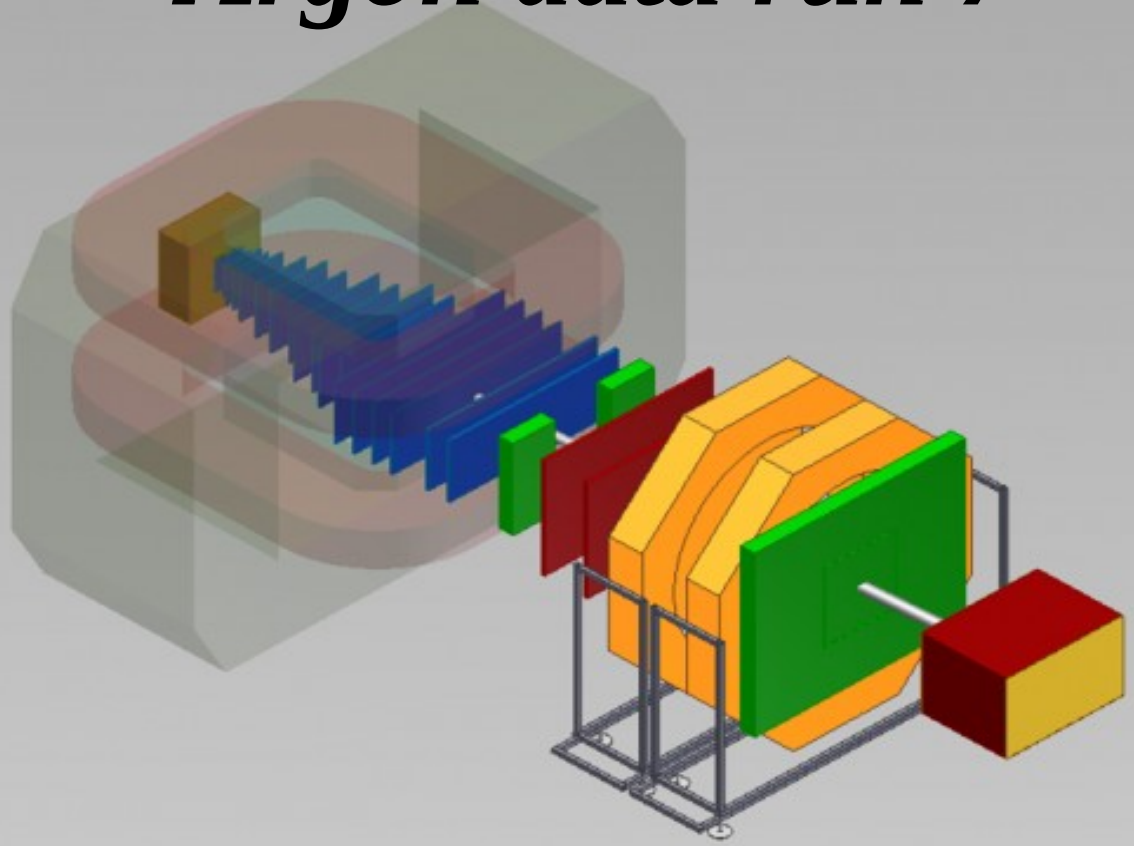
TOF700 efficiency and calibration Argon data run 7

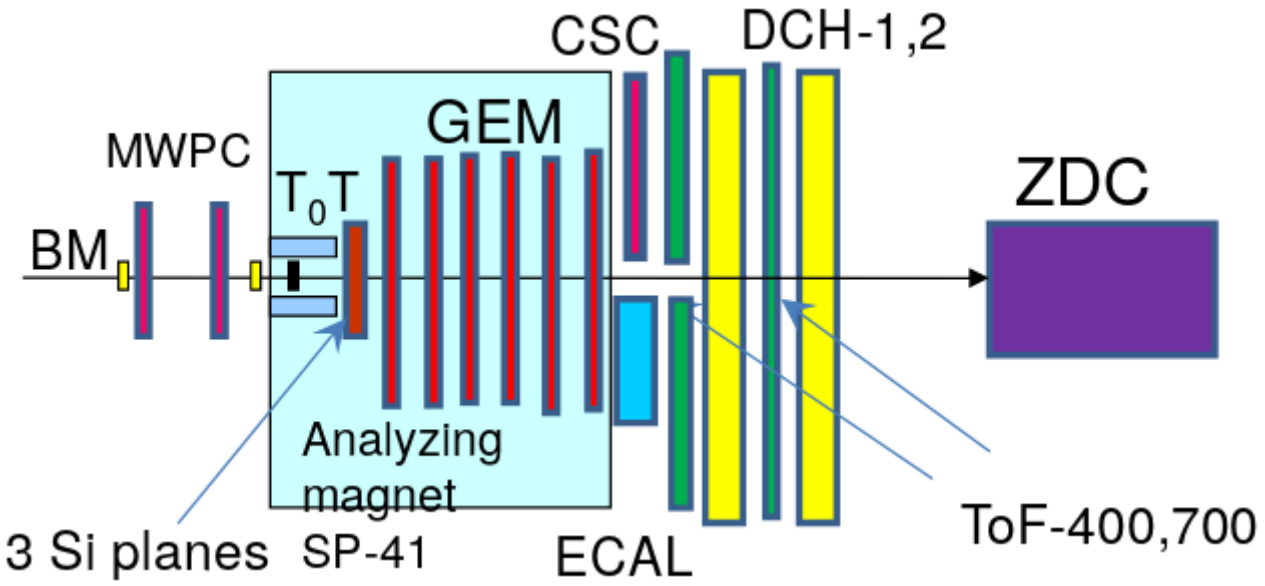


IV BM@N Collaboration Meeting
14.10.2019

Lalyo Kovachev[1,2], Yuri Petukhov[2]
1. FPET Plovdiv University Paisii Hilendarski, Bulgaria
2. VBLHEP Joint Intitute for Nuclear Research, Russia

Argon data run 7

Schematic drawing of the location of the TOF700 on the BM@N setup



* Raw Data taken in March 2018
* Ar beam, 3.2 GeV/n
* 13 million events

* Detectors used in analysis:
  GEM – gas electron multiplier
  DCH1,2 – drift chamber
  TOF700 – time of flight

TOF700 Particle Identification

GEM tracks from tracking group

DCH1 and **DCH1+2** tracks from DCH group

DCH1 denotes all tracks reconstructed by the **DCH1** chamber and **DCH1+2** is the part of reconstructed tracks which have been matched to the **DCH2** tracks.

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

Successfully matched tracks are **refitted** with **DCH** tracks

Refitted GEM tracks are extrapolated to the **TOF700** planes and matched against the **TOF700** hits

Notations

“Good” GEM tracks – those which pass cut selection.

