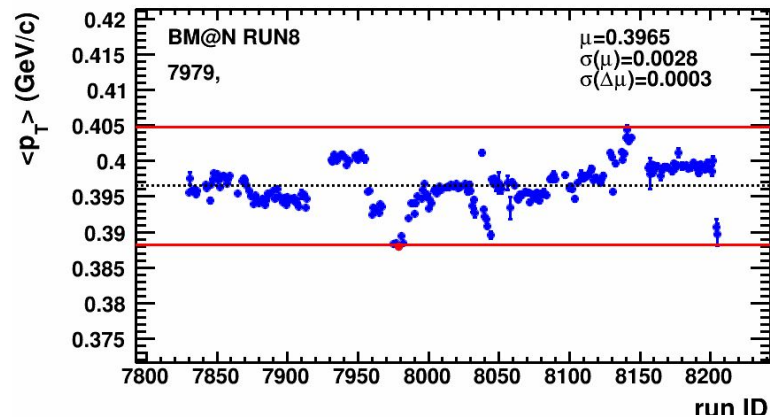
# QA Run-by-Run (Event)



# QA Run-by-Run (Tracks)

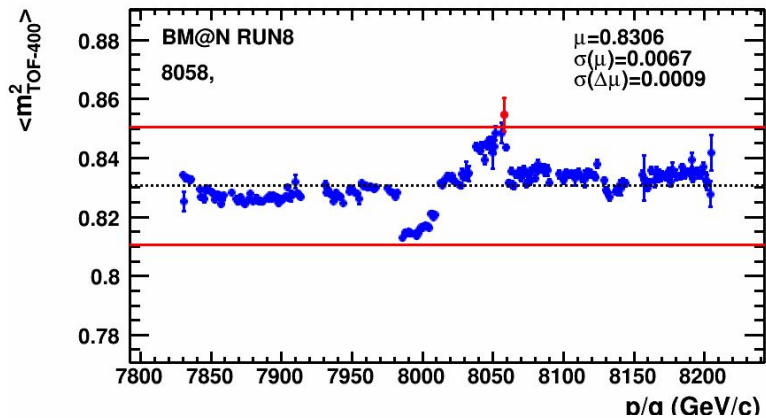


# QA Run-by-Run (Tracks)

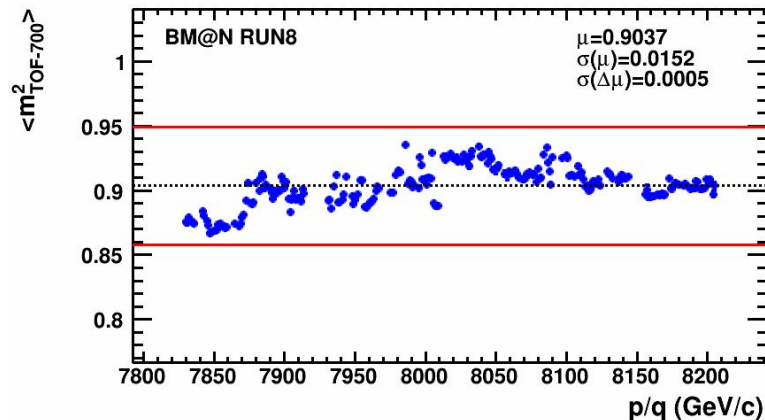




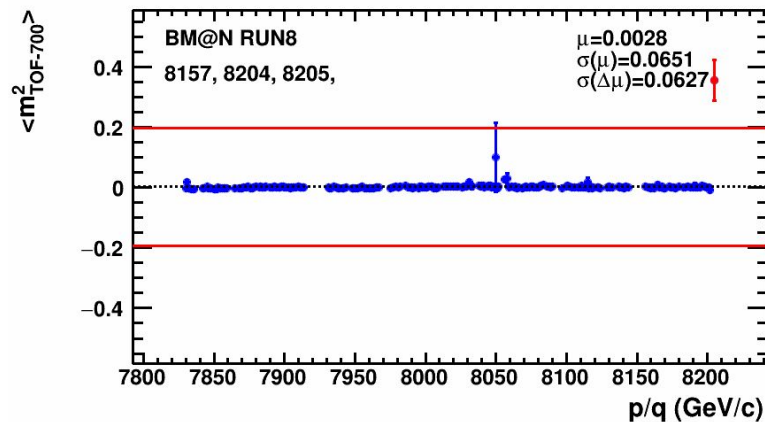
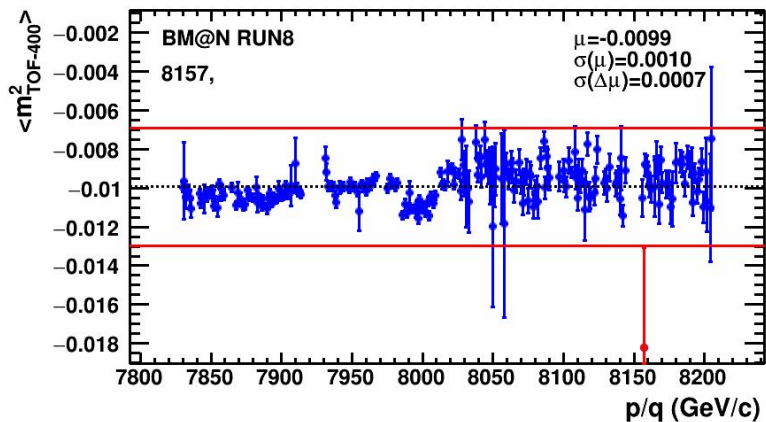
# QA Run-by-Run (Tracks)



$1 < p < 2$



$0.1 < p < 0.7$



# The BM@N experiment and motivation

Data:

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

