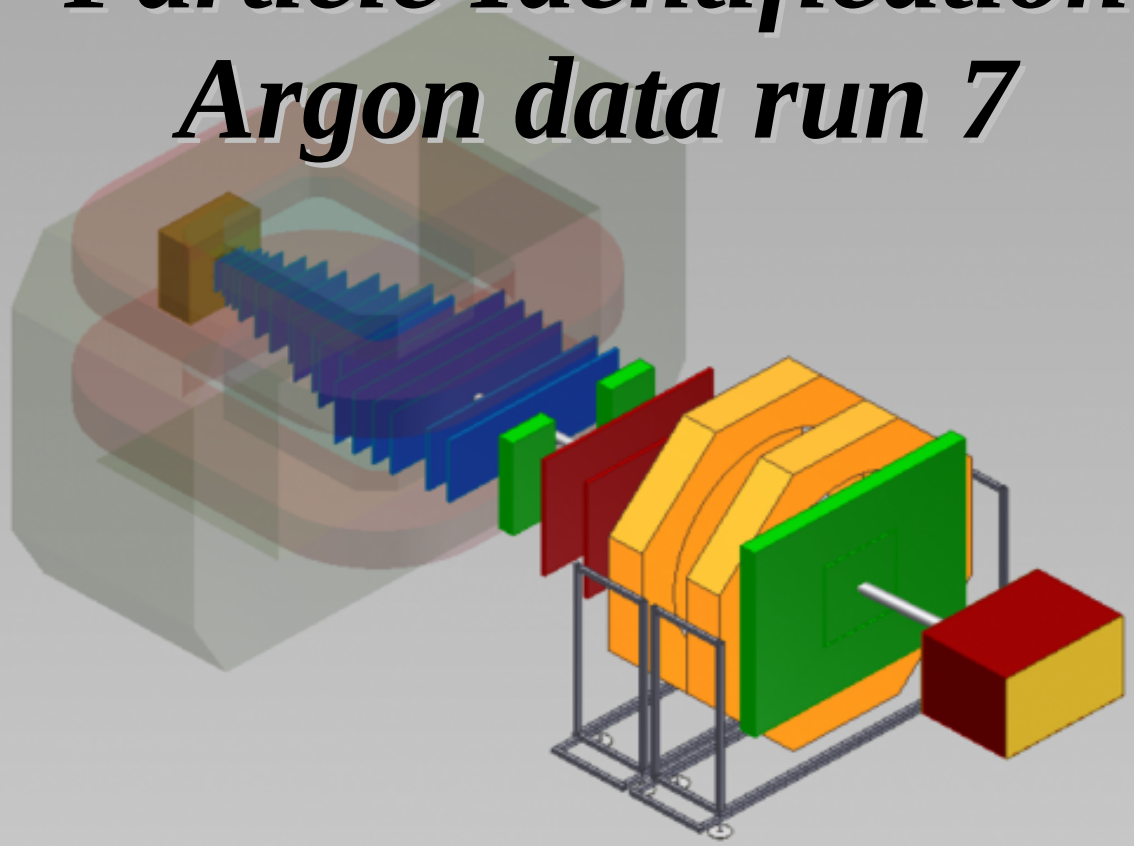
Current Progress in TOF700 Particle Identification Argon data run 7



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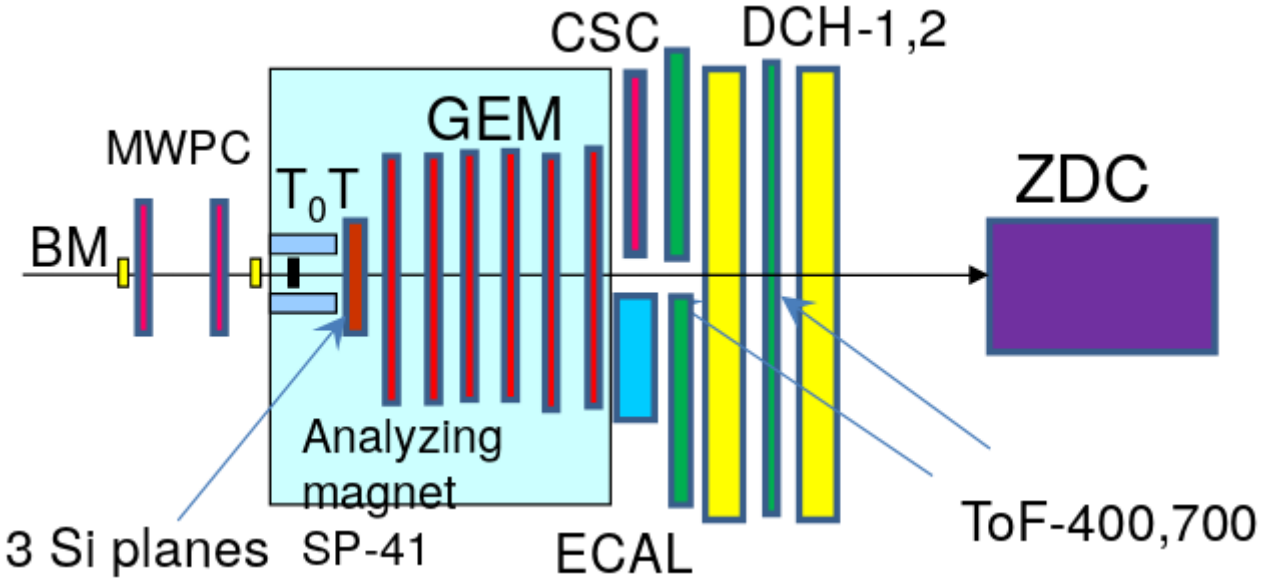
2. VBLHEP Joint Intitute for Nuclear Research, Russia

Argon data run 7

Ar beam 3.2 GeV/n
Targets Al,C,Sn,Cu,Pb



Schematic drawing of the BM@N setup

TOF700 Particle Identification chain

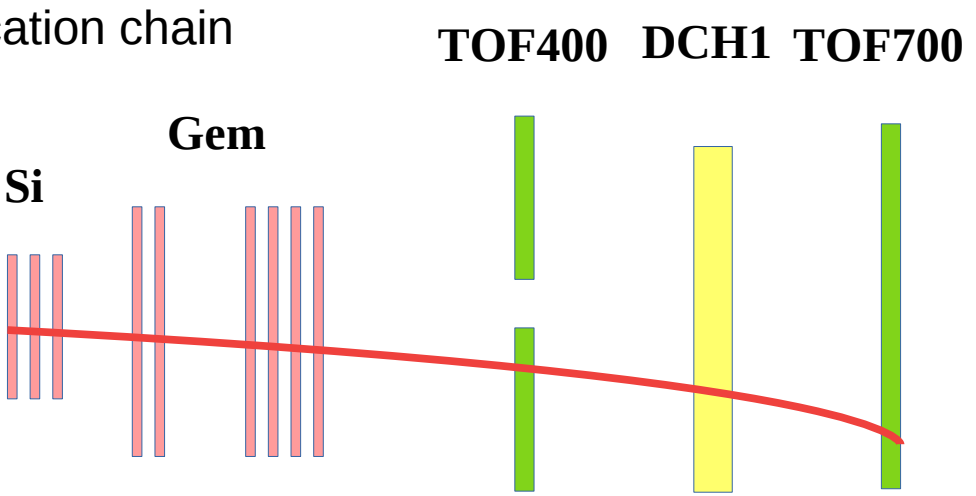
For **Data** and **MC** we use the **same** Identification chain

For **MC** we use **DCM QGSM** Generator

Si-GEM(data) tracks from **V. Plotnikov**

DCH tracks from **DCH group**

TOF700 hits from **Y. Petukhov**



Si-GEM tracks are extrapolated to the **DCH1** z-position
and matched against the **DCH1** tracks

Successfully matched tracks are extrapolated to the **TOF400** and **TOF700** planes
and matched against the **TOF400** and **TOF700** hits

Notations

"Good" Si-GEM tracks – those which pass cut selection.

"Good" tracks – successfully matched **"Good" Si-GEM tracks** with **DCH tracks.**

DxDCH1 – x-distance between **Si-GEM** and **DCH** tracks on **DCH1** plane.

DyDCH1 – y-distance between **Si-GEM** and **DCH** tracks on **DCH1** plane.

DxTOF400, DxTOF700 – x-distance between **Si-GEM+DCH** and **TOF400** and **TOF700** hits.

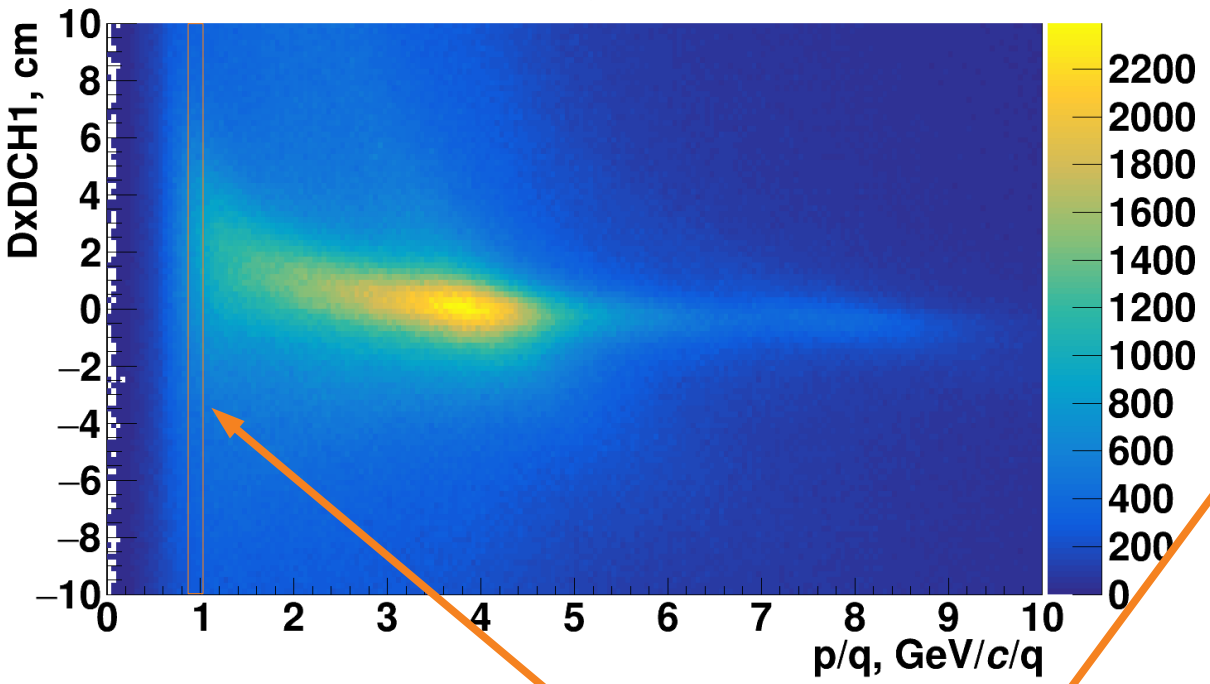
DyTOF400, DyTOF700 – y-distance between **Si-GEM+DCH** and **TOF400** and **TOF700** hits.

