

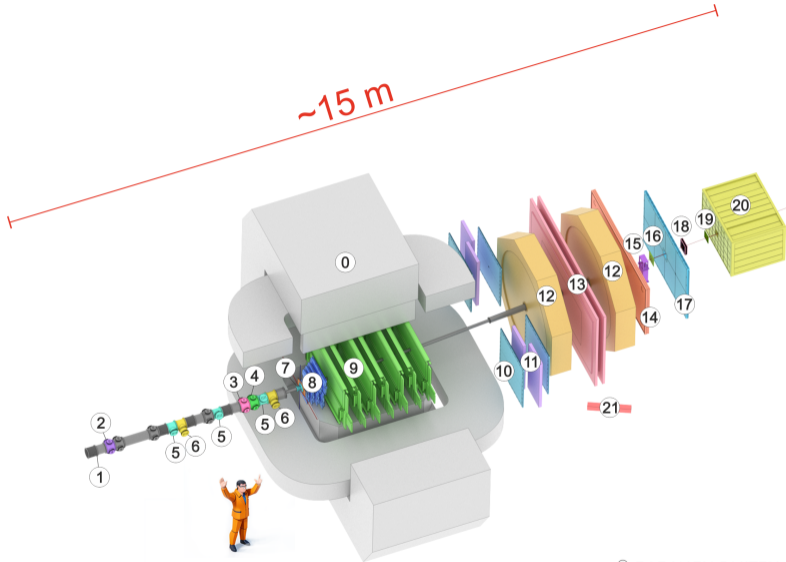


Coordinate and time alignment of the **TOF-700** detector

Sergei Merts, Vasilisa Lenivenko

Analysis and Detector Meeting of the BM@N Experiment

13/03/24



~15 m

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

TOF-700 setup

КАМЕРЫ. CRATE - HV-адреса каналов - Температура мал. камер

107 2-Б (19) HV1-18 Crate -1 ca -9 h -18	108 2-А (23) HV1-19 Crate -1 ca -10 h -16	109 2-Б (20) HV1-20 Crate -1 ca -9 h -19	110 2-А (24) HV3-23 Crate -3 ca -8 h -24	111 2-Б (16) HV3-21 Crate -3 ca -8 h -22	112 2-А (18) HV3-22 Crate -3 ca -9 h -27										
113 1-А (107) HV2-24 Crate -2 ca -5 h -14	1 1-Б (24) H-1-23 H-1-24	2 1-А (3) H-2-1 H-2-2	3 1-Б (23) H-2-5 H-2-6	4 1-А (26) H-2-9 H-2-10	5 1-Б (28) H-2-13 H-2-14	6 1-А (12) H-2-17 H-2-18	7 1-Б (27) H-2-21 H-2-22	8 1-А (29) H-2-29 H-2-30	9 1-Б (43) H-1-19 H-1-20	10 1-А (33) H-1-13 H-1-14	11 1-Б (39) H-1-21 H-1-22	12 1-А (23) H-1-15 H-1-16	13 1-Б (27) H-1-23 H-1-24	14 1-А (28) H-1-17 H-1-18	114 1-Б (30) HV4-17 Crate -4 ca -15 h -94
15 2-А (13) HV1-1 Crate -1 ca -12 h -40	16 2-Б (15) H-3-1 H-3-2	17 2-А (16) H-3-3 H-3-4	18 2-Б (17) H-3-5 H-3-6	19 2-А (18) H-3-7 H-3-8	20 2-Б (19) H-3-9 H-3-10	21 3-Б (10) H-3-11 H-3-12	22 2-А (20) H-3-13 H-3-14	23 2-Б (42) HV3-1 Crate -3	24 2-А (40) HV3-2 Crate -3	25 2-Б (42) HV3-3 Crate -3	26 2-А (22) HV3-4 Crate -3	27 2-Б (26) HV3-5 Crate -3	28 2-А (41) HV3-6 Crate -3	29 2-Б (17) HV3-7 Crate -3	116 2-А (22) HV3-24 Crate -3 ca -9 h -86
117 1-А (102) HV2-23 Crate -2 ca -5 h -39	27 1-Б (20) H-2-27 H-2-28	28 1-А (22) H-2-3 H-2-4	29 1-Б (26) H-2-7 H-2-8	30 1-А (28) H-2-11 H-2-12	31 1-Б (17) H-2-15 H-2-16	32 1-А (14) H-2-19 H-2-20	33 1-Б (27) H-2-23 H-2-24	34 1-А (30) H-2-31 H-2-32	35 1-Б (36) H-1-3 H-1-4	36 1-А (27) H-1-1 H-1-2	37 1-Б (37) H-1-5 H-1-6	38 1-А (28) H-1-7 H-1-8	39 1-Б (28) H-1-9 H-1-10	40 1-А (24) H-1-11 H-1-12	118 1-Б (26) HV4-18 Crate -4 ca -15 h -44
119 2-Б (6) HV1-22 Crate -1 ca -7 h -9	120 2-А (1) HV1-21 Crate -1 ca -8 h -3	121 2-Б (27) HV1-23 Crate -1 ca -8 h -15	122 2-А (31) HV3-18 Crate -3 ca -10 h -12	123 2-Б (25) HV3-19 Crate -3 ca -10 h -5	124 2-А (32) HV3-20 Crate -3 ca -11 h -10										

