

# ToF-400 calibration for $\pi^-$ particles in the Ar run

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## Issues

- ① Alignment of 11-18 ToF-400 planes without magnetic field.
- ② Alignment of 11-18 ToF-400 planes with magnetic field.
- ③ Estimation of 11-18 ToF-400 planes efficiency in the Ar run.

# BM@N setup

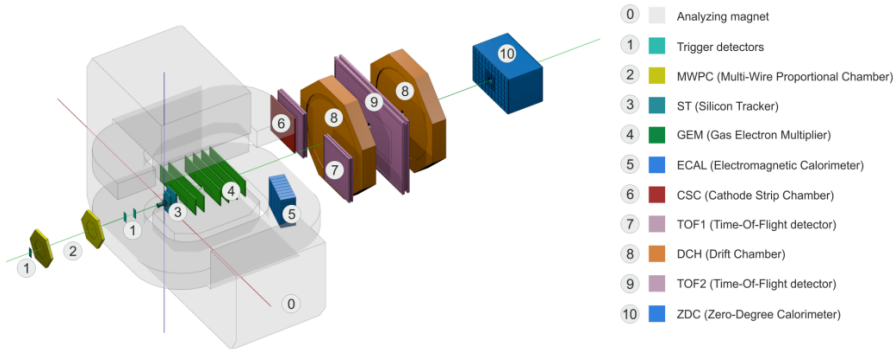


Figure 1: Scheme of BM@N setup.

# Time of Flight System (TOF-400)



Figure 2: Multigap Resistive Plate Chamber.

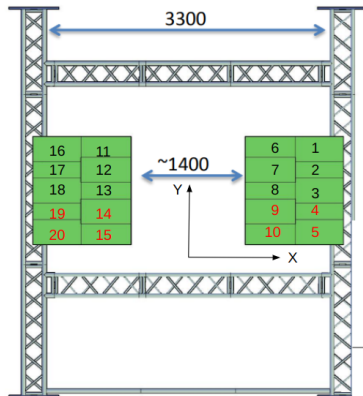


Figure 3: Scheme of ToF-400 configuration. Green planes are active area of mRPC.

# Analysis of experimental data. Residuals

- $D_x$  - difference between the extrapolated track  $X_{ext}$  from the Si/Gem system in the 11-18 TOF-400 plane and the  $X_{hit}$  coordinate of the hit for corresponding plane ( $D_x = X_{ext} - X_{hit}$ )
- $D_y$  - difference between the extrapolated track  $Y_{ext}$  from the Si/Gem system in the 11-18 TOF-400 plane and the  $Y_{hit}$  coordinate of the hit for corresponding plane ( $D_y = Y_{ext} - Y_{hit}$ )

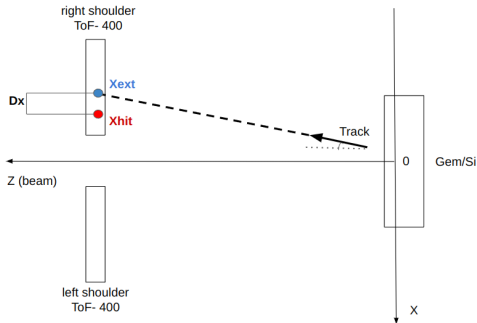
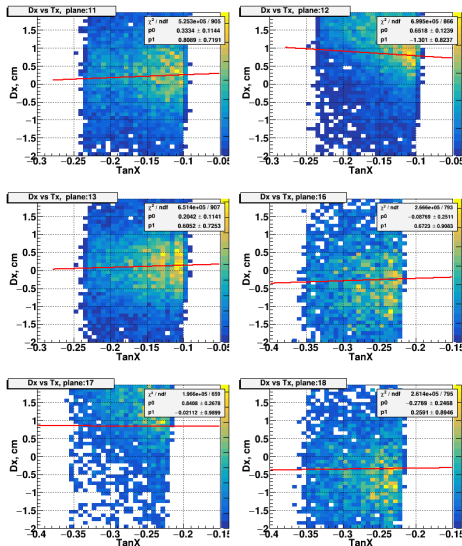


Figure 4: Scheme of residuals  $D_x$  for TOF-400

# Alignment of 11-18 ToF-400 planes without magnetic field

- Dx residual vs TanX 2D-histogram before alignment.
- Fit function:  
 $p0 \cdot x + p1 = 0$ .  
The value of the parameter  $p0$  (slope of the straight line) is a corrective value for Dz residual.