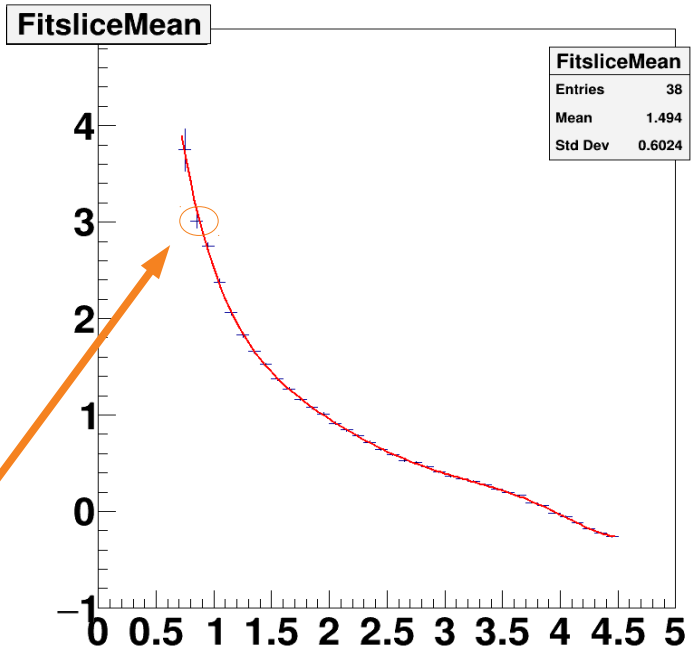
TOF700 Efficiency – $$TOF700_{eff} = \frac{N_{matched\ tracks}}{N_{extr\ tracks}}$$ **,** where

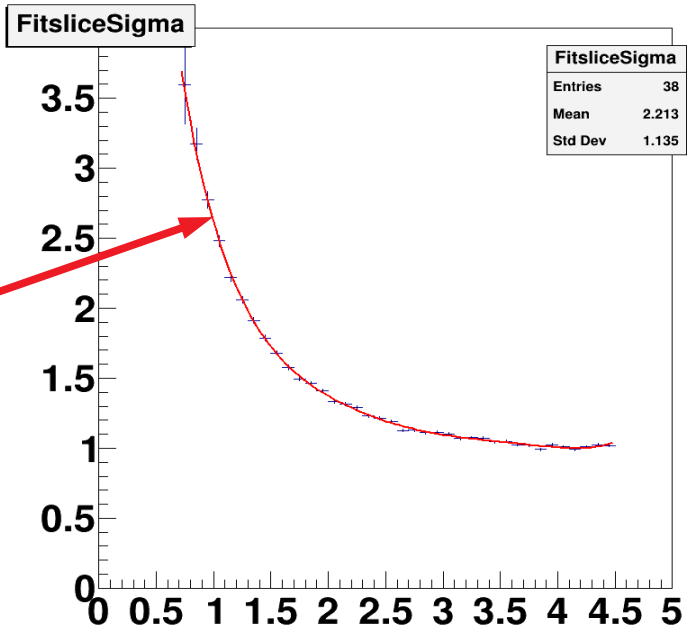
$\mathbf{N_{matched\ tracks}}$ is the number of good **Si-GEM+DCH** tracks extrapolated to **TOF700** and matched to hits.
$\mathbf{N_{extr\ tracks}}$ is the number of all good **Si-GEM+DCH** tracks extrapolated to **TOF700.**

$\mathbf{N_{correct\ identified\ trs}}$ is **Si-GEM+DCH** tracks identified in **TOF400** and **TOF700** and correspond to the **same particle mass square peak.**

DX Corrections







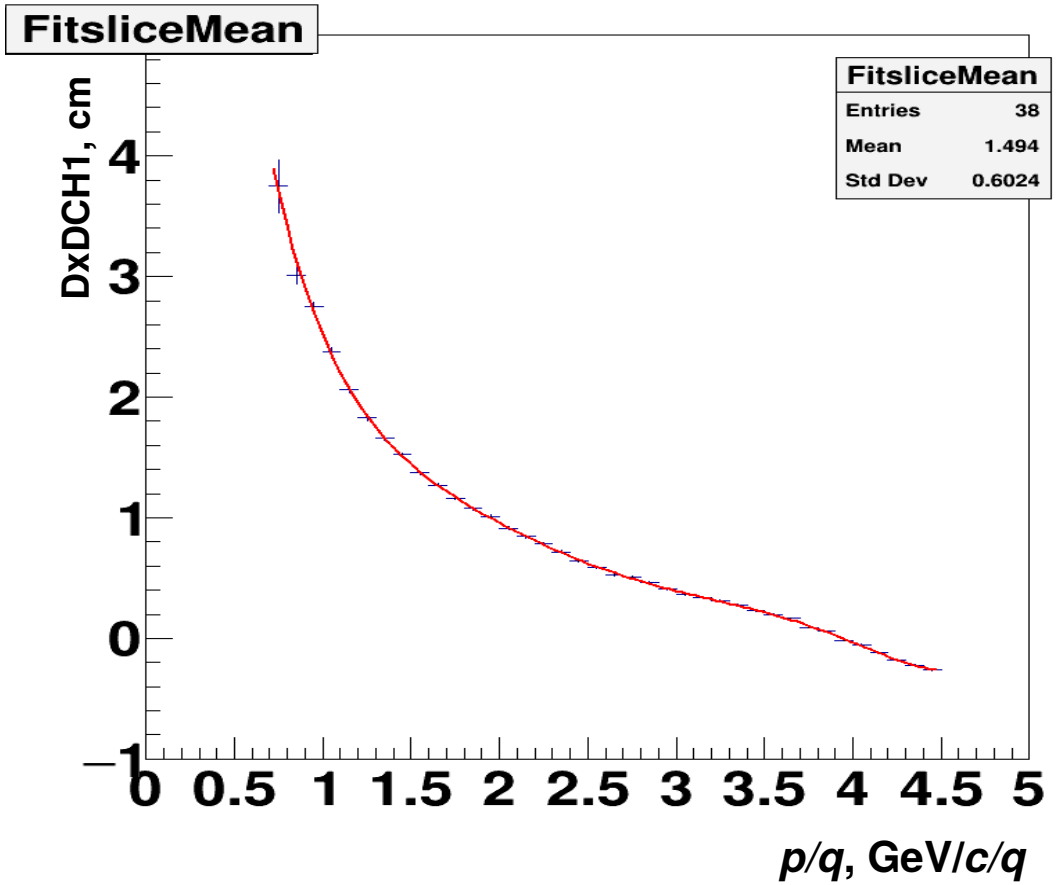
We used the FitSlices method for DxDCH1 vs p/q plot, producing projections of DxDCH1-axis each bin(slice) of p/q axis. Each slice is fitted with a **Gauss+pol2**

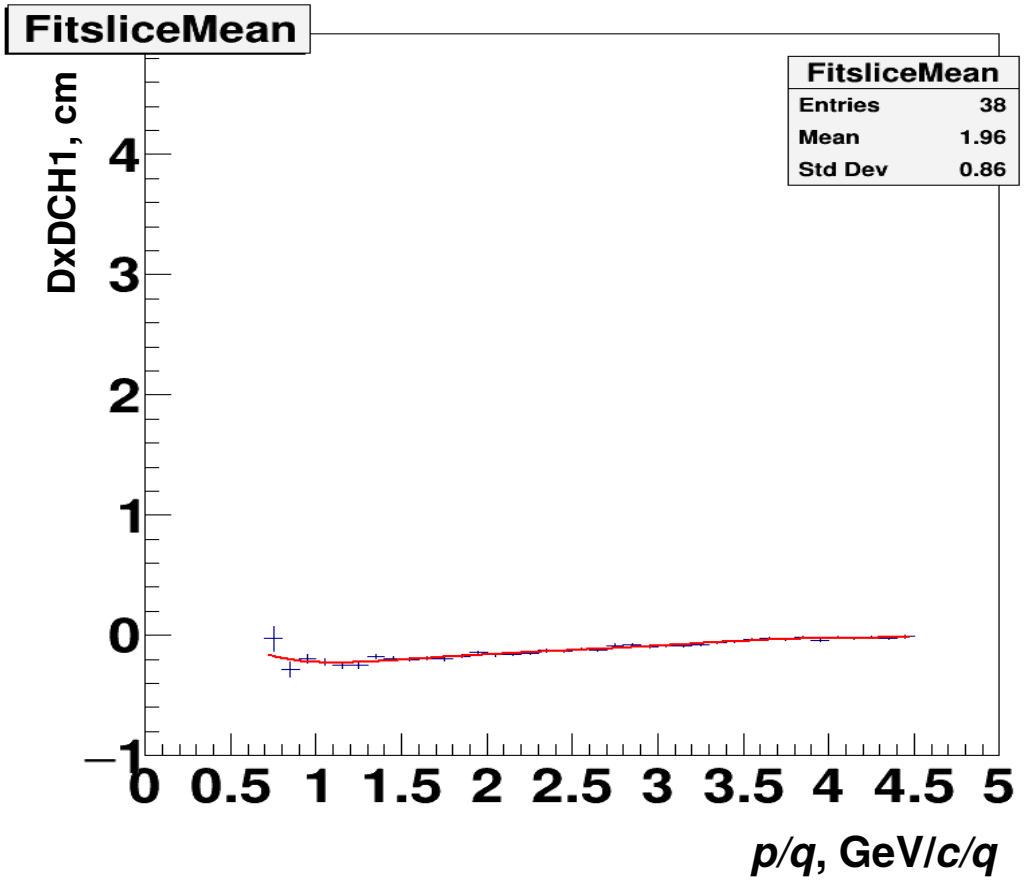
The resulting dependencies Gaus mean and sigma vs p/q are fitted with a polynomial function **pol9**

Based on these functions, in further analysis we performs corrections on X coordinate for GEM track extrapolated to the DCH1