59 modules with 32/16 strips

Time correction

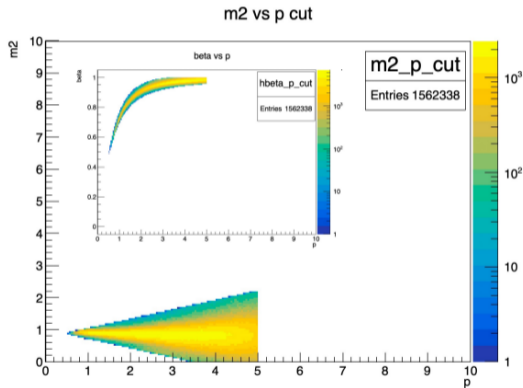
- Select protons by mass
- For each selected proton calculate theoretical time of flight by length (L) and momentum (ρ)

$$T_{\text{theor}} = \frac{L \cdot \sqrt{m^2 + \rho^2}}{\rho \cdot c}$$

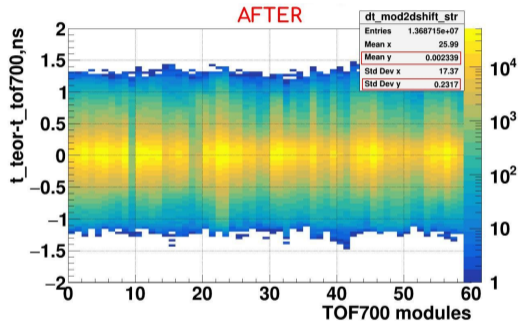
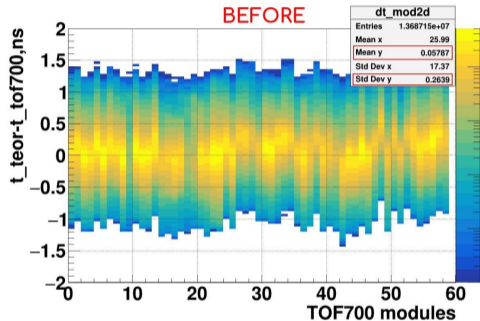
- Calculate time correction
- $dT = T_{\text{theor}} - T_{\text{TOF}}$
- Use dT to correct T_{TOF} for each particles

Repeat independently for each module (59) / strip (32×59)