# Alignment of 11-18 ToF-400 planes without magnetic field

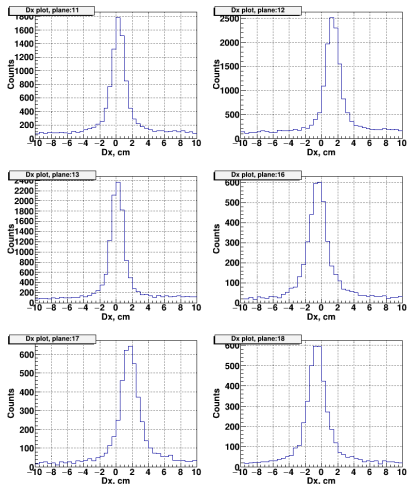


Figure 5: Dx residual histogram before alignment

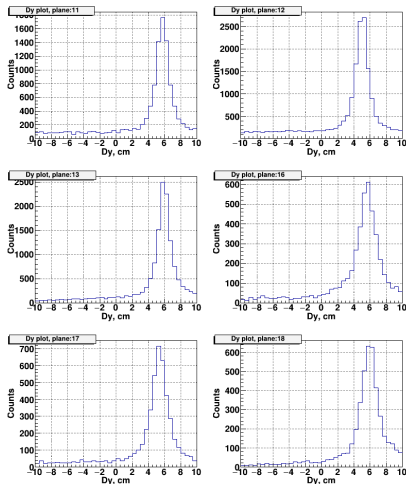


Figure 6: Dy residual histogram before alignment

# Alignment of 11-18 ToF-400 planes without magnetic field

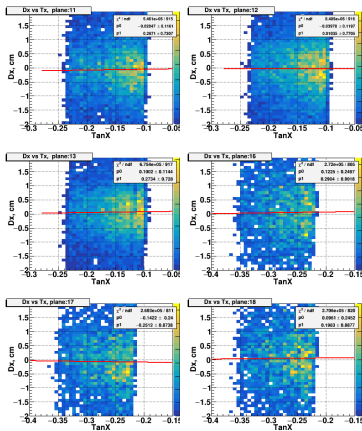


Figure 7: Dx residual vs TanX 2D-histogram after alignment



# Alignment of 11-18 ToF-400 planes without magnetic field

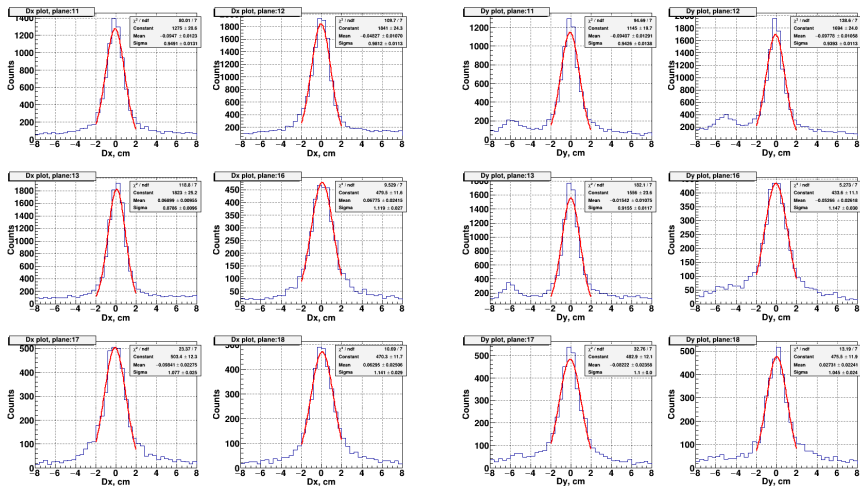


Figure 8: Dx residual histogram after alignment Figure 9: Dy residual histogram after alignment

# Alignment of 11-18 ToF-400 planes with magnetic field

Even after alignment without magnetic field, additional alignment with magnetic field was required.