Dx – x-distance between **GEM** and **DCH** tracks on **DCH1** plane

Dy – y-distance between **GEM** and **DCH** tracks on **DCH1** plane

X – **DCH** track X-coordinate on **TOF700** chamber plane

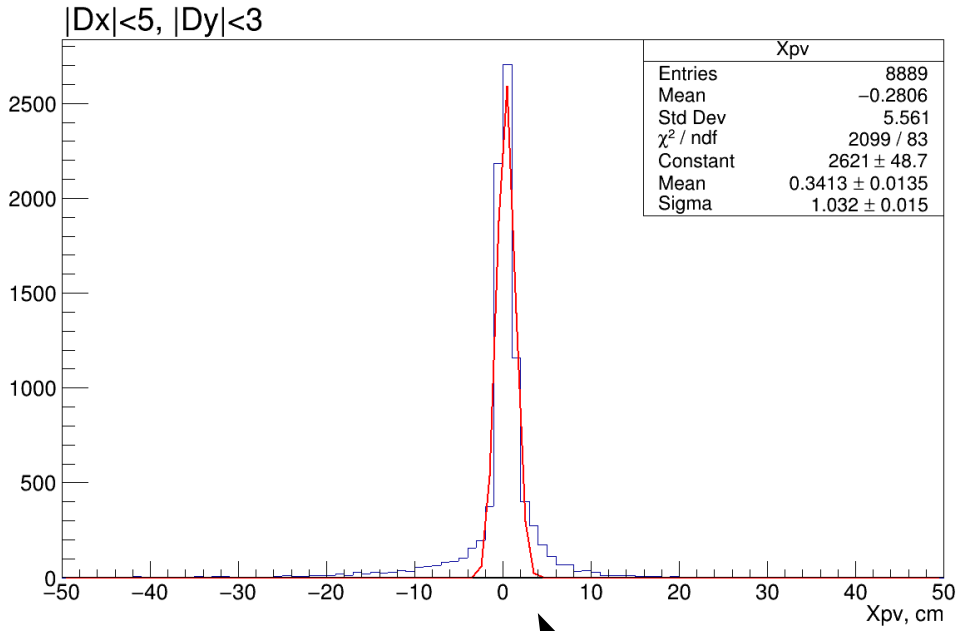
Y – **DCH** track Y-coordinate on **TOF700** chamber plane

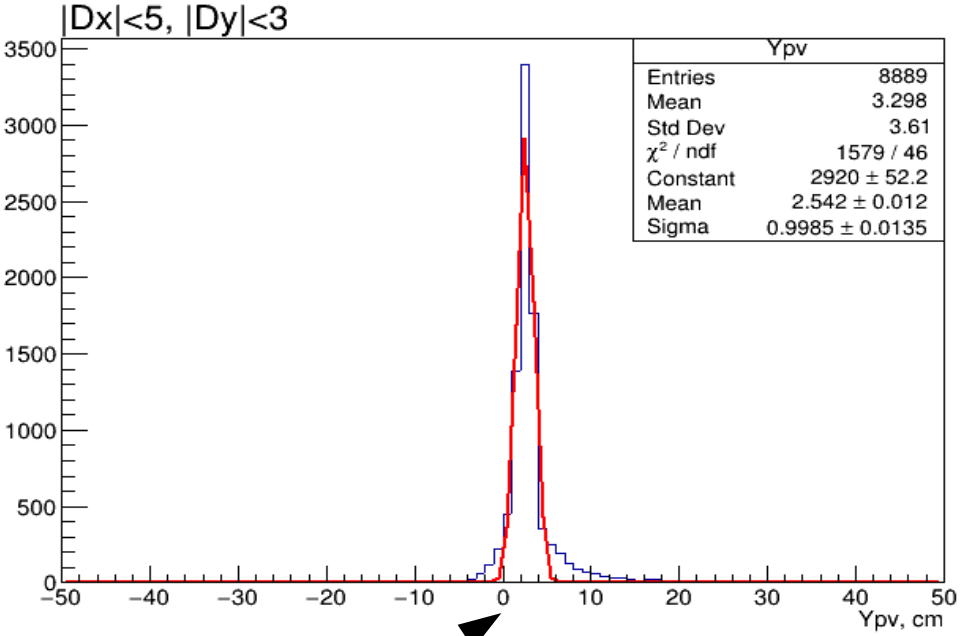
TOF700 Efficiency – $TOF700_{eff} = \frac{N_{matched\ hits}}{N_{extr\ tracks}}$ **,** where

$N_{matched\ hits}$ is the number of tracks extrapolated to **TOF700** and matched to hits

$N_{extr\ tracks}$ is the number of all tracks extrapolated to **TOF700**

GEM tracks Cut Selection



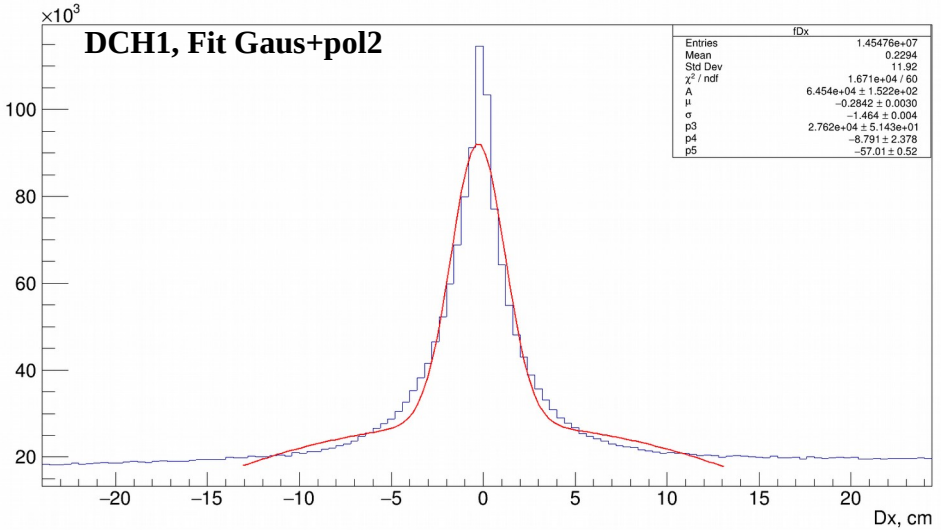


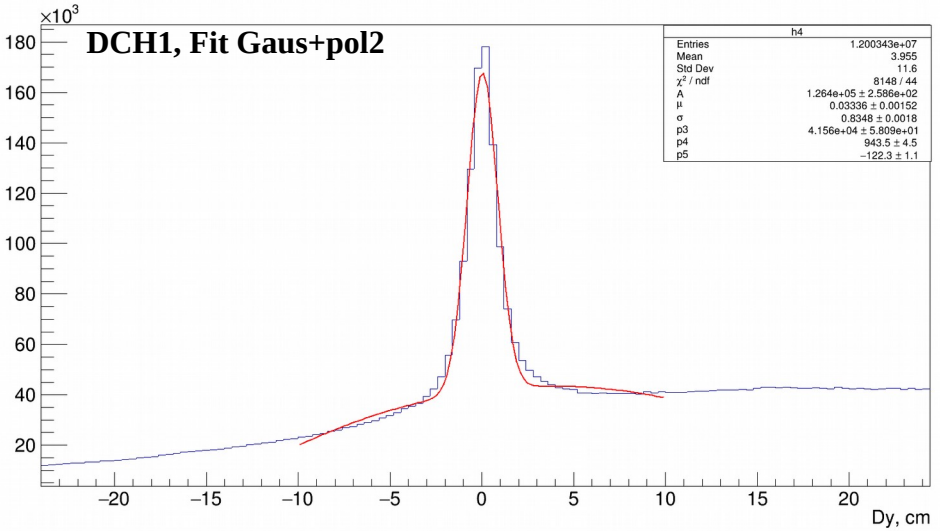
Number of **GEM hits > 4** to skip fake tracks and tracks with bad parameters

Primary vertex cut **(-3.5<Xpv<4.0 and -1.0 <Ypv < 6.0)** for track's length calculation

GEM tracks which pass the criteria are considered "good"