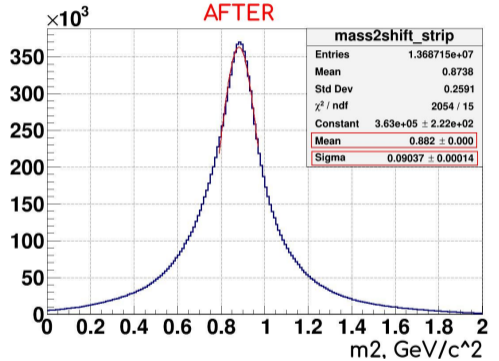
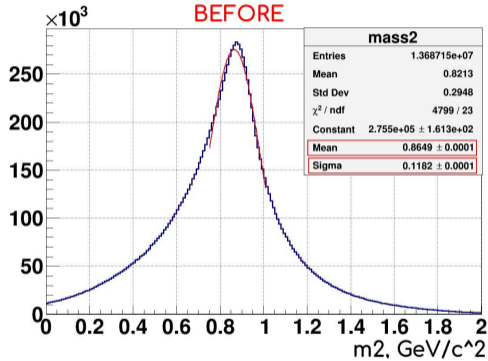
Used statistics: $1e6$ events



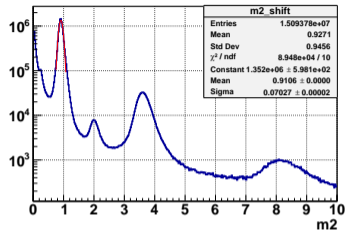
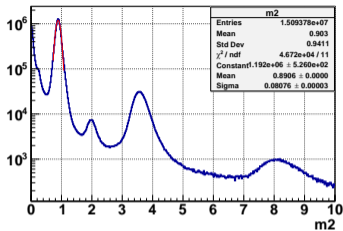
Time difference for protons by modules



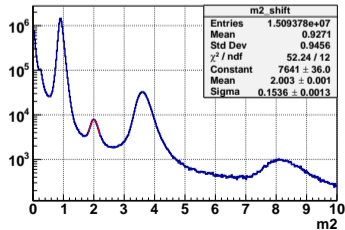
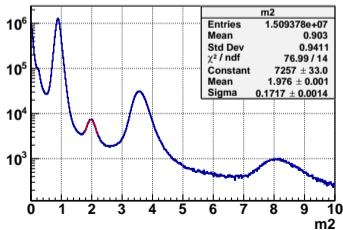
Mass for protons



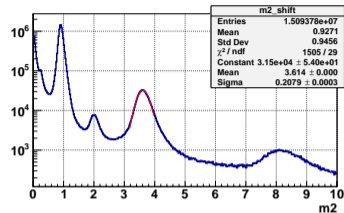
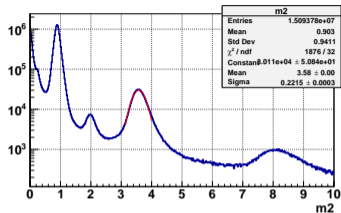
Proton mass (0.880)



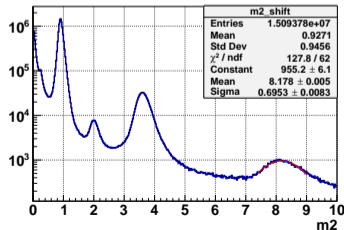
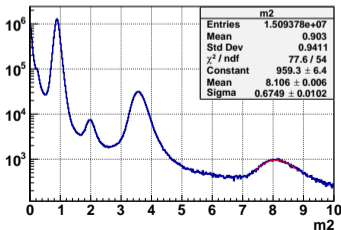
He3 mass (1.980)



Deuteron mass (3.519)



Tritium mass (7.919)