DX Corrections DCH1

Before → **After**



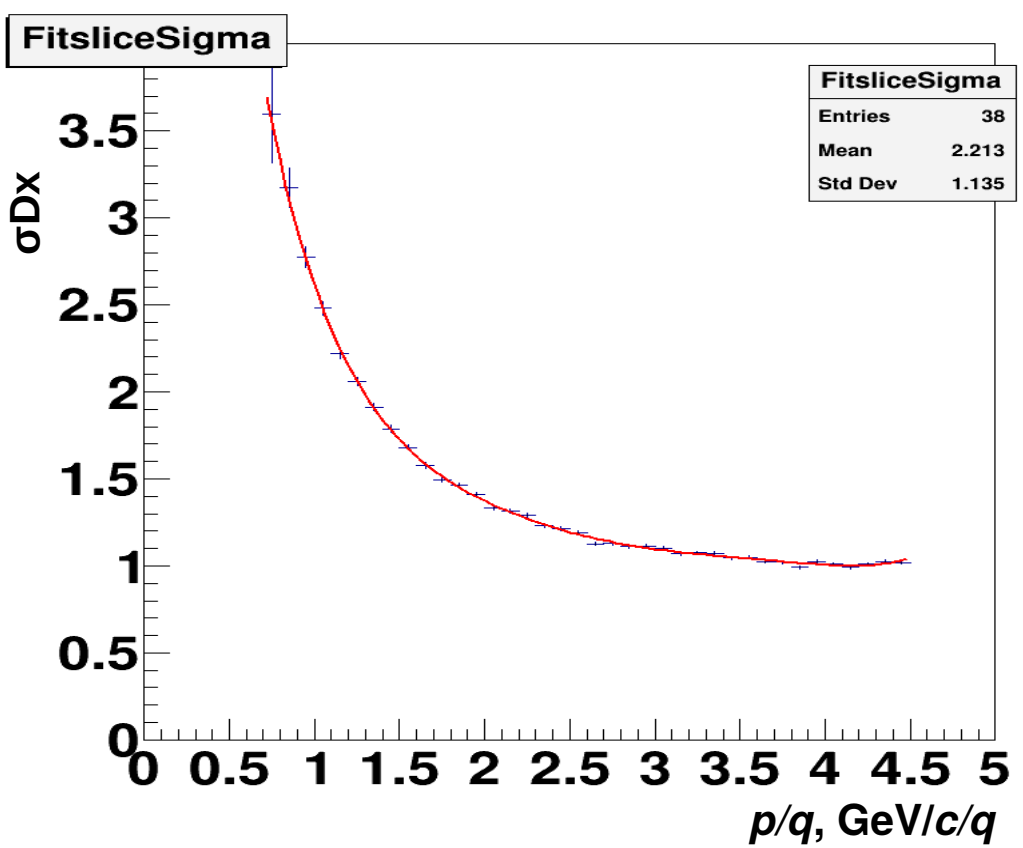


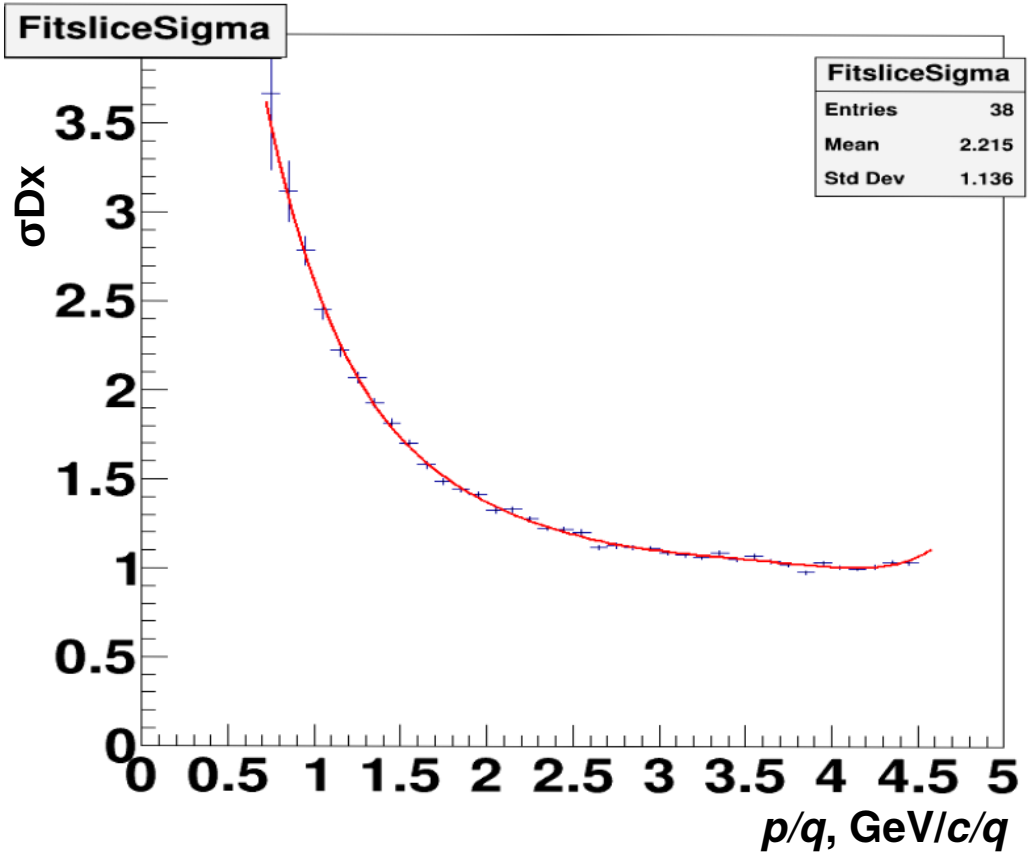
Good corrections results!

Negligible shifts of mean values of the order of a few millimeters.

DX Corrections DCH1

Before → **After**

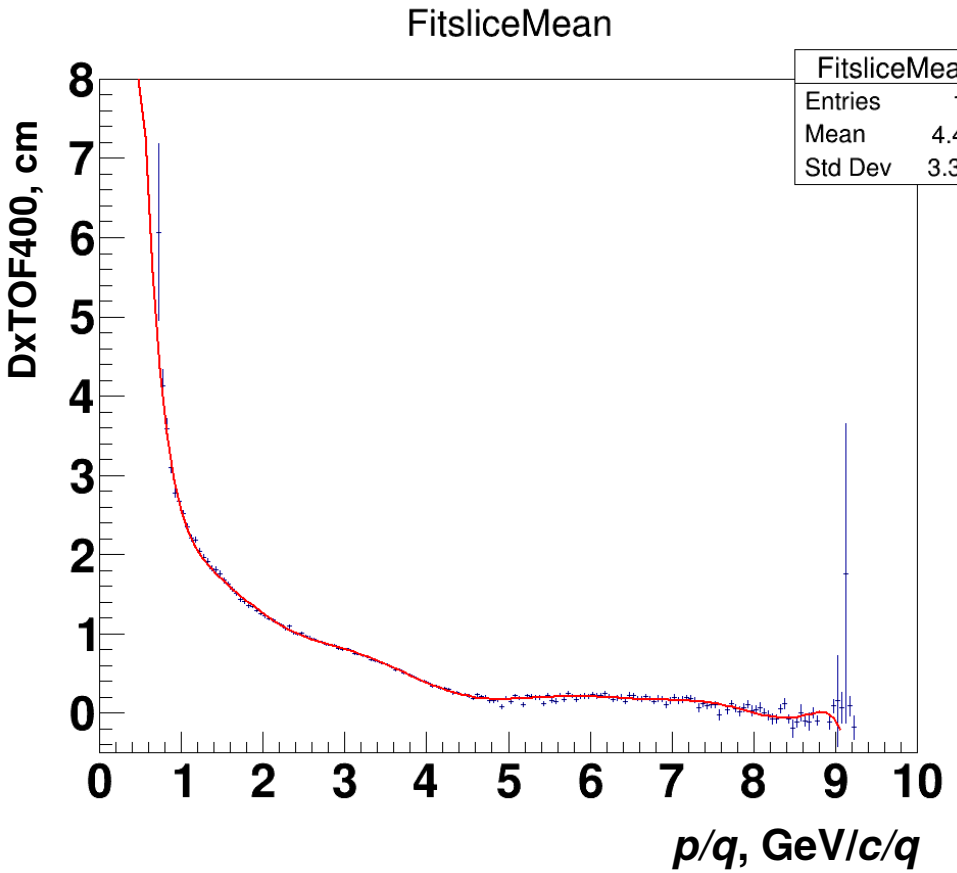


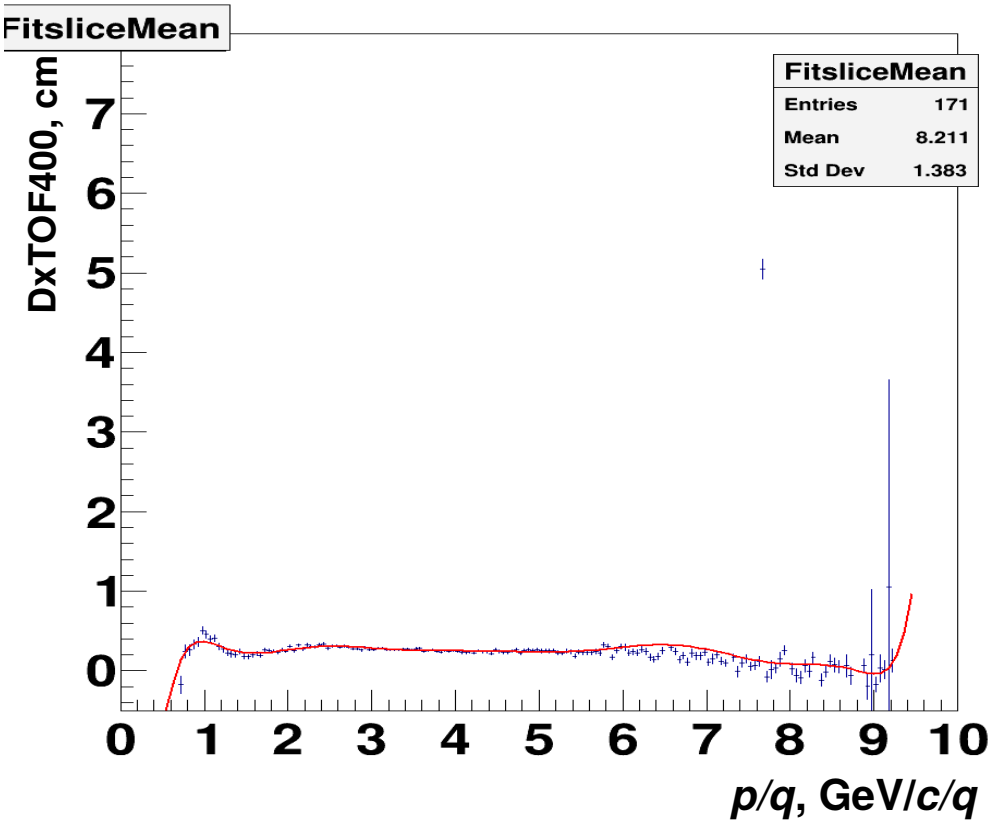


We use the fit function of sigma vs p/q dependence as a basis for a **<u>new matching criteria</u>** defined in sigma units.

DX Corrections TOF400

Before → **After**

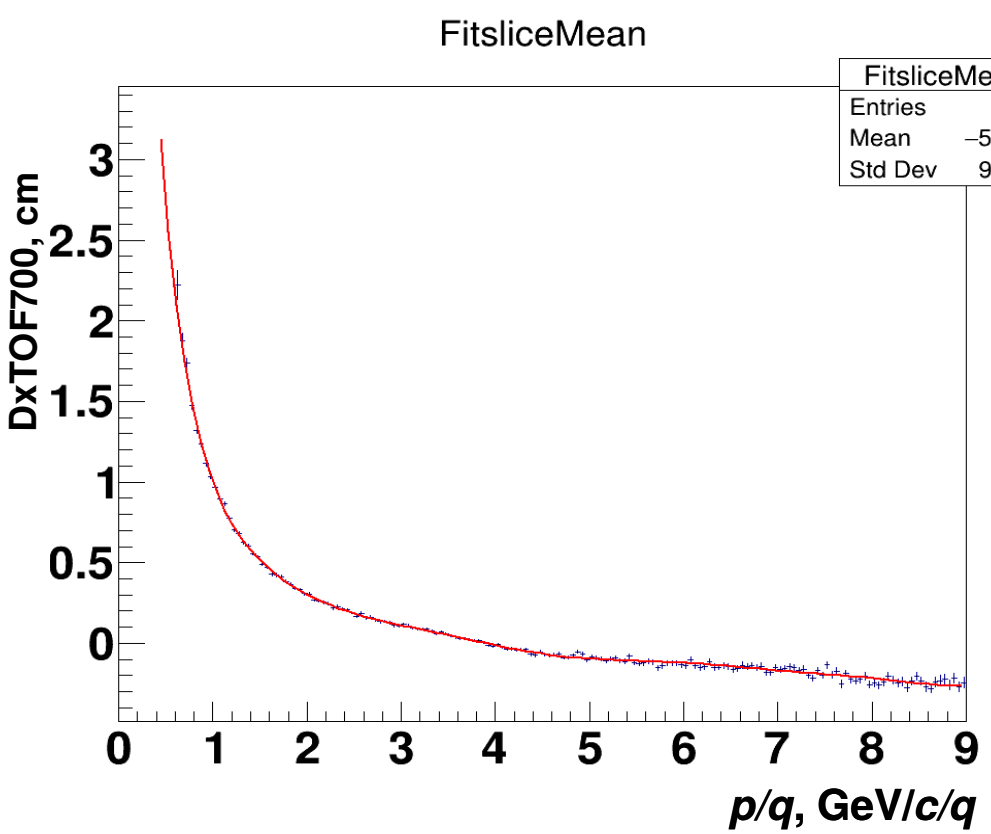


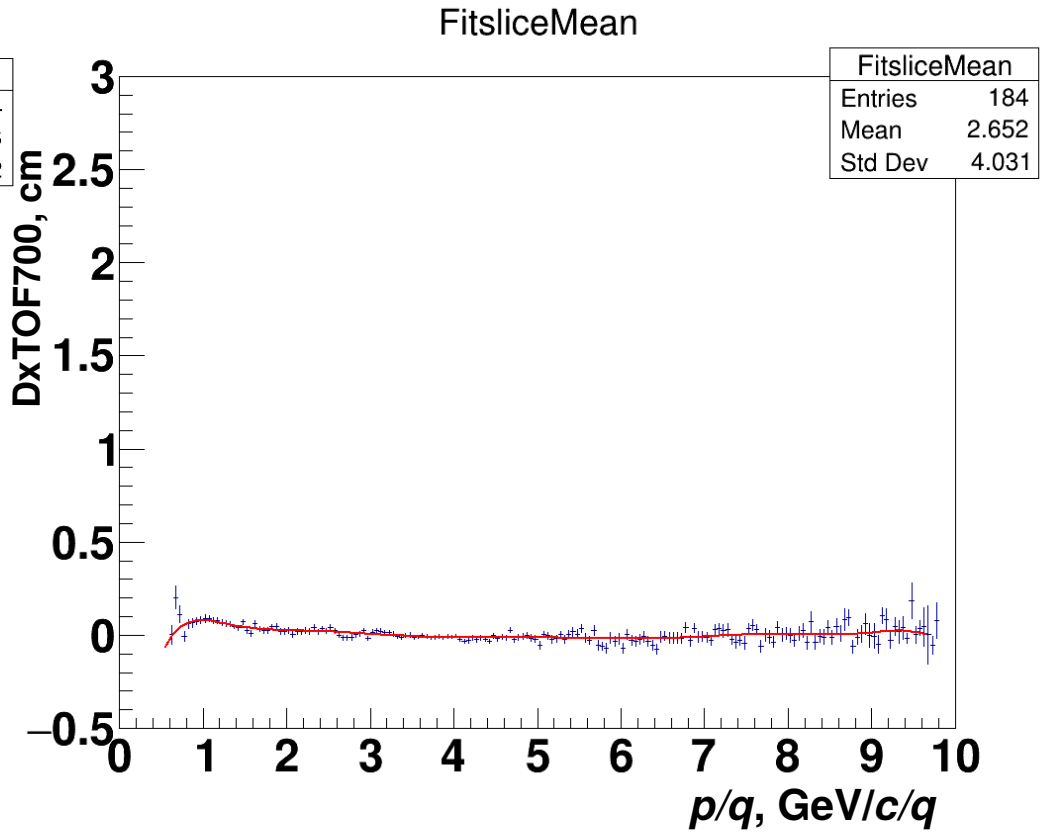


Negligible shifts of mean values of the order of a few millimeters.