GEM-DCH1 Matching Criteria

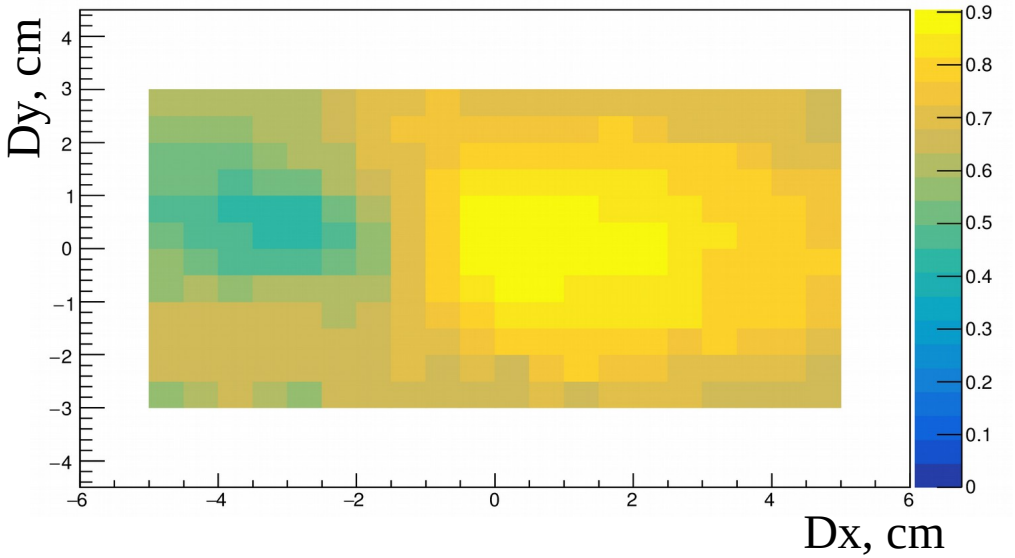




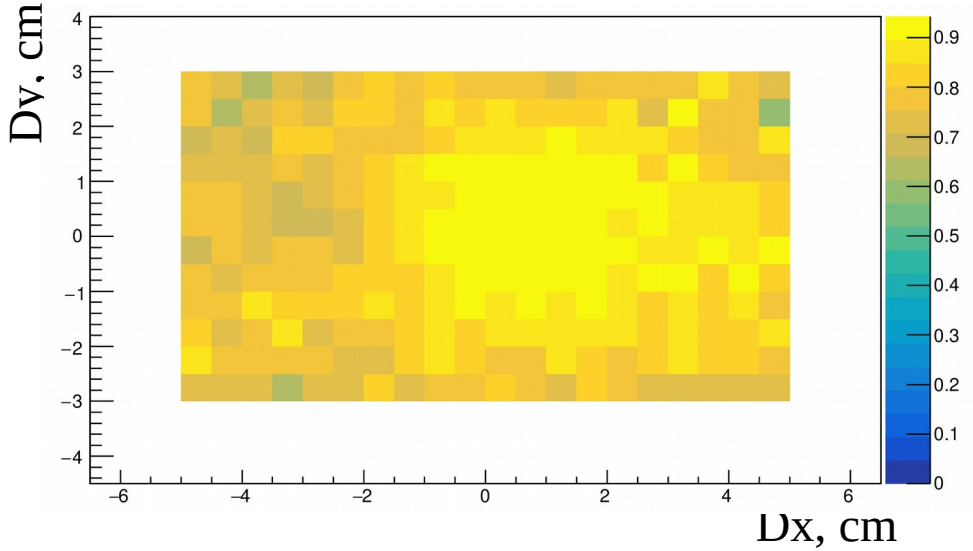
Function: Gaus + pol2
Dx-peak is situated in interval of ±5cm
Dy-peak is between ±3cm
Dx σ ~ 1.33
Dy σ ~ 0.73
Matching criteria: **Abs(Dx)<5 and Abs(Dy)<3 cm**

TOF700 Efficiency vs DxDy

DCH1



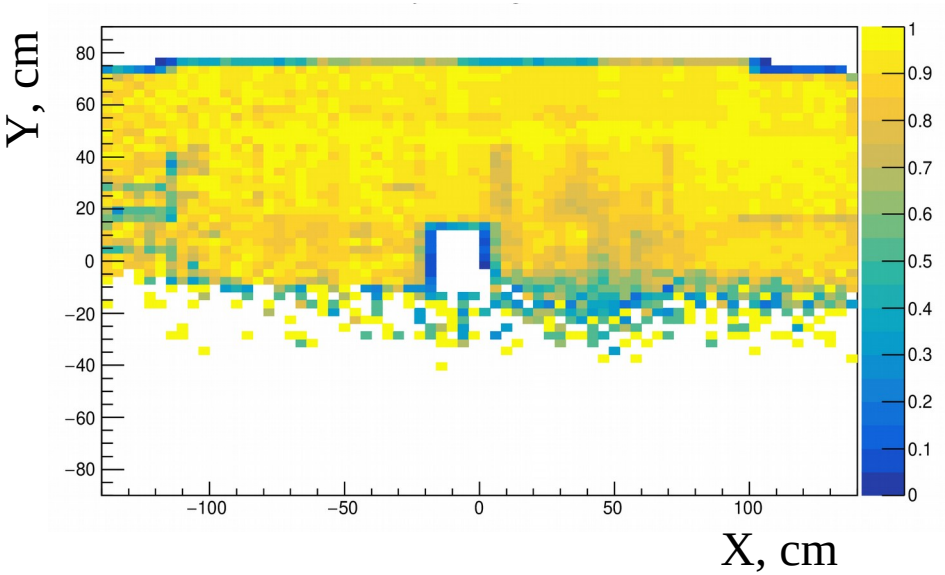
DCH1+2



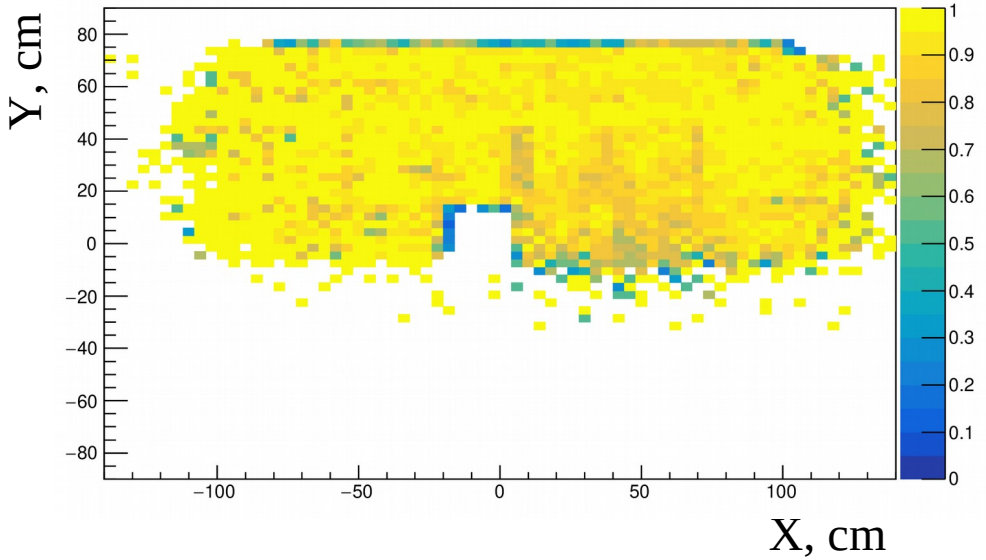
GEM acceptance **Y > -3 cm**, at **Y < -3 cm** more fake **GEM** tracks