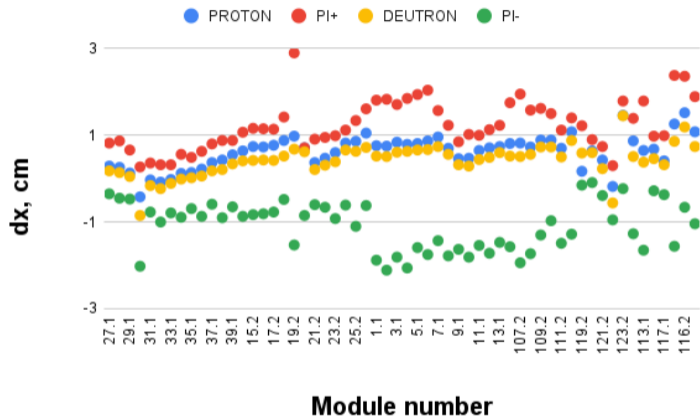
Coordinate correction

The next conditions and cuts were used

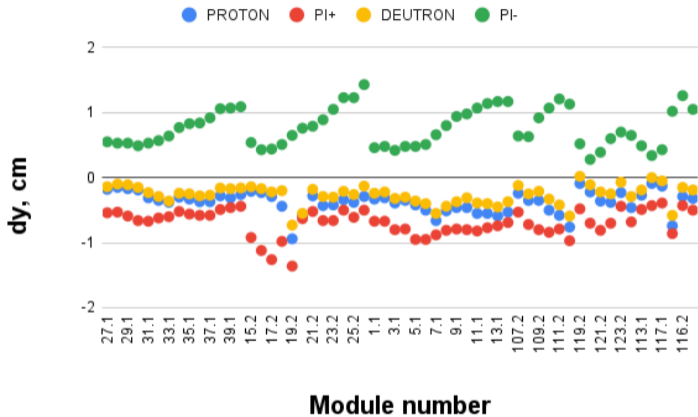
- $\approx 22e6$ events
- At least **2 tracks** in primary vertex
- $-1.0 < PV_X < 1.5$
 $-1.0 < PV_Y < 1.2$
 $-0.5 < PV_Z < 0.5$
- At least **5 hits** on track
- Time corrections implemented

Matching

- Propagate track to PV_Z , if distance between PV and track on PV_Z more than 1.0 cm, skip track
- Propagate track to TOF-700 planes
- Find nearest hit in ± 3 cm for X and Y directions
- Calculate length of track
- Correct time by proton peak correction coefficients
- Calculate mass and momentum of track
- Fill independent distributions for protons, π^- , π^+ and deuterons



There is module and momentum dependence



There is module and momentum dependence

КАМЕРЫ. CRATE - HV-адреса каналов - Температура мал. камер

115	116	117	118	119	120
3-4 (2)	3-4 (2)	3-4 (2)	3-4 (2)	3-4 (2)	3-4 (2)
HV-15	HV-15	HV-23	HV-23	HV-23	HV-23
Date -1	Date -1	Date -1	Date -1	Date -1	Date -1
1-8	1-8	1-8	1-8	1-8	1-8

115	116	117	118	119	120
1-4 (2)	1-4 (2)	1-4 (2)	1-4 (2)	1-4 (2)	1-4 (2)
HV-24	HV-24	HV-24	HV-24	HV-24	HV-24
Date -2	Date -2	Date -2	Date -2	Date -2	Date -2
1-8	1-8	1-8	1-8	1-8	1-8

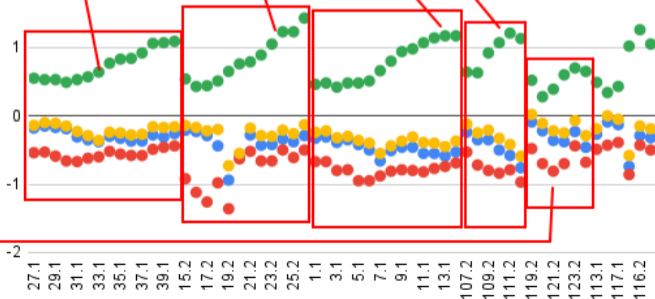
115	116	117	118	119	120
2-4 (2)	2-4 (2)	2-4 (2)	2-4 (2)	2-4 (2)	2-4 (2)
HV-17	HV-17	HV-17	HV-17	HV-17	HV-17
Date -1	Date -1	Date -1	Date -1	Date -1	Date -1
1-8	1-8	1-8	1-8	1-8	1-8