DX Corrections TOF700

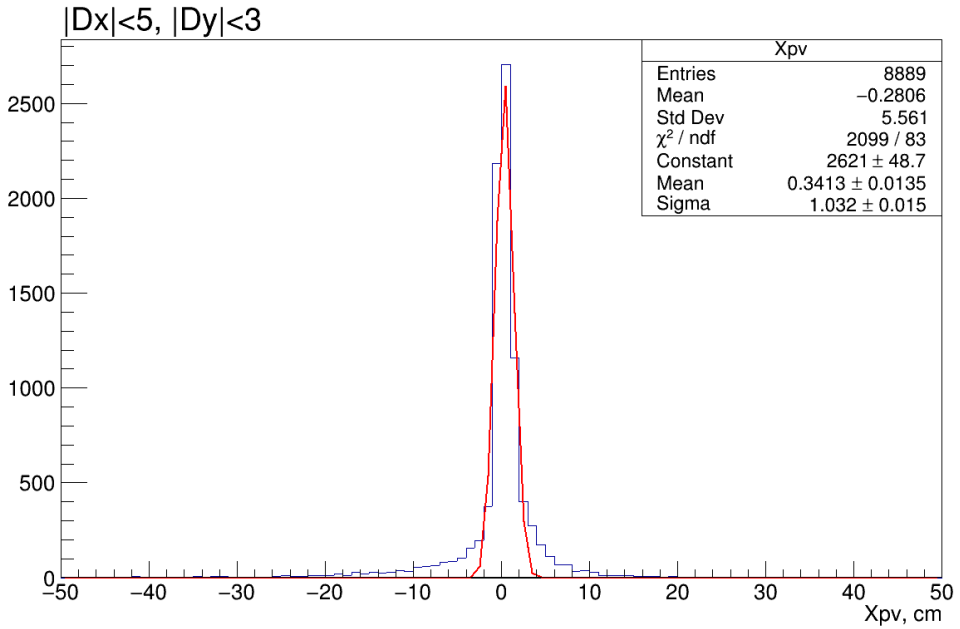
Before → **After**

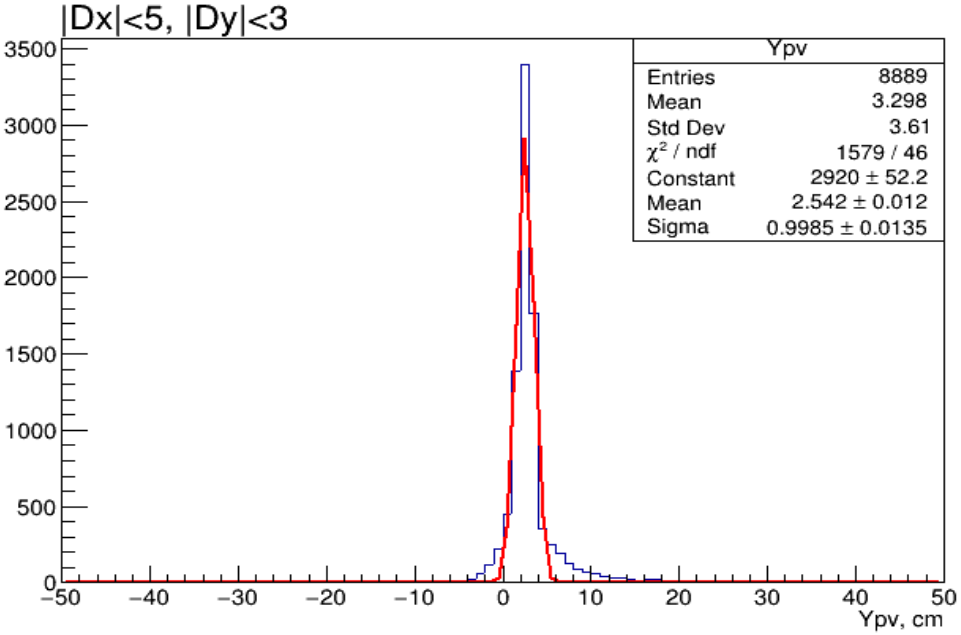




Negligible shifts of mean values of the order of a few millimeters.

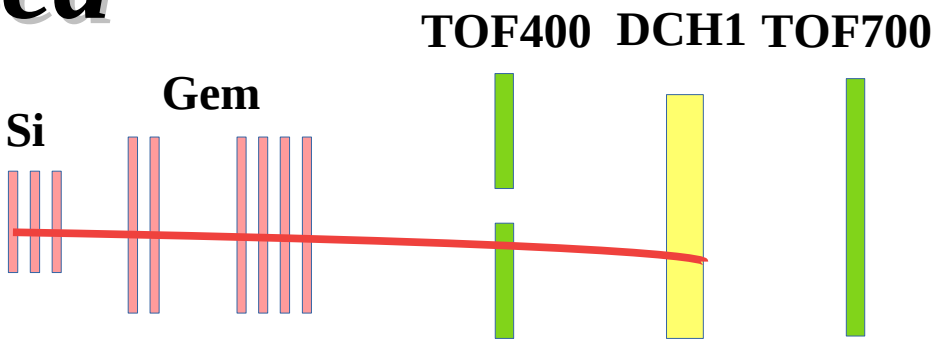
Si-GEM tracks Cut Selection

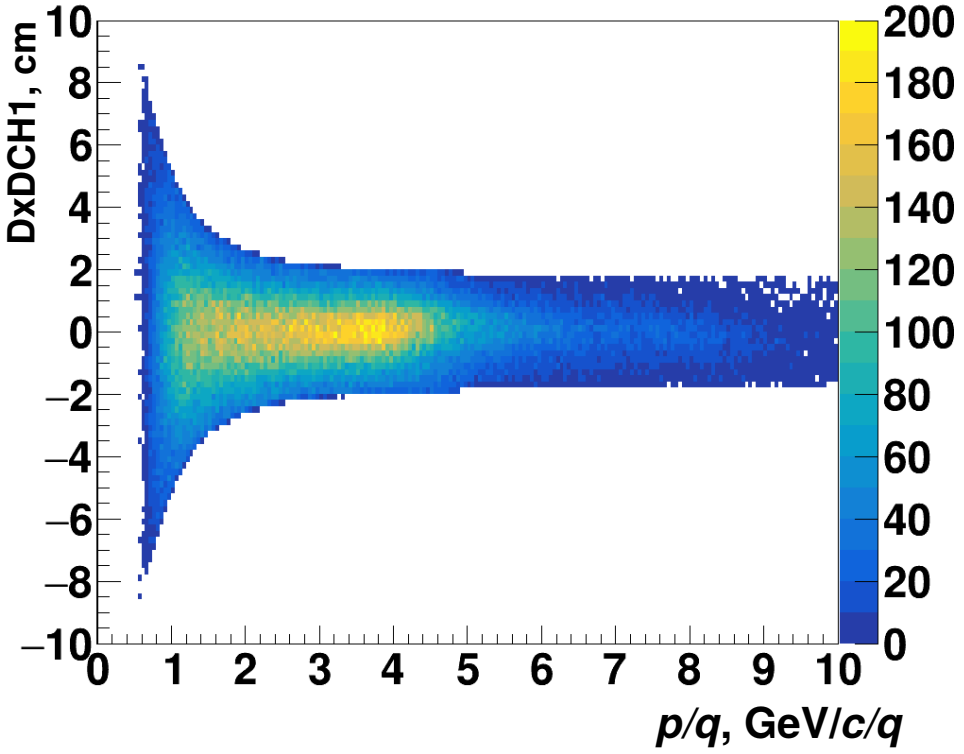


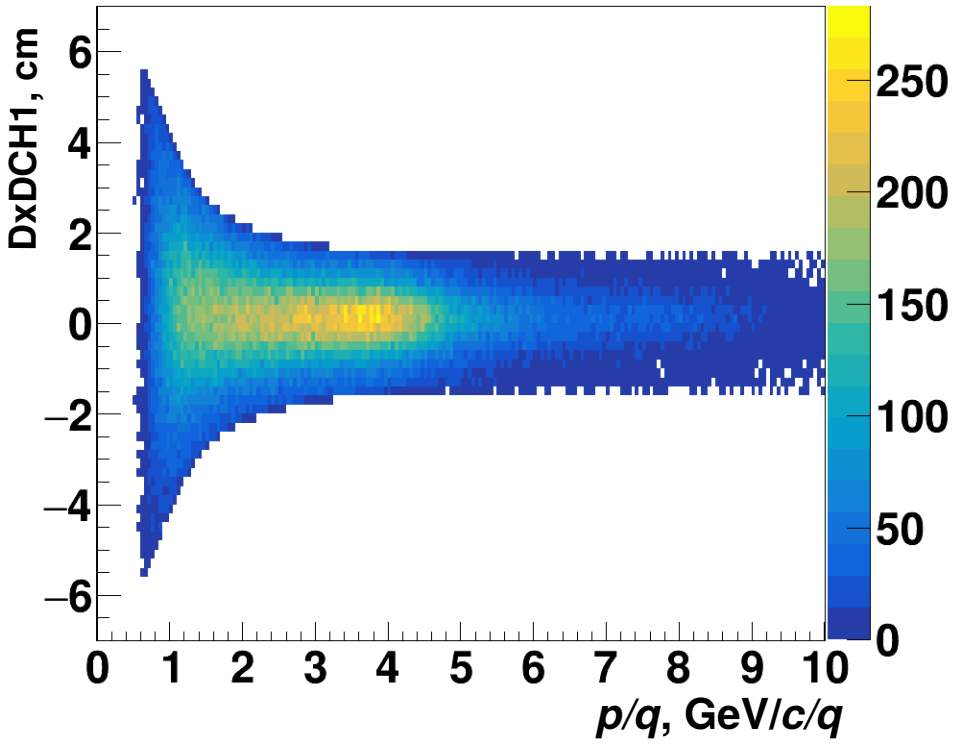


Number of **Silicon** **hits > 1 && GEM hits > 3**
(to skip fake tracks and tracks with bad parameters)
Primary vertex cut for track's **length** calculation
(**-3.5 < Xpv < 4.0** and **-1.0 < Ypv < 6.0**)