TOF700 Efficiency vs XY

DCH1

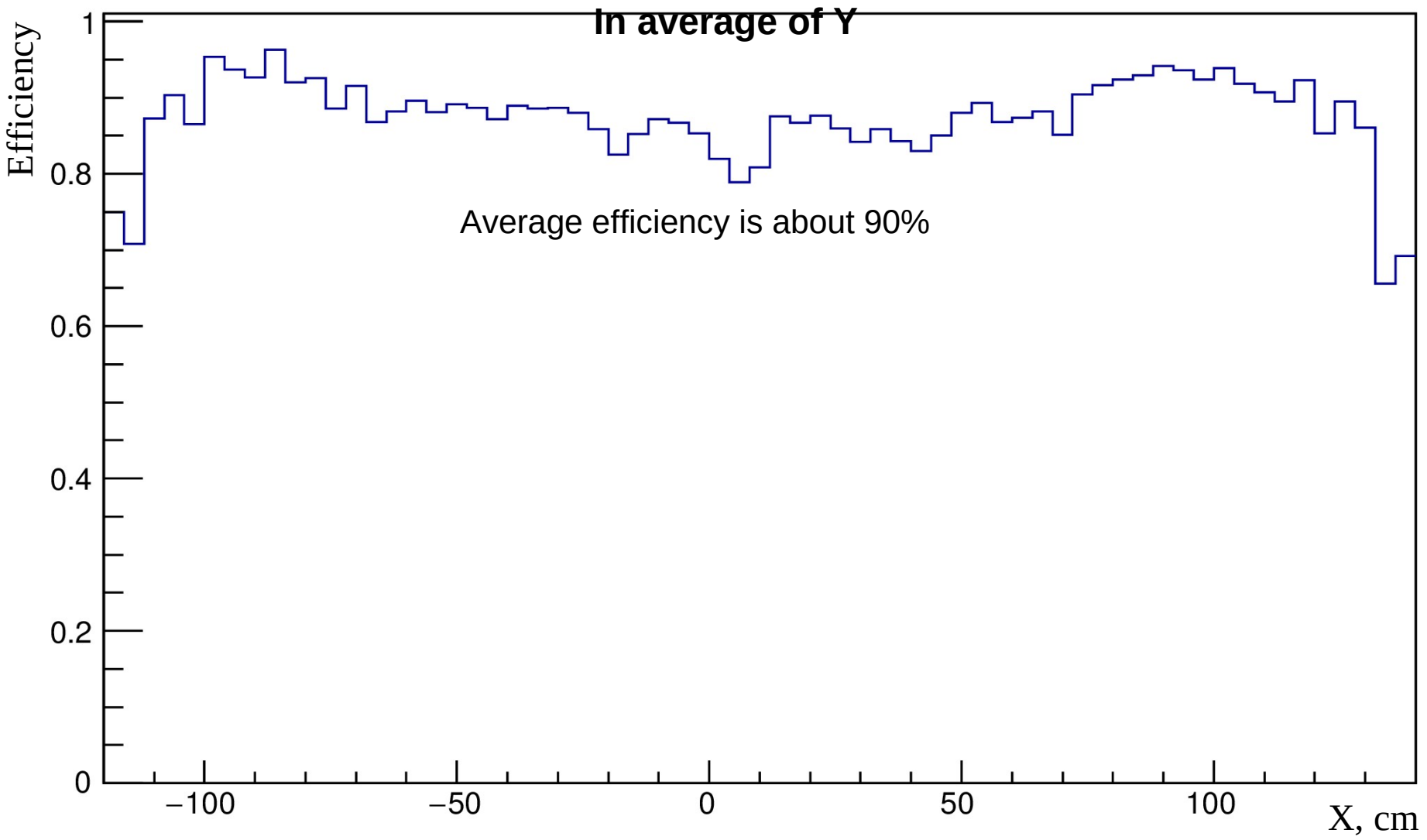


DCH1+2

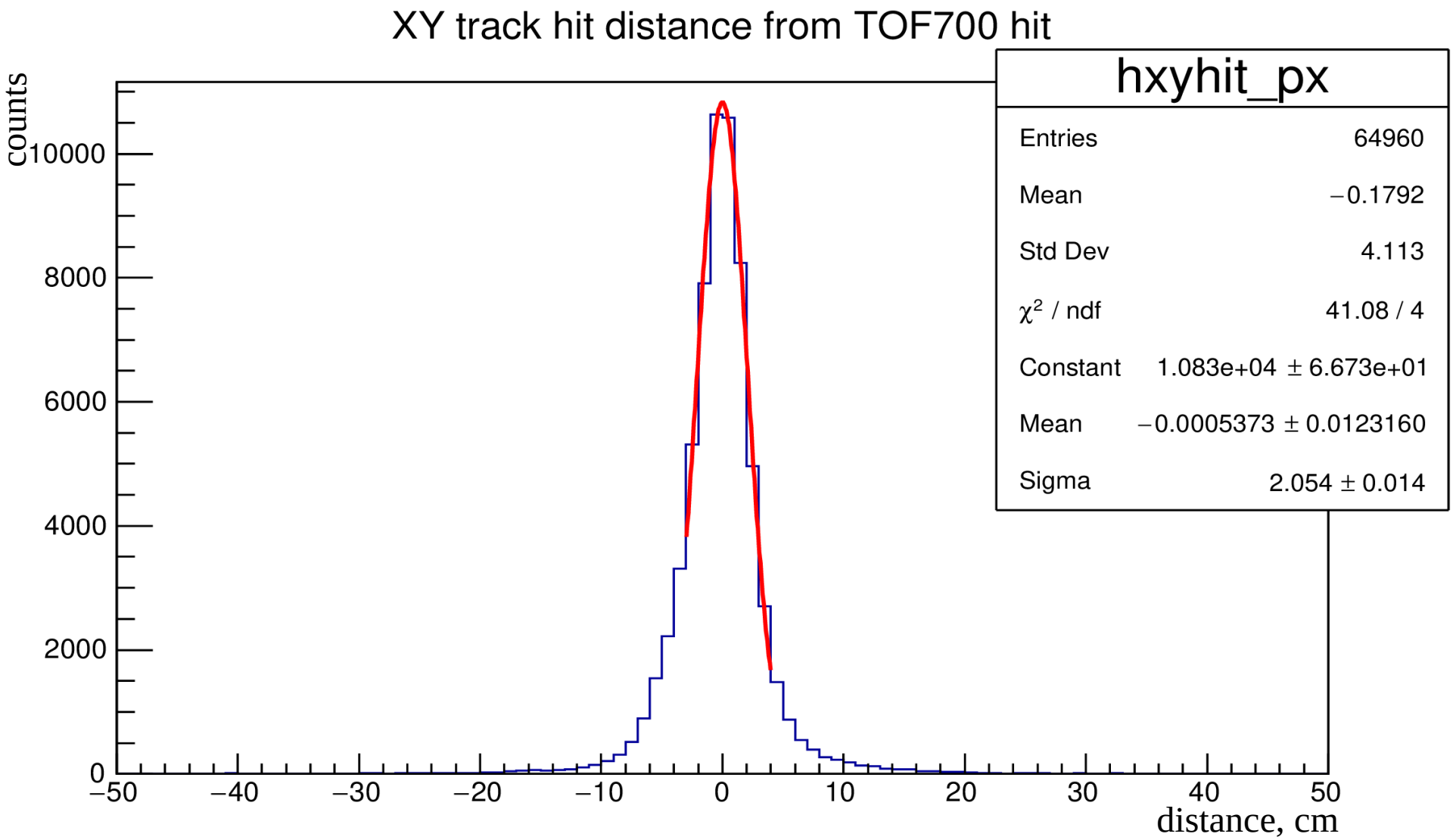


Efficiency is good enough. Small edge effect.