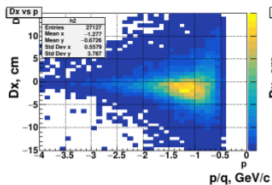


Figure: st 11

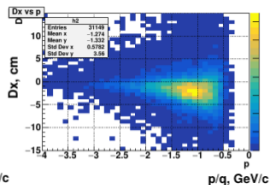


Figure: st 12

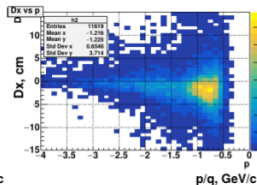


Figure: st 13

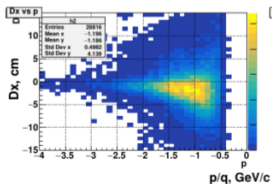


Figure: st 16

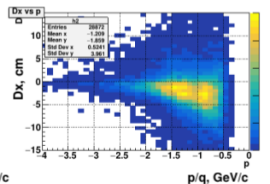


Figure: st 17

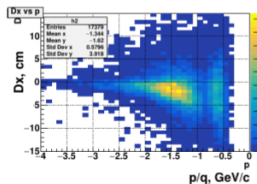


Figure: st 18

Figure 10: Dx residual vs momentum before alignment

# Alignment of 11-18 ToF-400 planes with magnetic field

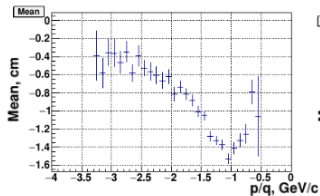


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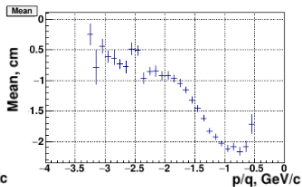


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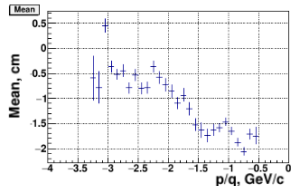


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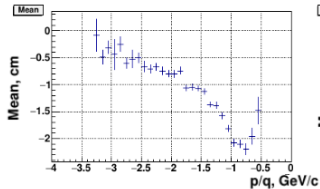


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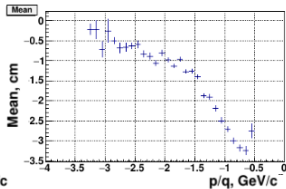


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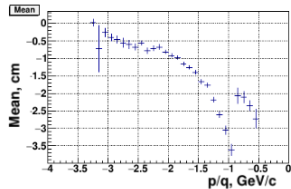


Figure: st 18

Figure 11: Histogram of mean residuals (MeanD $\times$ ) value before alignment

# Alignment of 11-18 ToF-400 planes with magnetic field

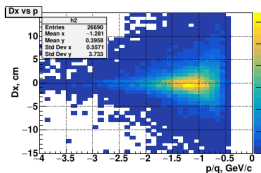


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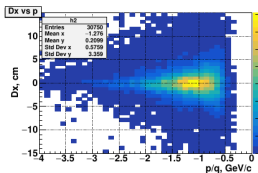


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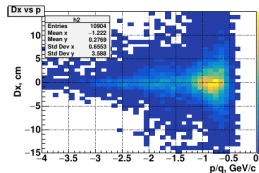


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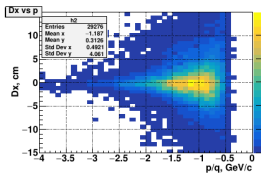


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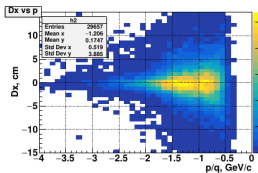


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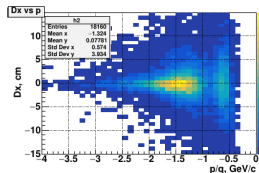


Figure: st 18

Figure 12:  $Dx$  residual vs momentum after alignment

# Alignment of 11-18 ToF-400 planes with magnetic field

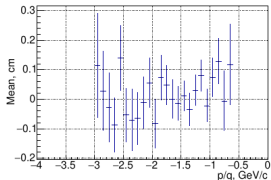


Figure: st 11

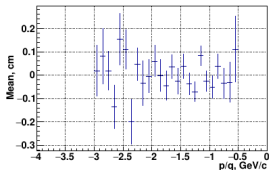


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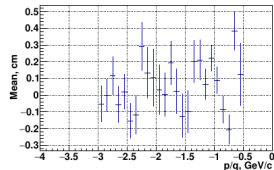