New Momentum-based Si-GEM-DCH Matching Criteria

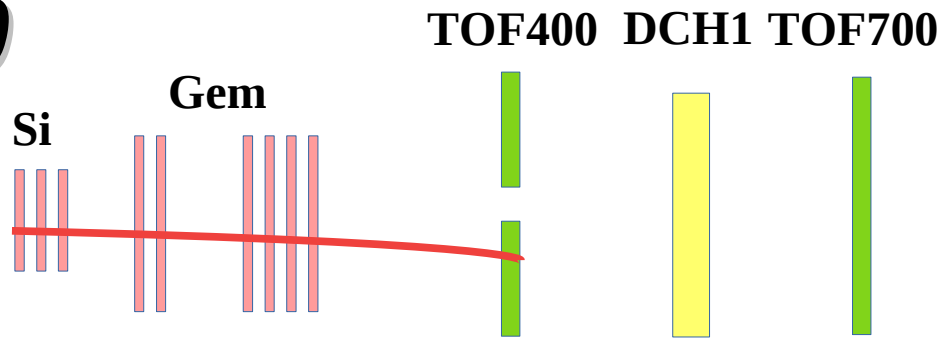


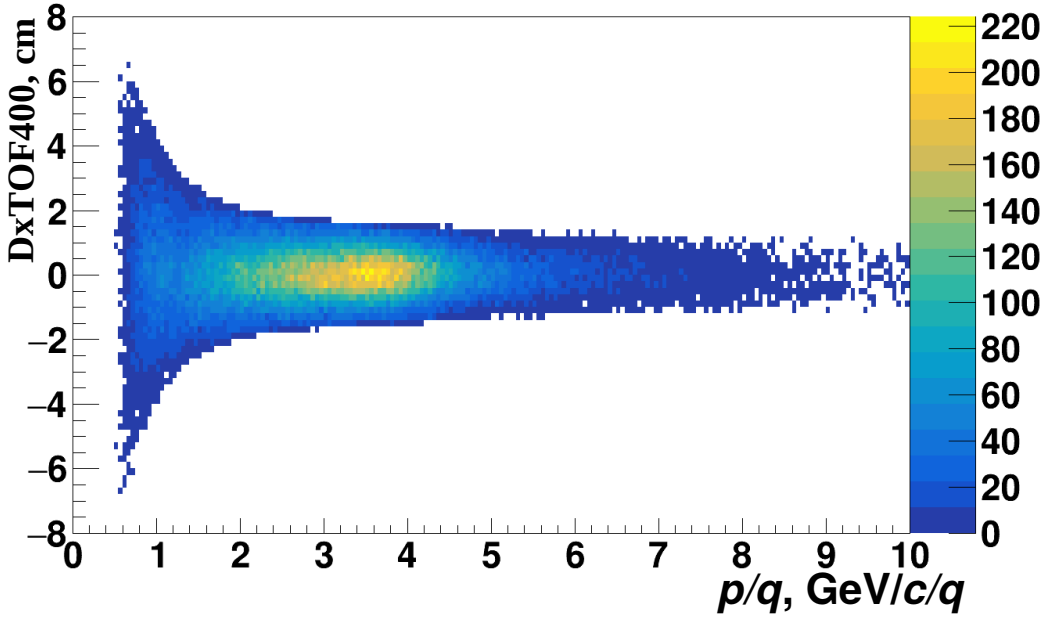


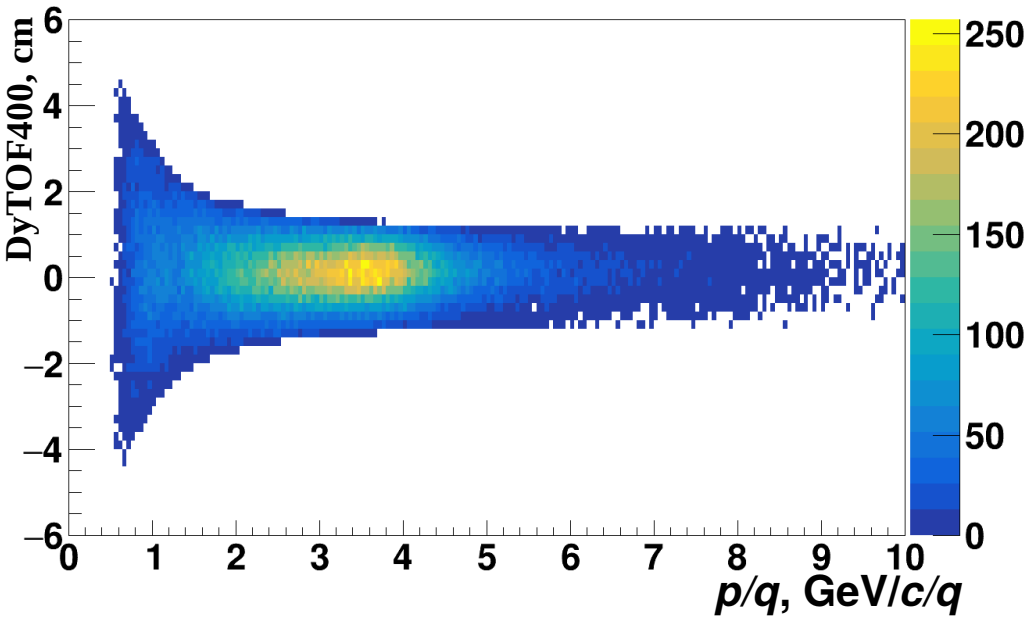


Matching criteria:
±2σDx, ±2σDy

New Momentum-based Si-GEM-DCH-TOF400 Matching Criteria

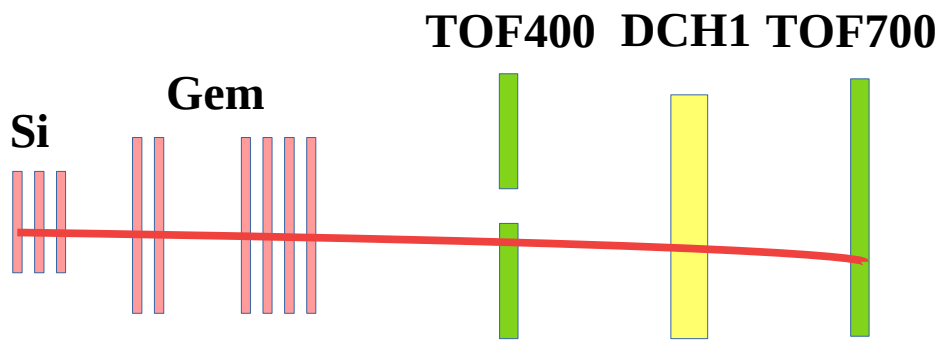


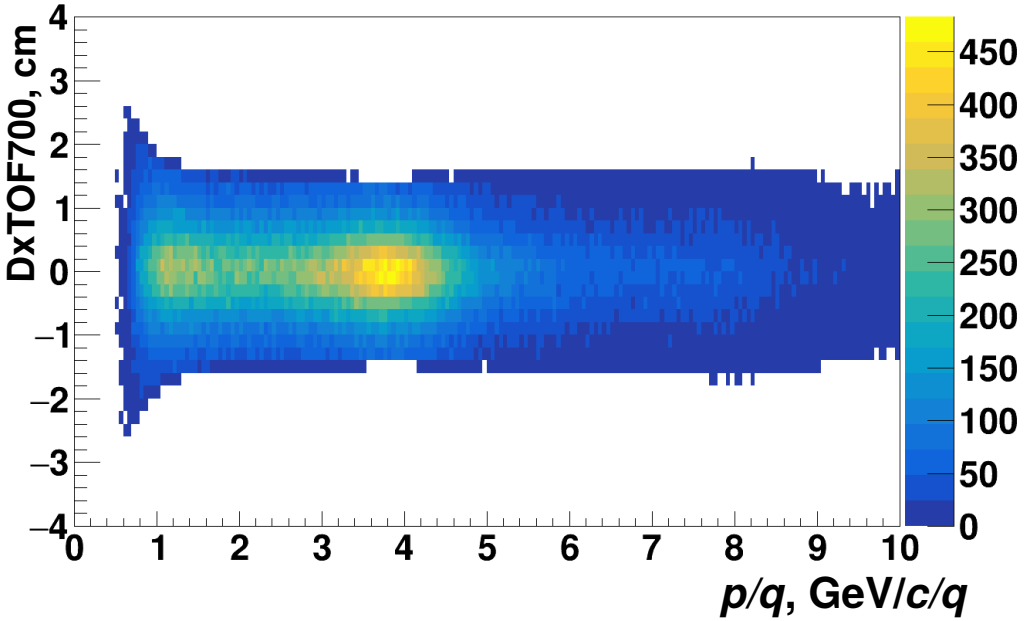


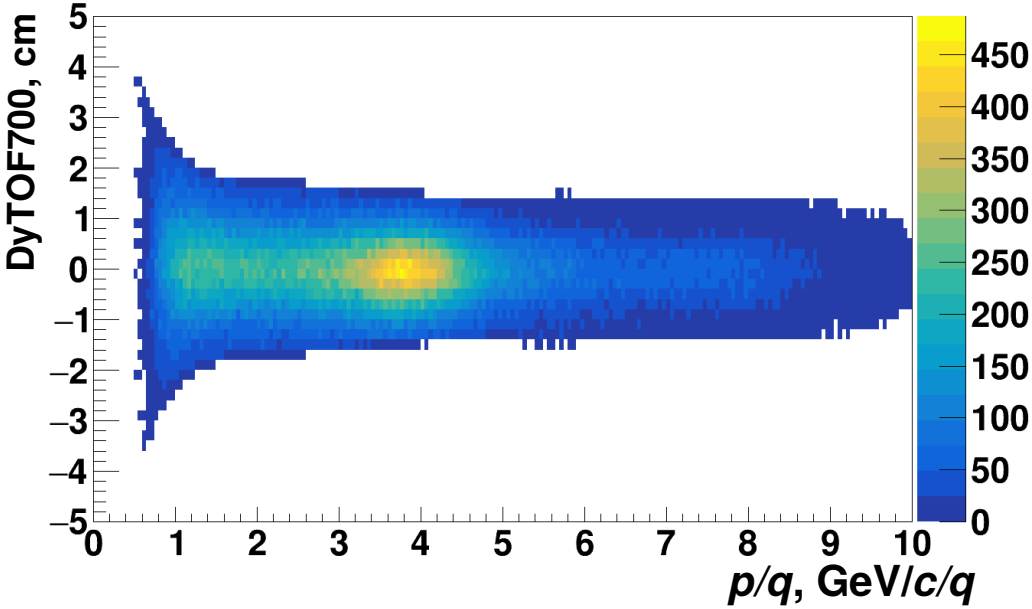


Matching criteria:
±2σDx, ±2σDy

New Momentum-based Si-GEM-DCH-TOF700 Matching Criteria





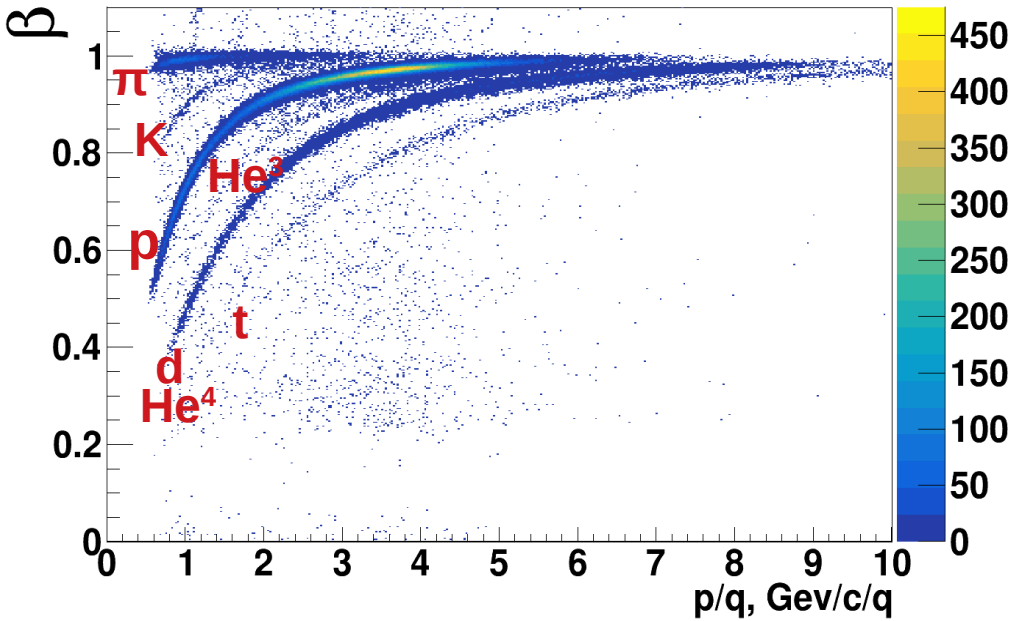


Matching criteria:
±2σDx, ±2σDy

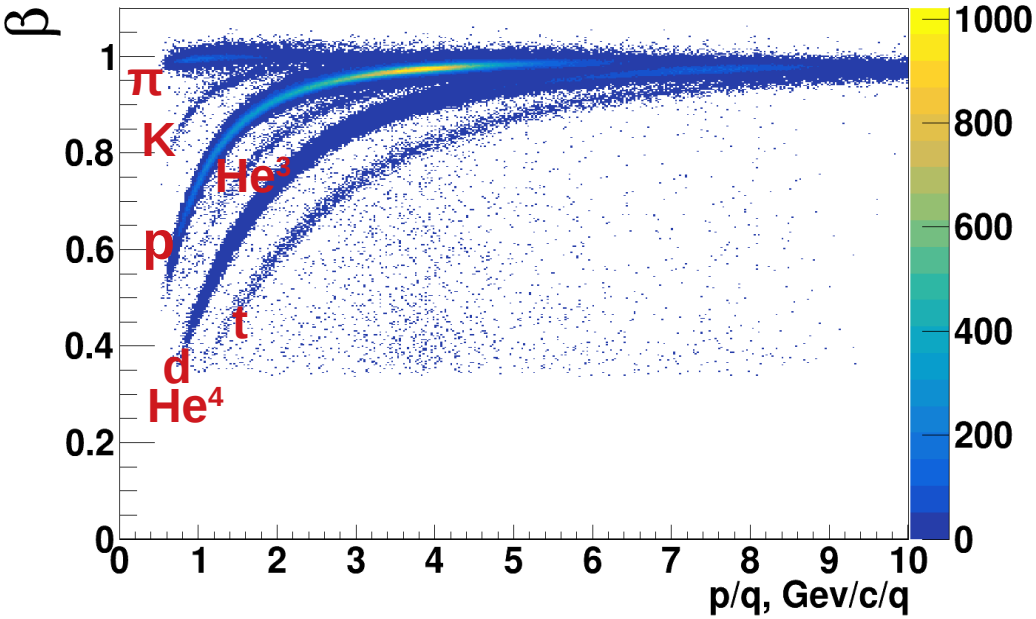
Much narrower Dx in low momenta for TOF700