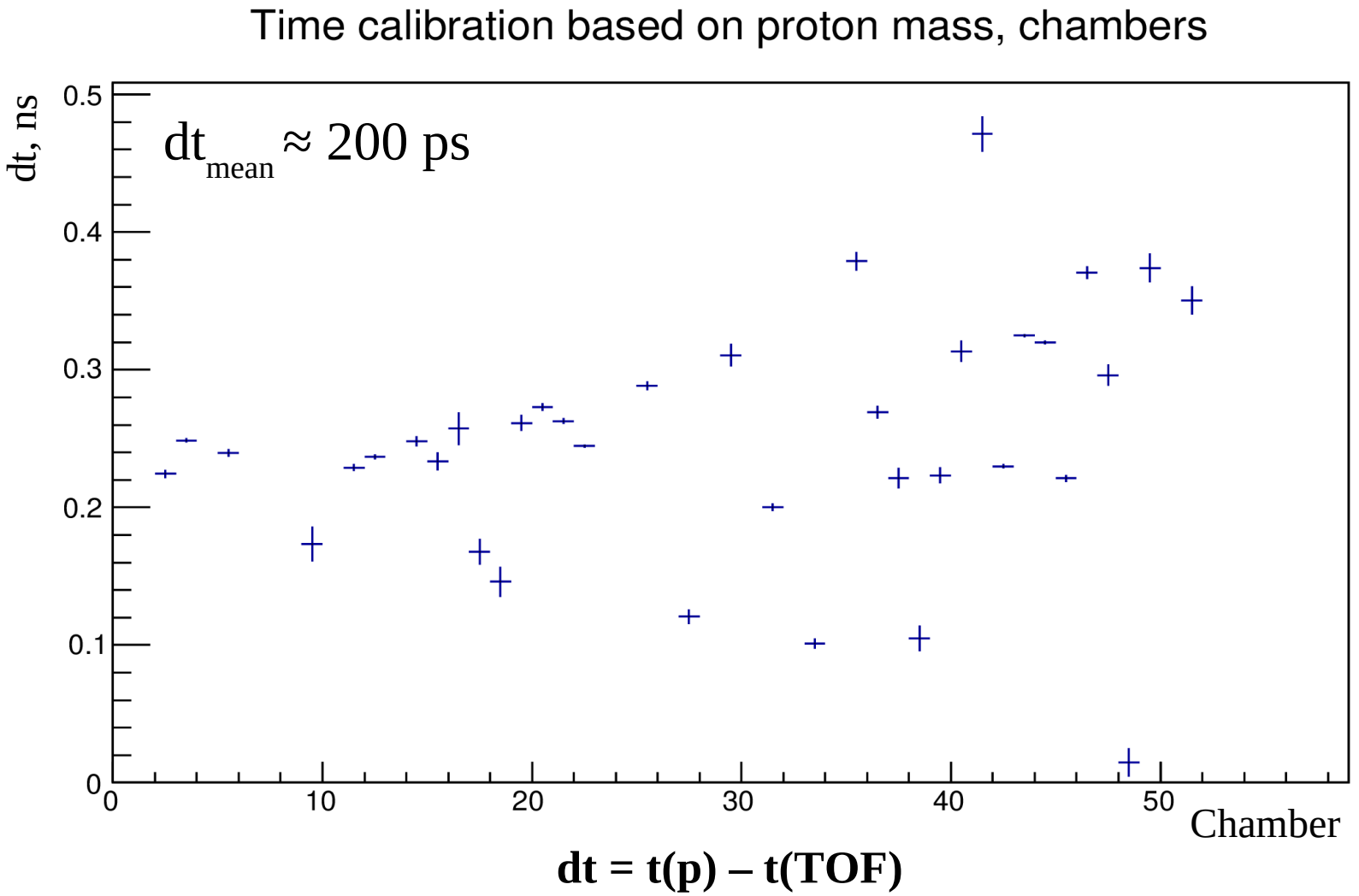
TOF700 Efficiency



TOF700 residuals hit-track



Time corrections for chambers

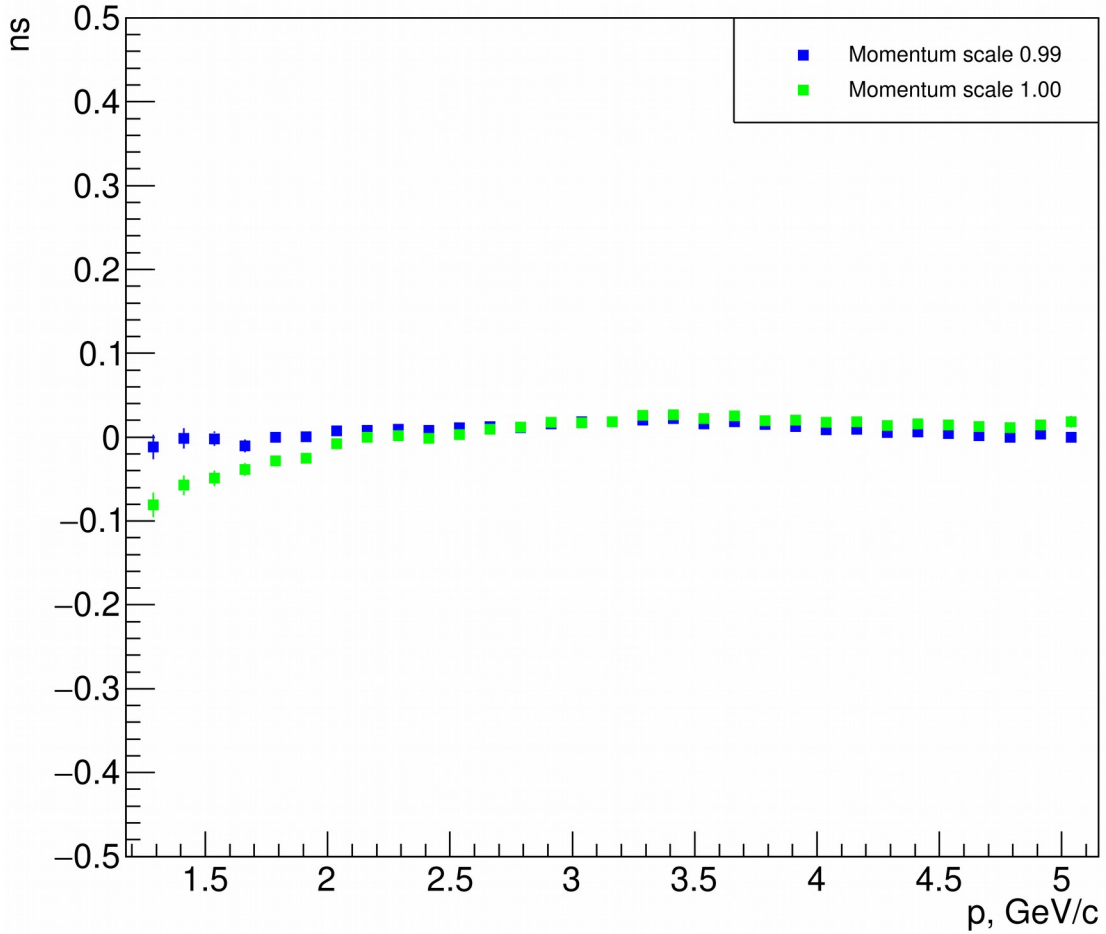


dt = t(p) – t(TOF)

t(TOF) - the particle time of flight measured by ***TOF700***

t(p) - particle time of flight calculated by measuring the momentum and length of flight for a **proton hypothesis**