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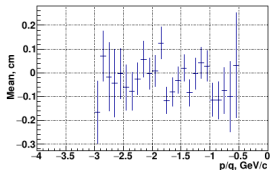


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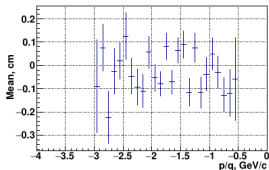


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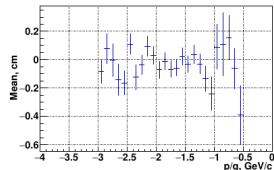


Figure: st 18

Figure 13: Histogram of mean residuals (MeanD<sub>x</sub>) value after alignment

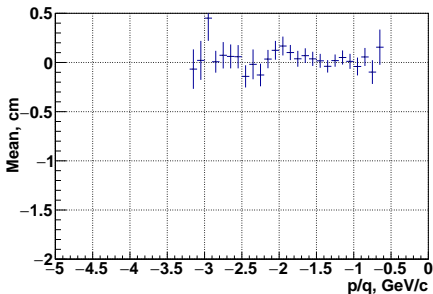
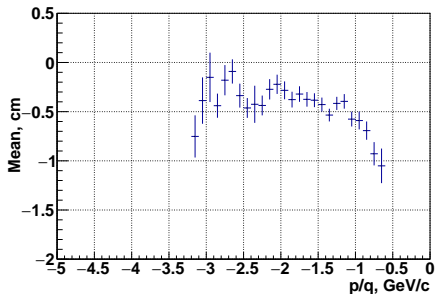
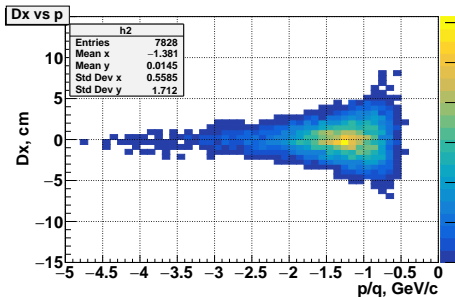
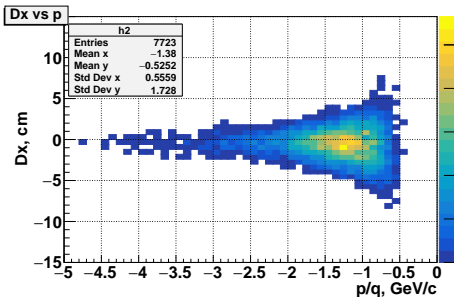
# Estimation of 11-18 ToF-400 planes efficiency in the Ar run

- Each plane was divided into cells 10x6 cm in size.
- **Denominator** - The track crossed the cell.
- **Numerator** - TOF-400 hit was found in the area of the track extrapolation point, which belongs to the same plane.

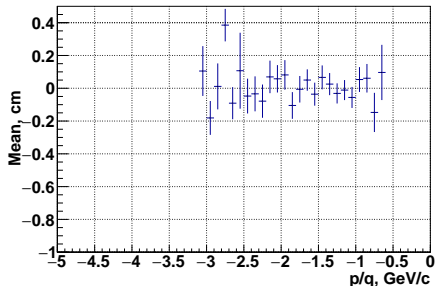
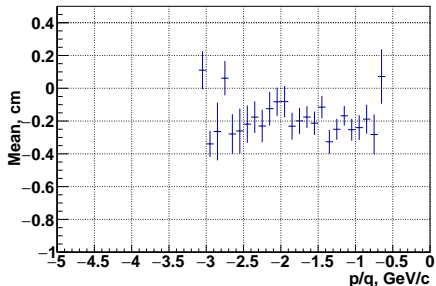
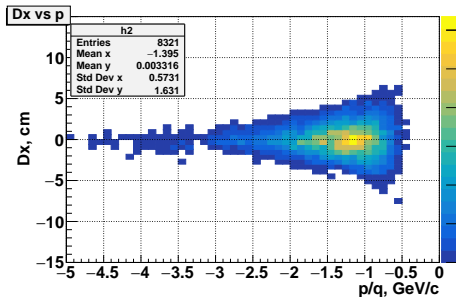
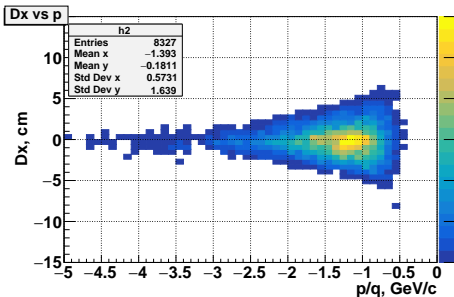
It was used parameters of GEM track confirmed in DCH detector for estimation of efficiency. The additional corrections were required.