Beta vs momentum

TOF400



TOF700



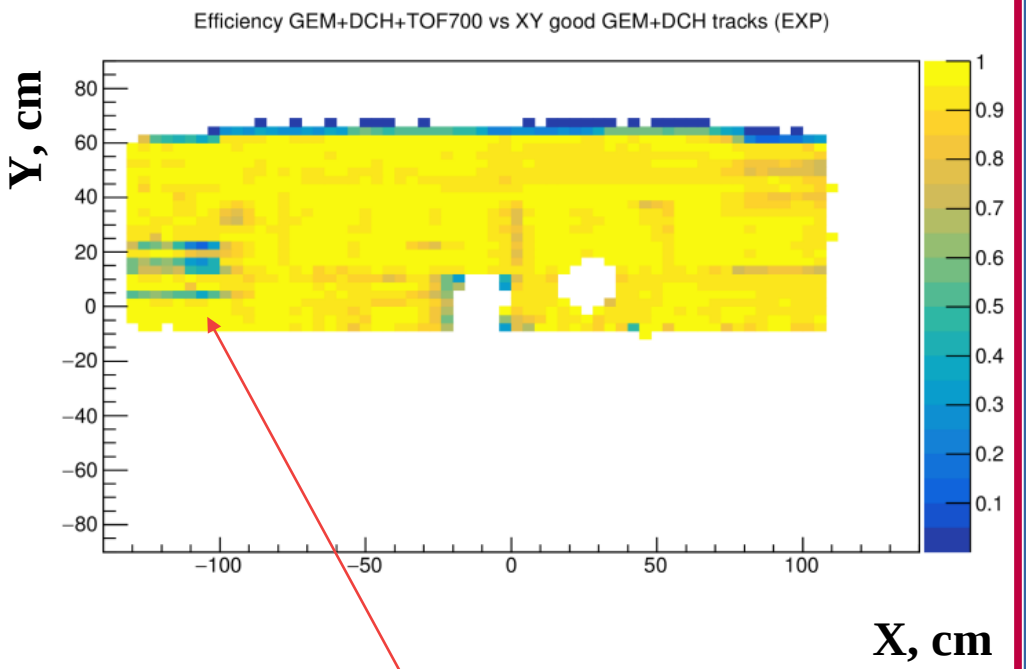
Input Gem tracks are filtered through Drift Chamber but **a lot of tracks** which enter in to TOF400 acceptance do not enter in acceptance of Drift Chamber

New matching criteria allows to identify more particles in low momentum intervals and improve **particle separation** in **TOF700** detector

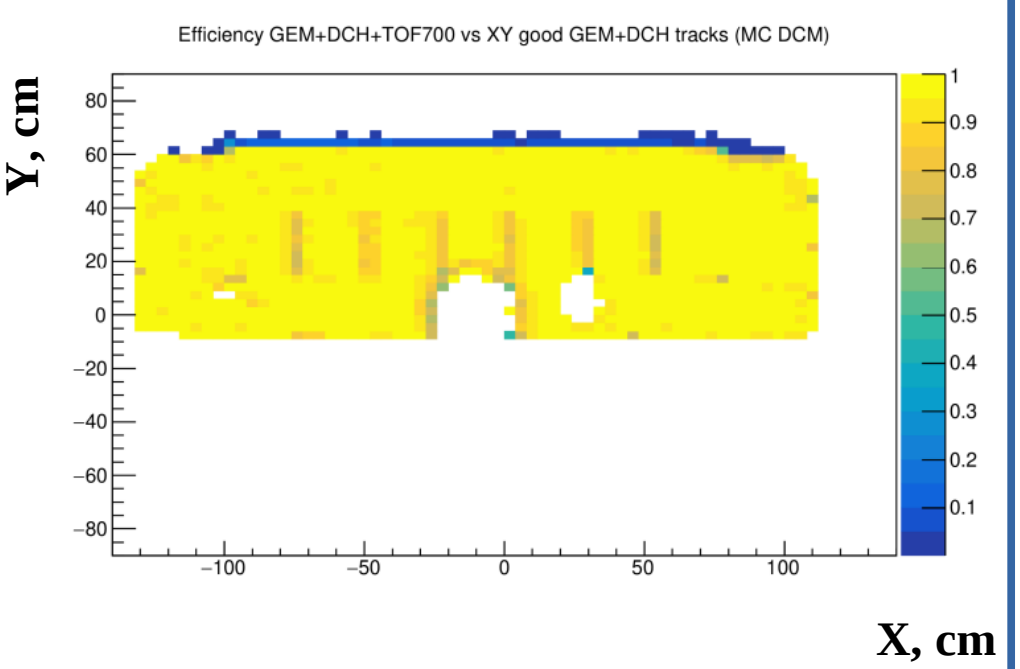
XY-Efficiency for a good track Si-GEM + DCH matching with hit TOF700.

Overall a very good efficiency with a minor edge-effect inefficiency

Data



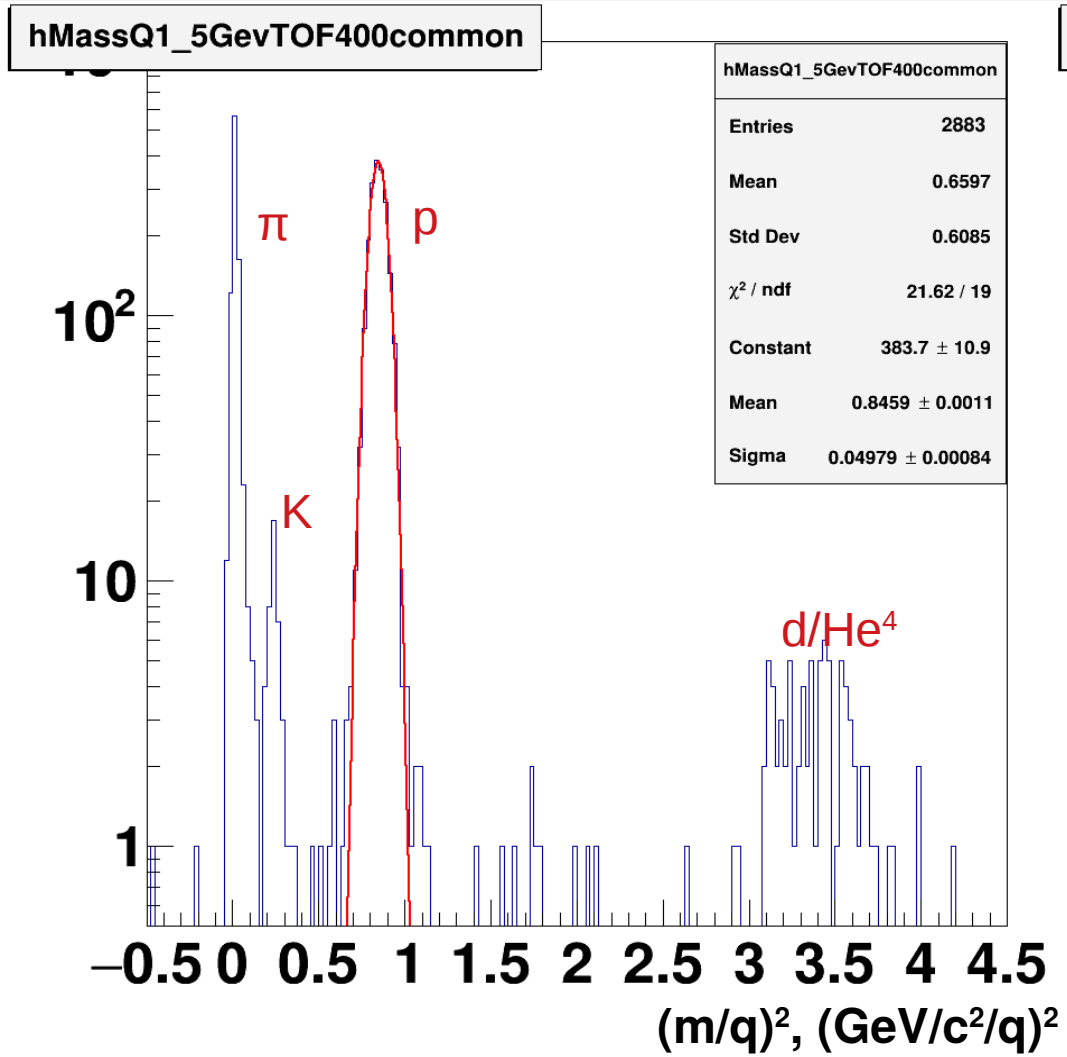
MC



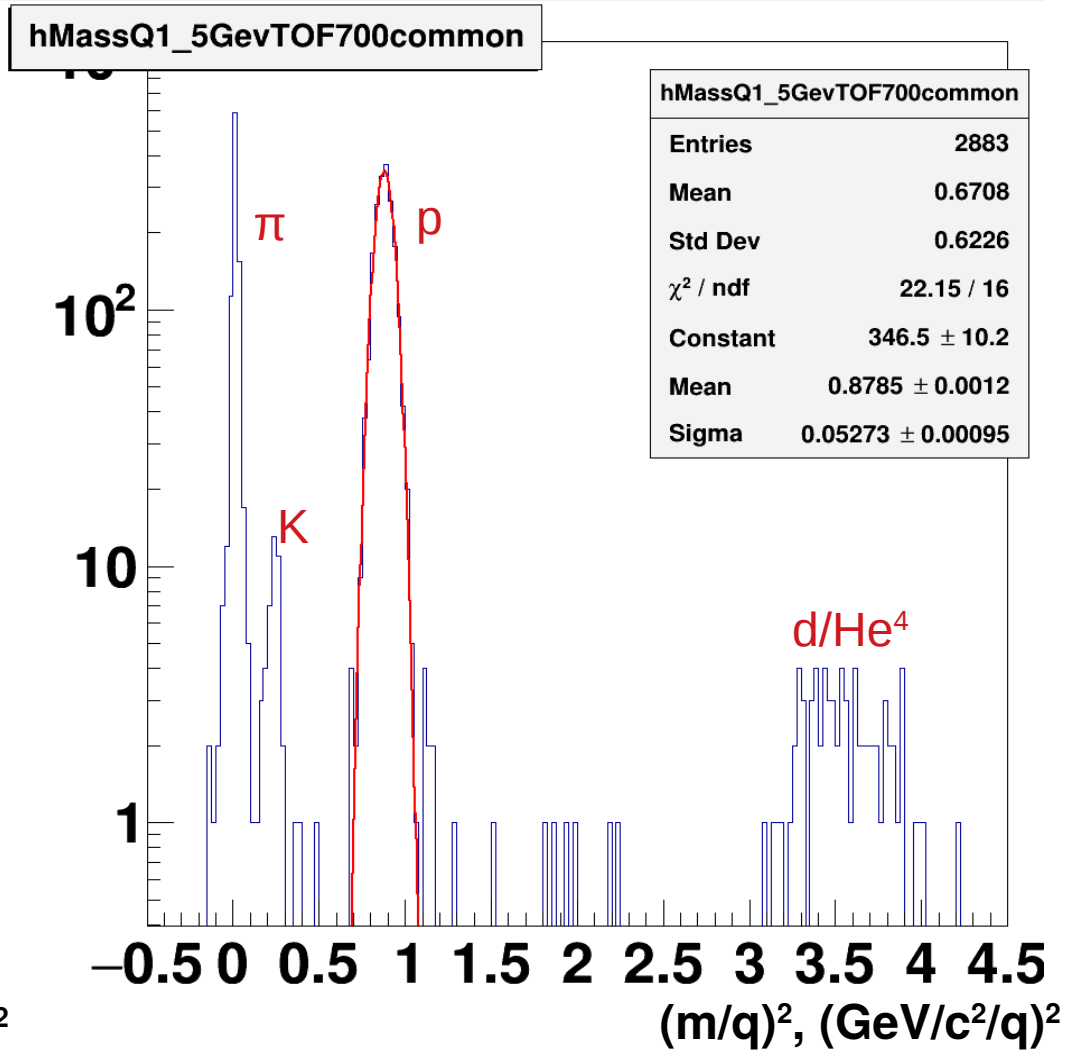
Decreased efficiency for negatively charged particles due to not optimal calibration due to low statistics. This is understood and will be fixed.