Time position vs momentum



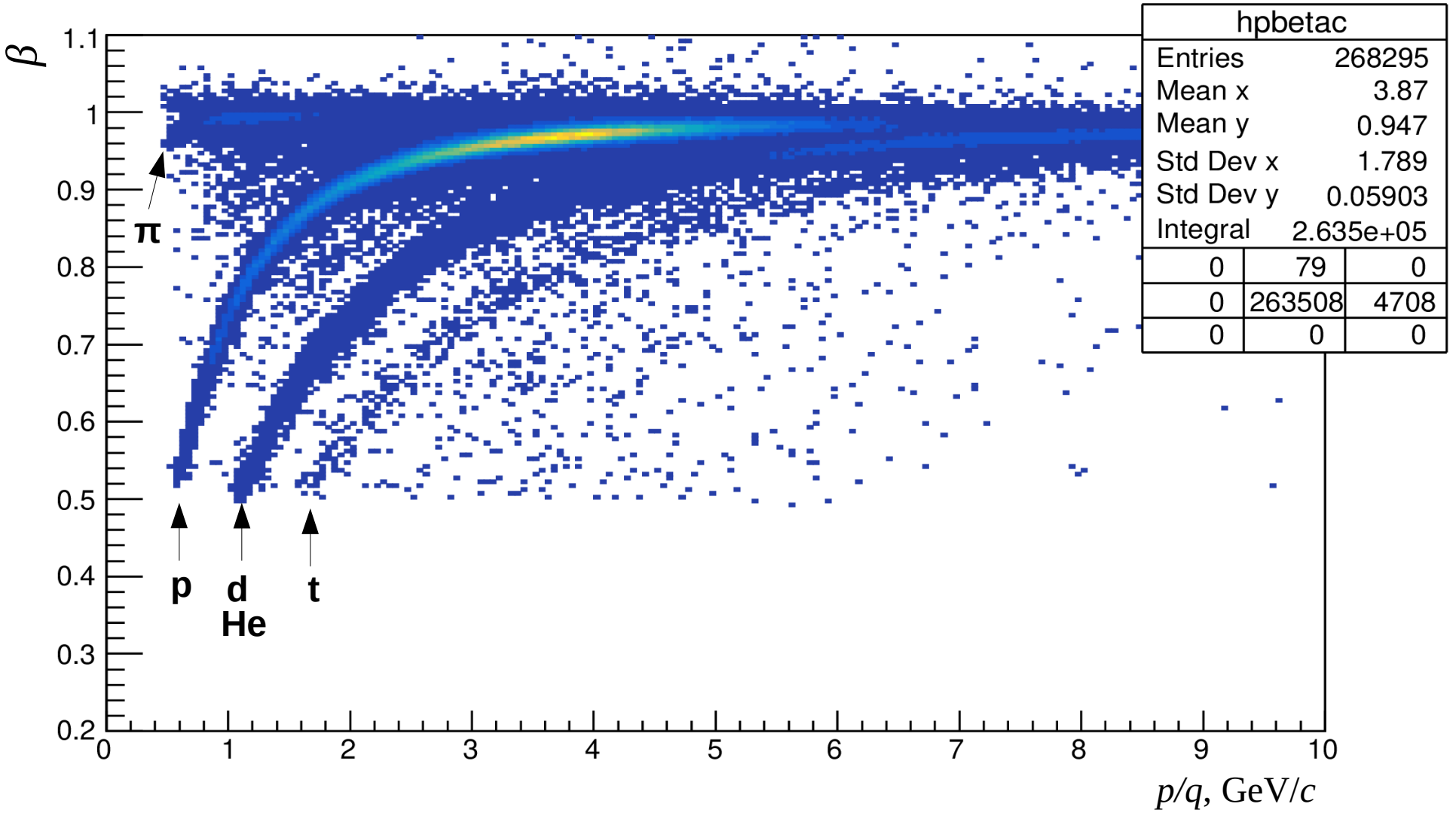
Dependence dt vs p is asymmetric with respect to dt=0, which reveals a systematic deviation

A possible reason is the difference between system of coordinates for tracking and for field map

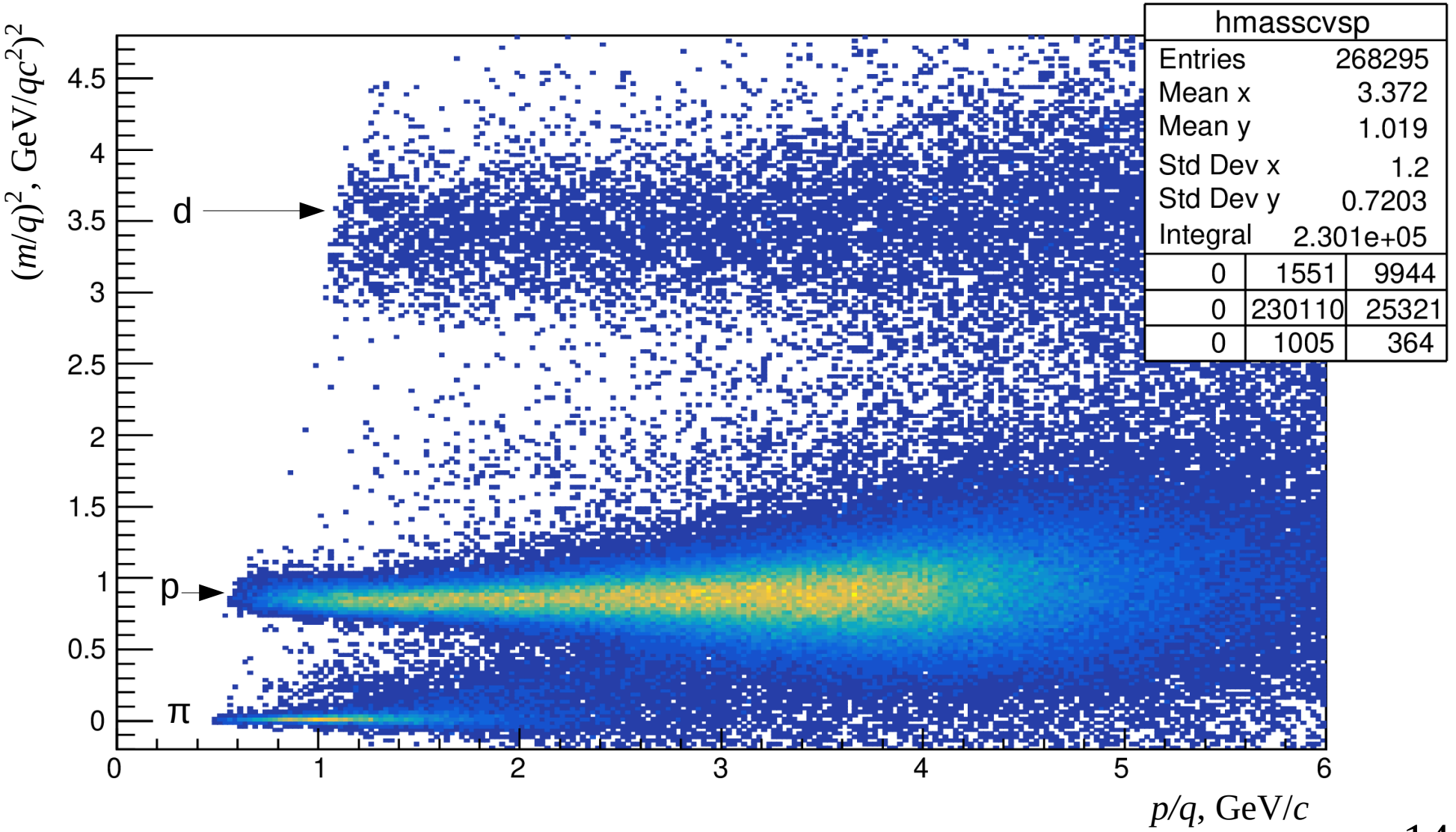
Magnetic Field integral is changed

After calibration the distribution became symmetric along dt=0 by scaling momentum by factor of 0.99