$$Efficiency = \frac{\sum Numerator(Ar)}{\sum Denominator(Ar)}$$

# Additional corrections, Plane 11

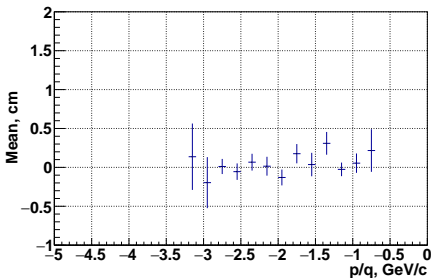
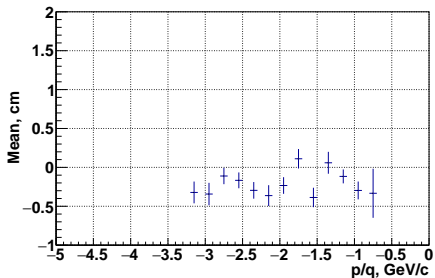
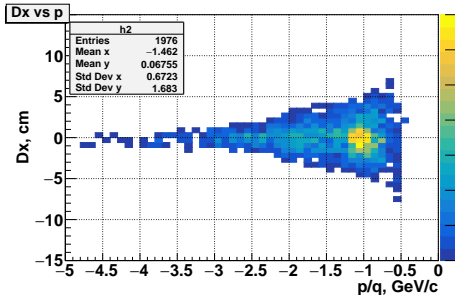
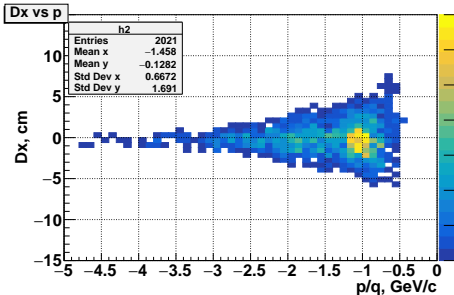


# Additional corrections, Plane 12

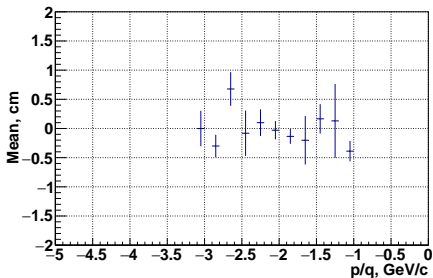
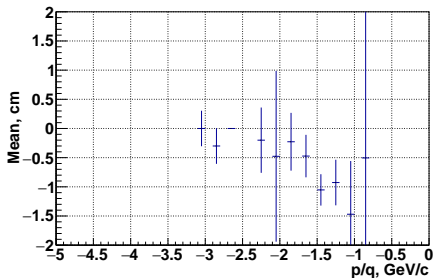
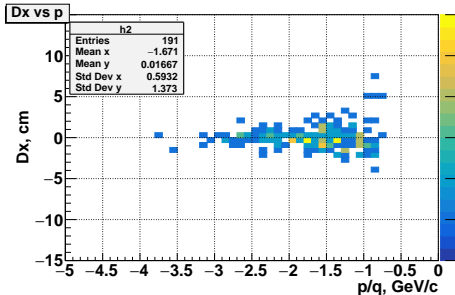
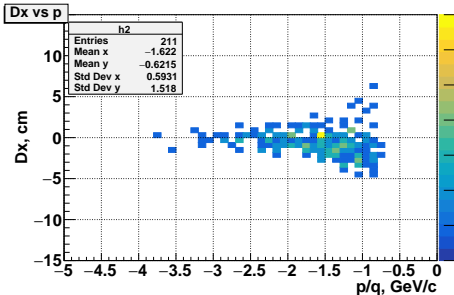