Particles mass square of common tracks of momenta below 1.5 GeV

TOF400

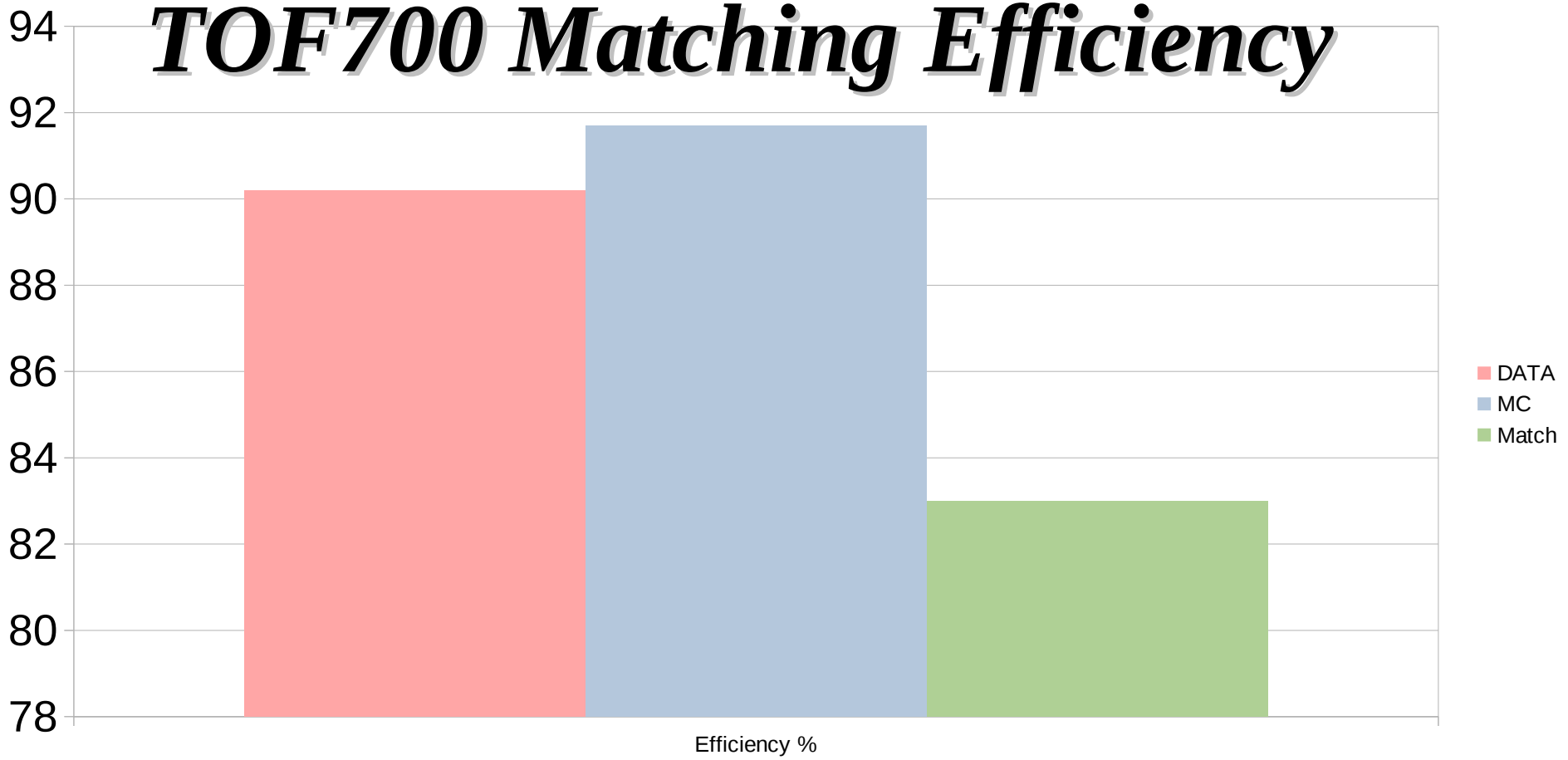


TOF700



We check the **(m/q)²** of each track, reconstructed by each system,
to see if it is within a peak that corresponds to the same particle hypothesis

TOF700 Matching Efficiency



$E_{DATA} = \frac{N_{matched\ tracks}}{N_{goodtracks}}$	$E_{MC} = \frac{N_{matched\ tracks}}{N_{goodt\ tracks}}$	$E_{correct\ identifeid\ tr} = \frac{N_{correct\ idf\ trs}}{N_{idf\ tracks}}$
DATA	**MC**	**Correct Identified**
90.2%	**91.7%**	**83.1% (of ~16% common)**

Conclusion

* The analysis of **TOF700 matching efficiency** was performed.
It showed sufficient efficiency for both the hit **detection** and **matching** procedures.

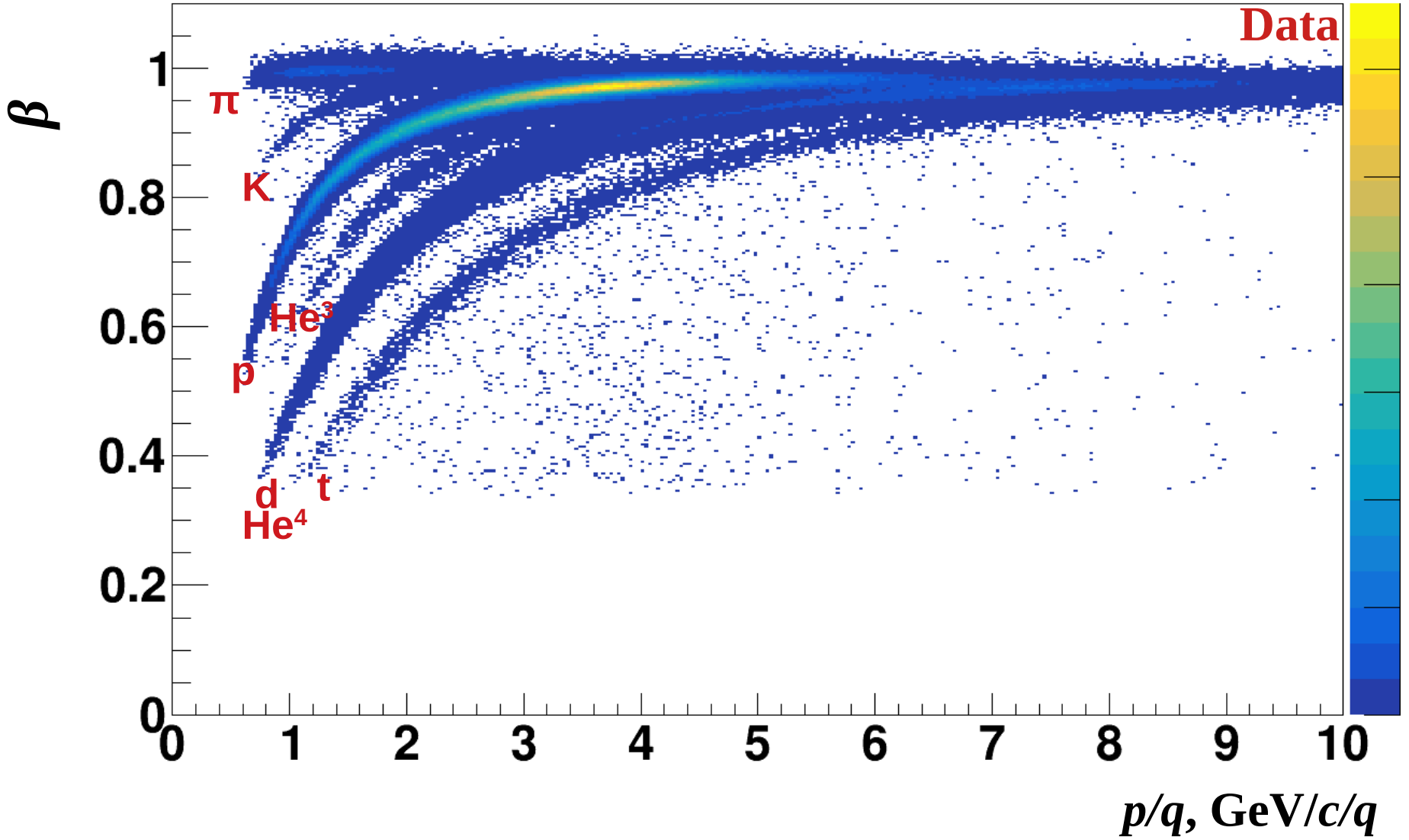
* **PID** procedure allows for **separation** of **π, K, p, He3, d/He4, t** in the area of up to 2 GeV/*c*. Separation of higher momentum regions requires a decrease in the time of flight error.

* Further analysis and calibration should **improve** identification and results.

Thank you for your attention!