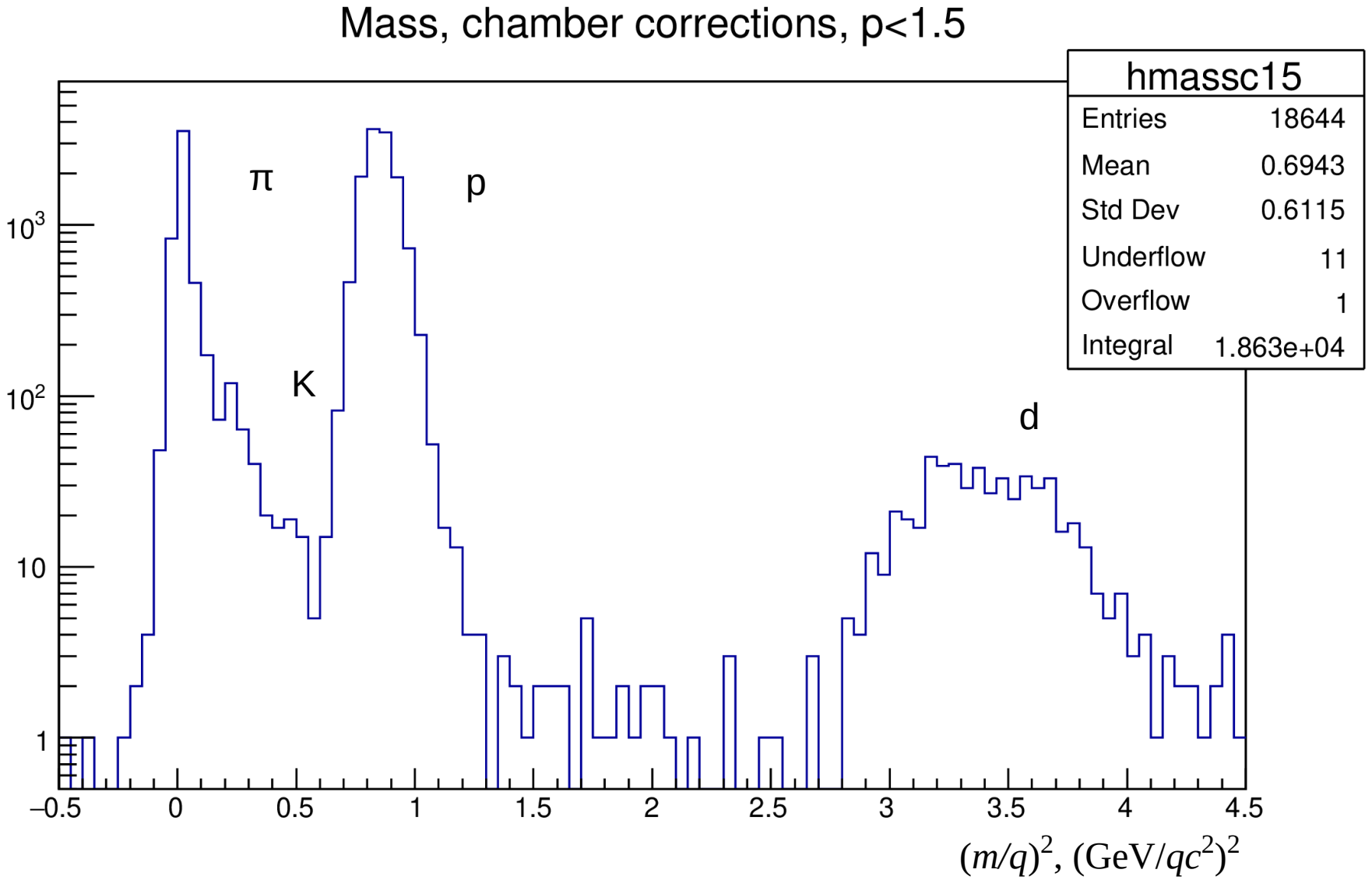
Beta vs momentum after proton hits corrections (argon run 7)



Dependence of Mass vs momentum after proton hits corrections (argon run 7)

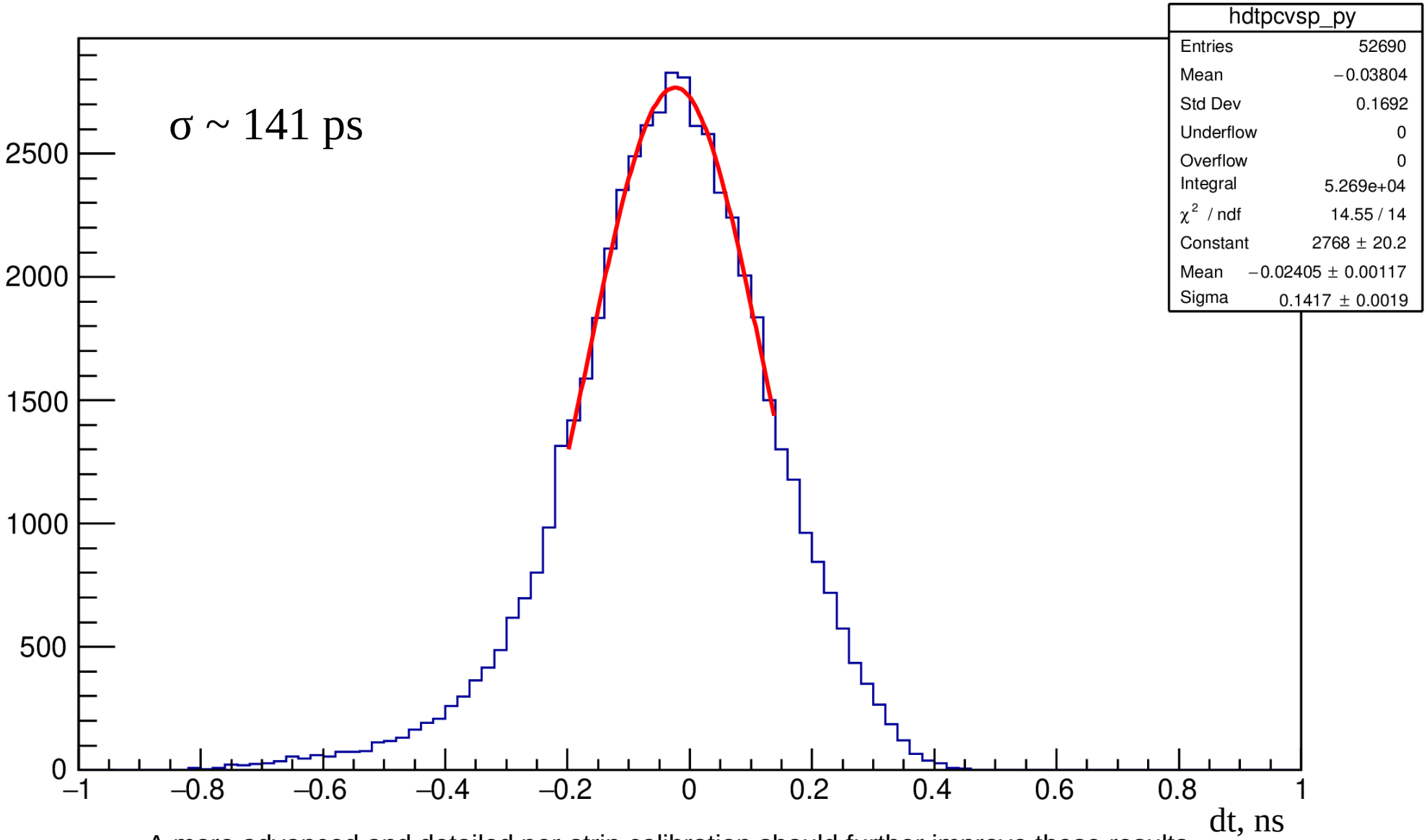


Reconstructed M²



Time resolution estimation

protons, 2<pq<5, chamber correction, argon run 7



A more advanced and detailed per-strip calibration should further improve these results.

Conclusion

* The analysis of TOF700 efficiency was performed.
  It showed sufficient efficiency for both the detector and matching procedures.
  Using matched tracks for both DCH chambers showed higher efficiency.

* Preliminary per-chamber calibration was done.
  Even the preliminary results allow for the use of identification.