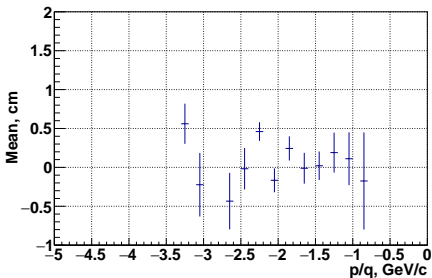
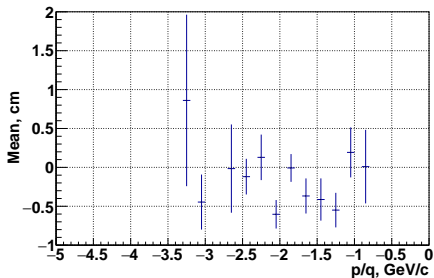
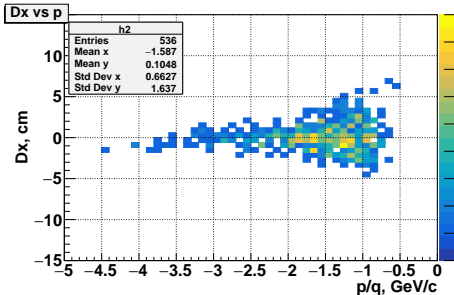
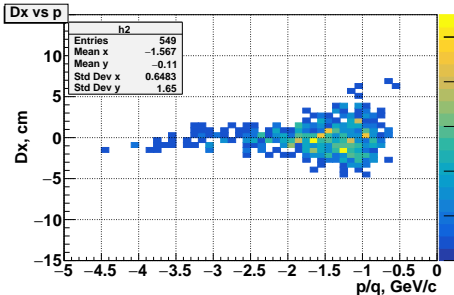
# Additional corrections, Plane 13



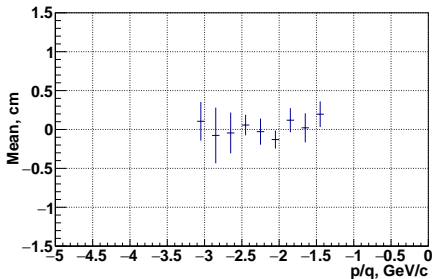
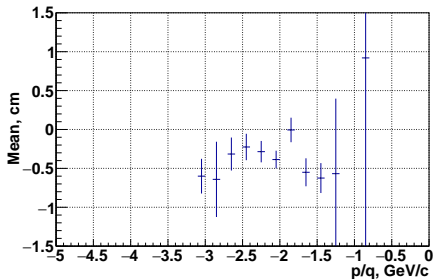
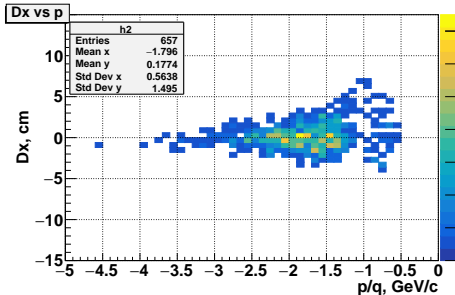
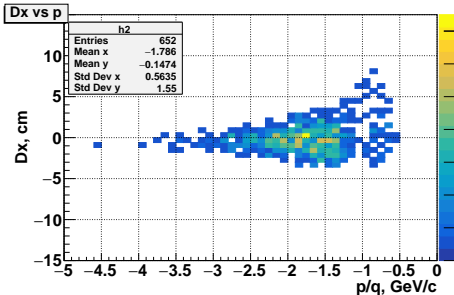
# Additional corrections, Plane 16



# Additional corrections, Plane 17



# Additional corrections, Plane 18



# Estimation of 11-18 ToF-400 planes efficiency in the Ar run

Plane	11	12	13	16	17	18
<b>New eff</b>	<b>92,0 %</b>	<b>92,2 %</b>	<b>67,6 %</b>	<b>91,5 %</b>	<b>88,6 %</b>	<b>90,5 %</b>
Old eff	88,5 %	85,1 %	65,5 %	65,8 %	69,1 %	81,8 %

## Conclusion

- 1 Alignment of 11-18 ToF-400 planes without magnetic field has been done.
- 2 Alignment of 11-18 ToF-400 planes with magnetic field has been done.
- 3 Estimation of 11-18 ToF-400 planes efficiency in the Ar run is in progress.

Thank you for your attention!