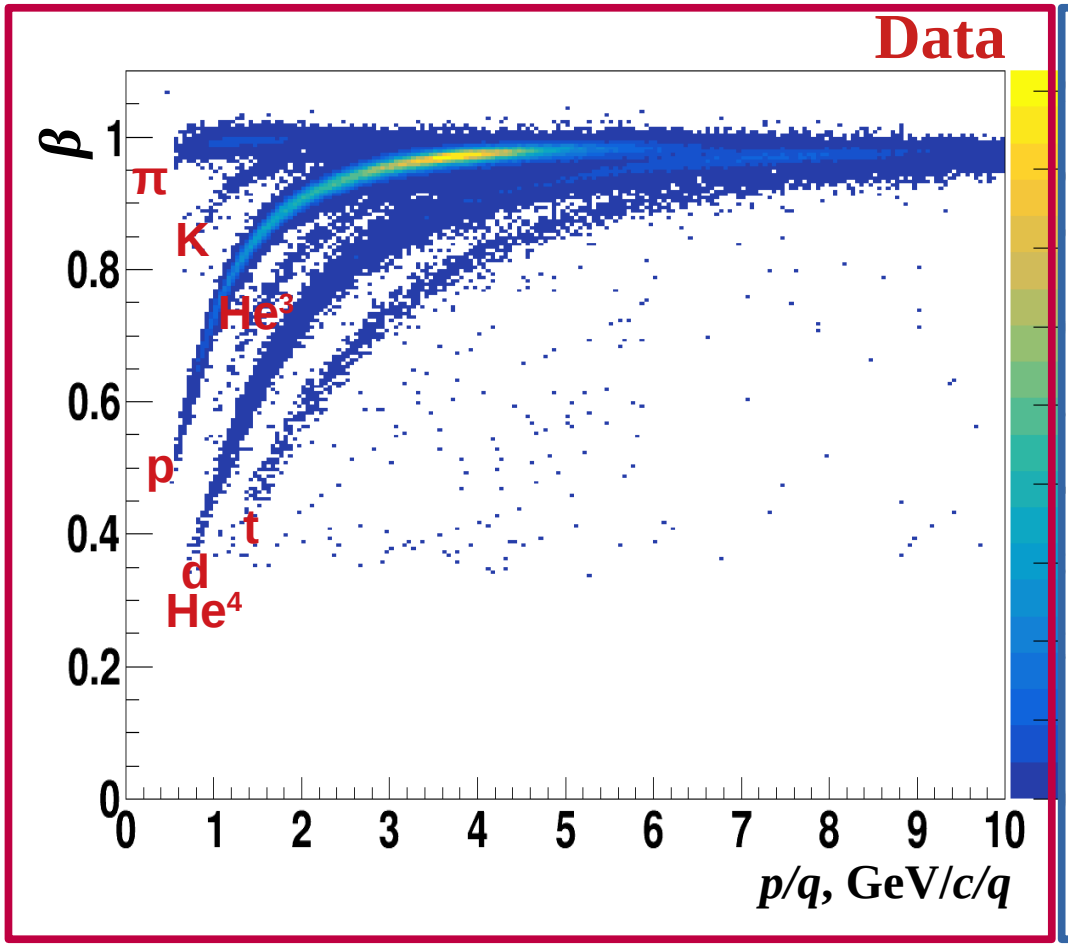
BACKUP

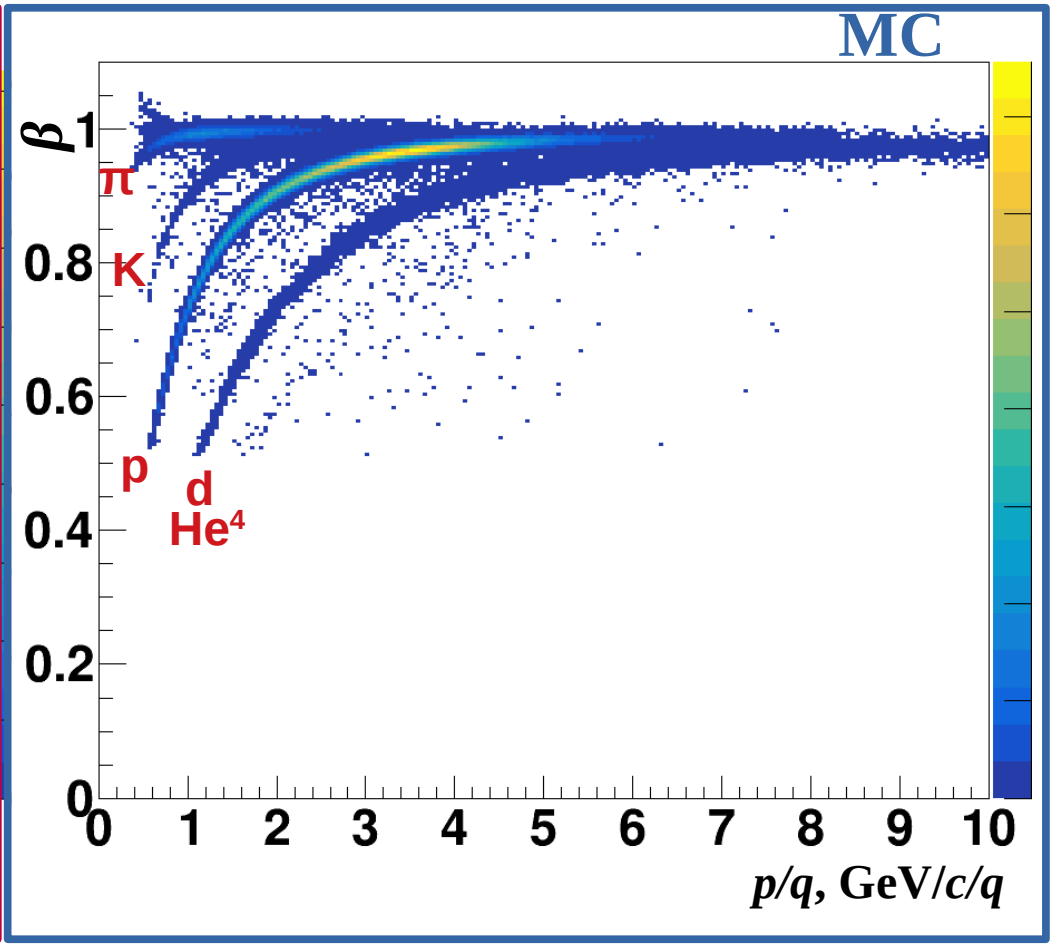
Beta vs momentum



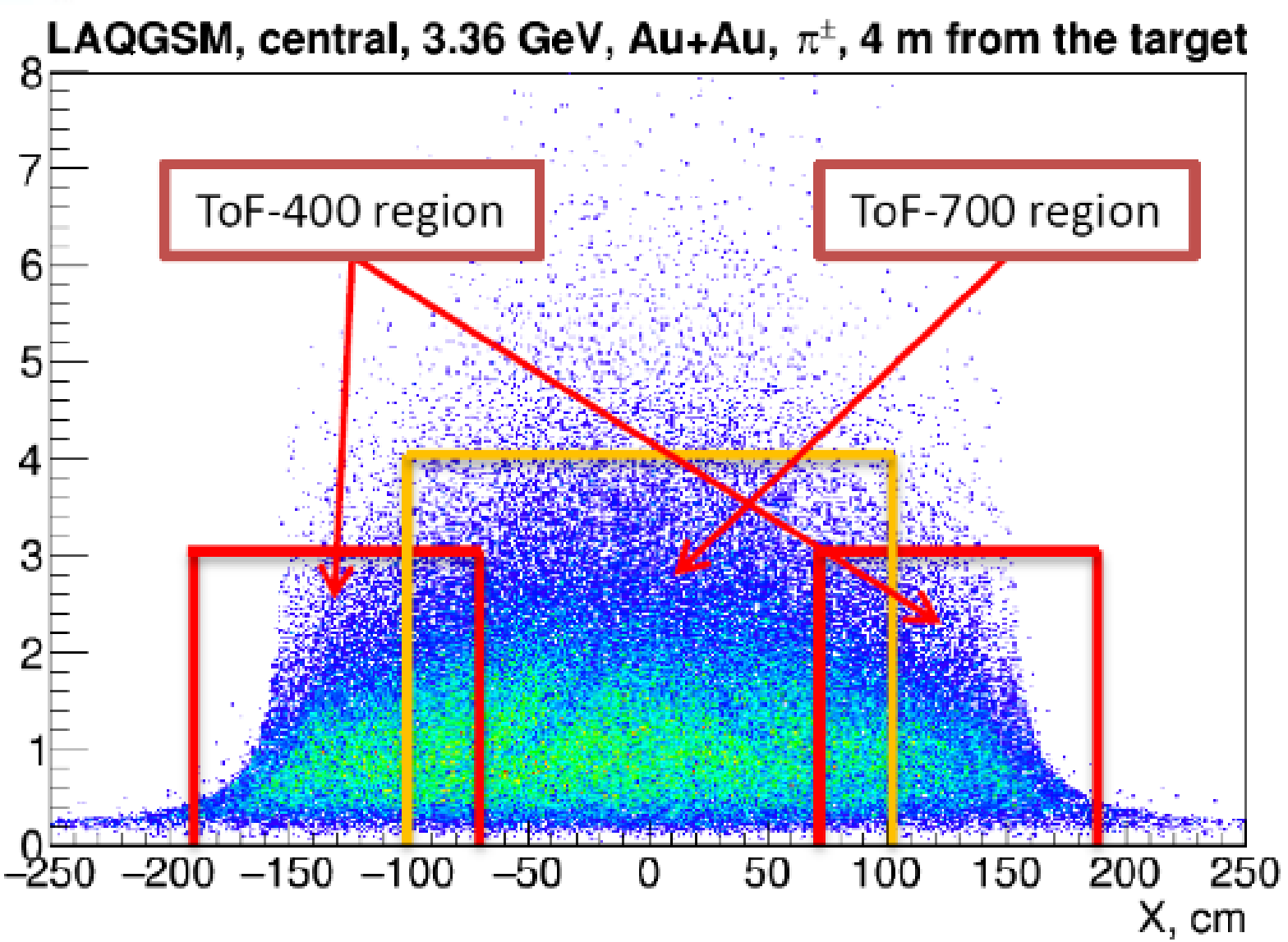
Data plot, but with **larger** Argon data sample.

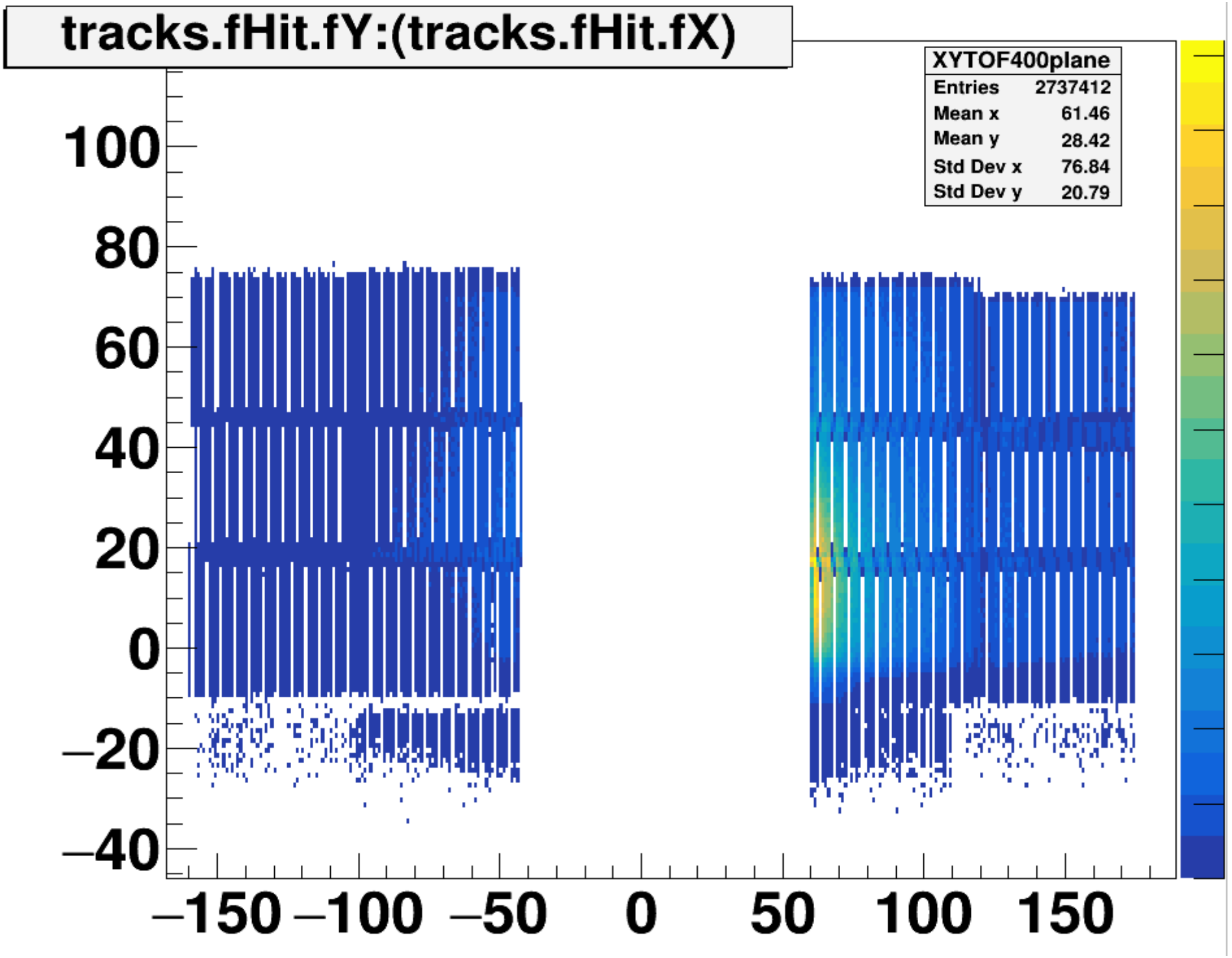
Beta vs momentum





Data plot chosen to represent **similar statistics**
actual data statistics on the next slide


LAQGSM, central, 3.36 GeV, Au+Au, π±, 4 m from the target
ToF-400 region
ToF-700 region
8
7
6
5
4
3
2
1
0
−250
−200
−150
−100
−50
0
50
100
150
200
250
X, cm


tracks.fHit.fY:(tracks.fHit.fX)
XYTOF400plane
Entries 2737412
Mean x 61.46
Mean y 28.42
Std Dev x 76.84
Std Dev y 20.79
100
80
60
40
20
0
−20
−40
−150
−100
−50
0
50
100
150