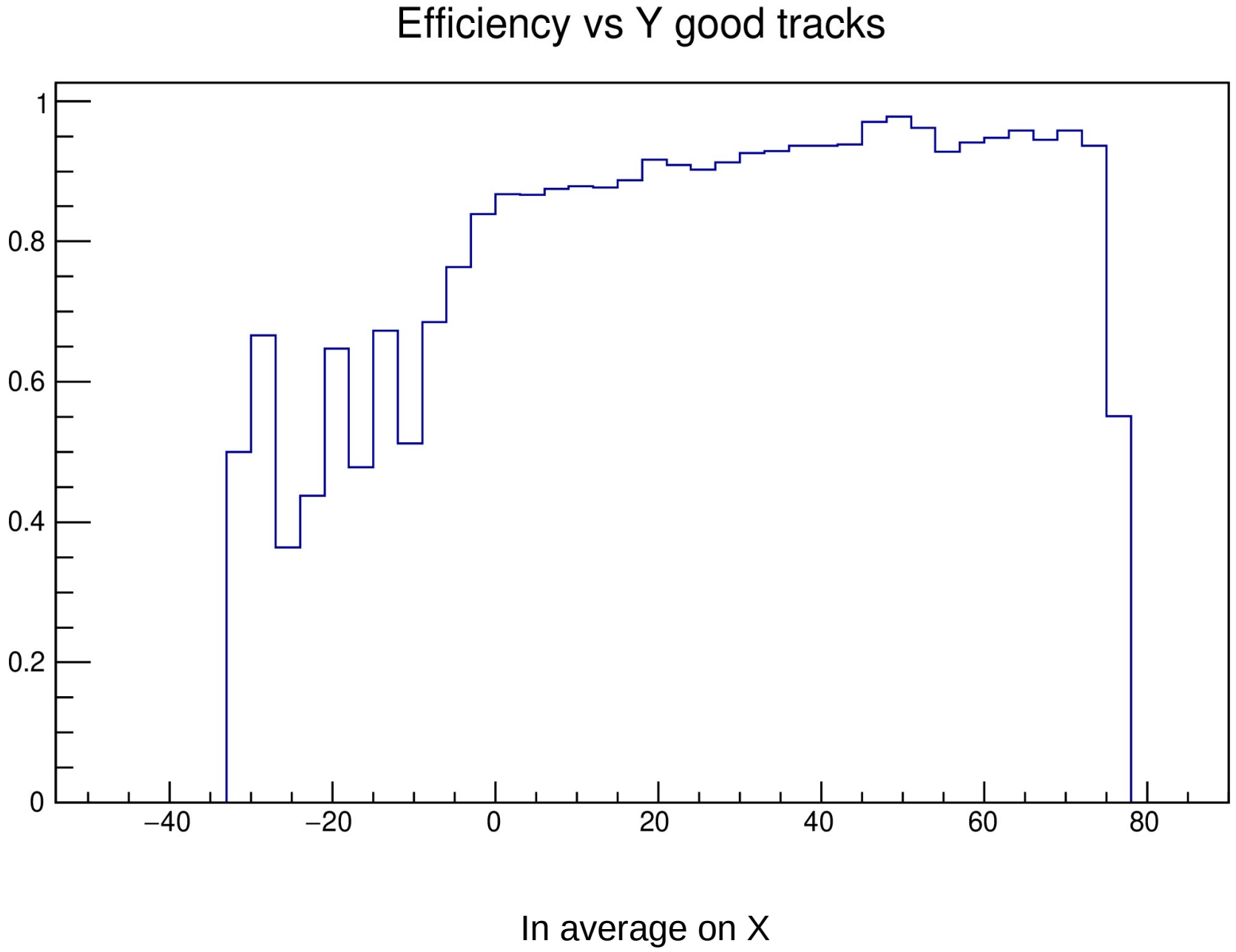
* PID procedure alows for separation of pions, protons, and deutrons in the area of up to 2 GeV/*c*.
  Separation of higher momentum regions requires a decrease in the time of flight error.

* Further analysis and calibration should improve identification and results.

Thank you!

Backup

TOF700 efficiency, DCH1+DCH2 tracks



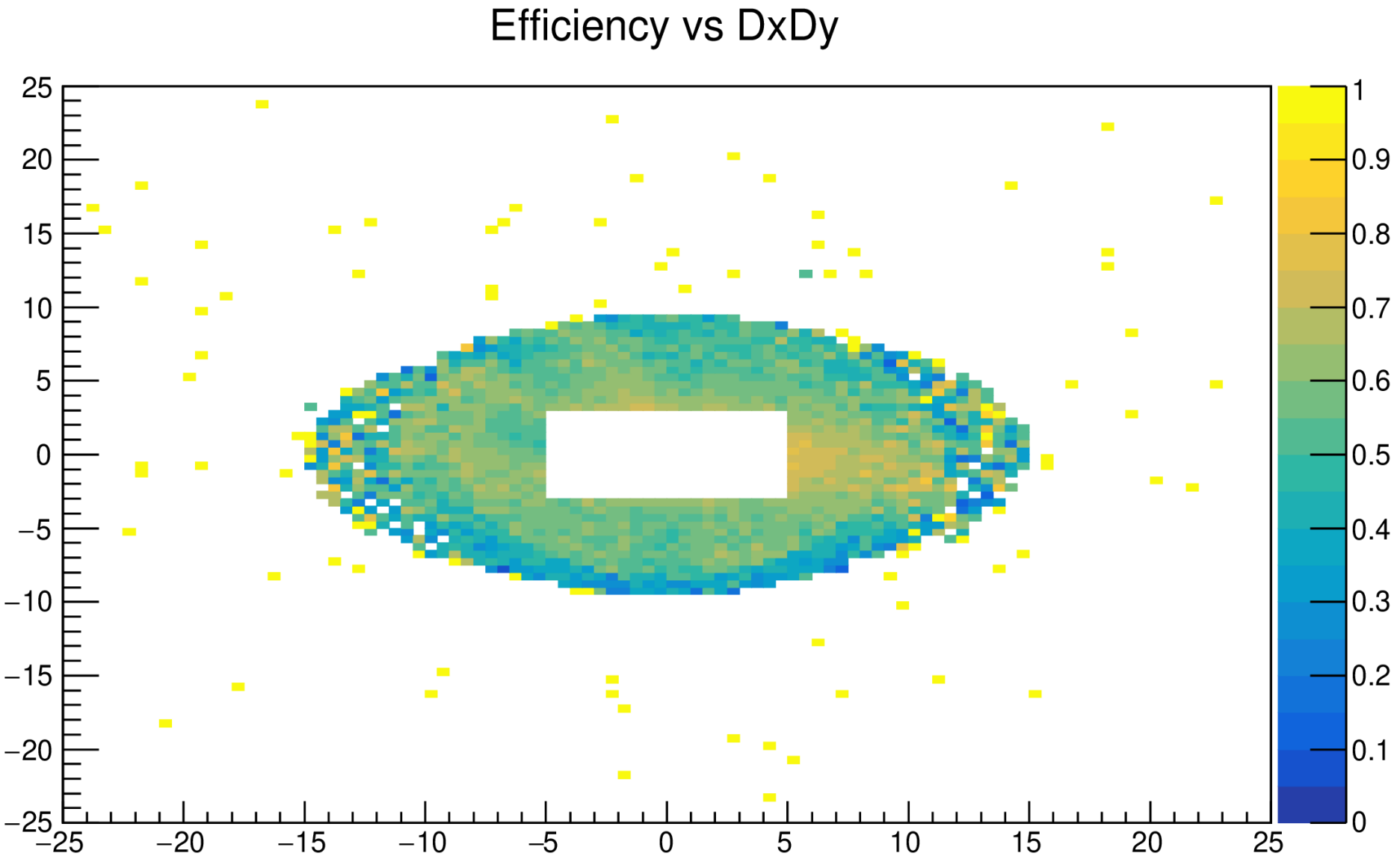
Then “background” criteria:
Not (Abs(Dx)<5 and Abs(Dy)<3 cm)

Estimation for “background”
is about 25% of matching tracks.

“Background” tracks:
bad GEM and good DCH
good GEM and bad DCH
bad GEM and bad DCH

“Bad” - big parameter error or FAKE!

TOF700 efficiency, DCH1 tracks, “background”



TOF700 efficiency, DCH1 tracks, “background”