115	116	117	118	119	120
1-4 (2)	1-4 (2)	1-4 (2)	1-4 (2)	1-4 (2)	1-4 (2)
HV-22	HV-22	HV-22	HV-22	HV-22	HV-22
Date -2	Date -2	Date -2	Date -2	Date -2	Date -2
1-8	1-8	1-8	1-8	1-8	1-8

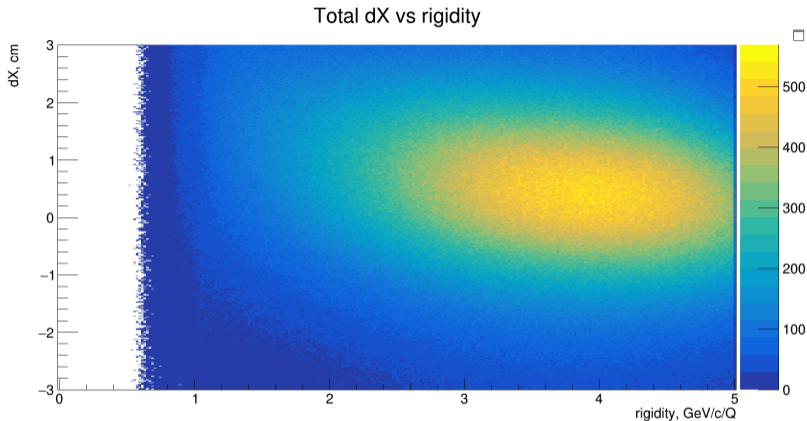
115	116	117	118	119	120
3-4 (2)	3-4 (2)	3-4 (2)	3-4 (2)	3-4 (2)	3-4 (2)
HV-15	HV-15	HV-23	HV-23	HV-23	HV-23
Date -1	Date -1	Date -1	Date -1	Date -1	Date -1
1-8	1-8	1-8	1-8	1-8	1-8

● DEUTRON ● PI

dy, cm

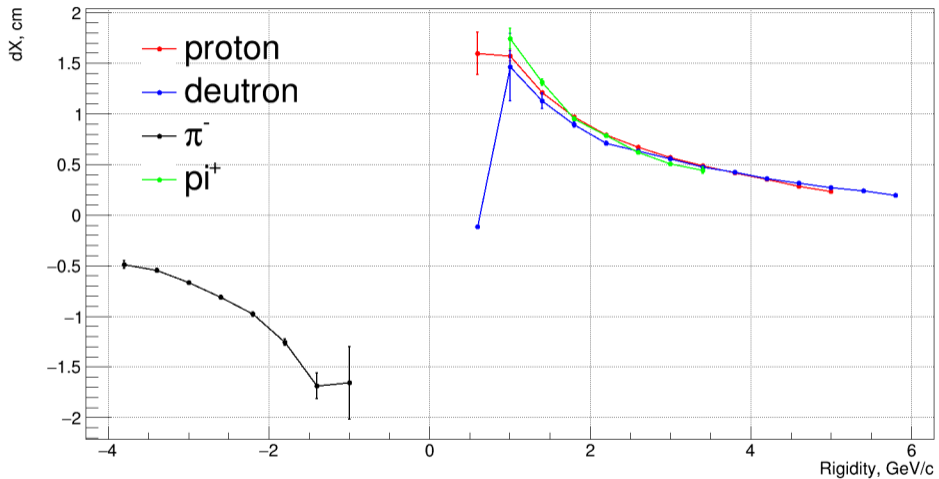


dX vs momentum for selected protons

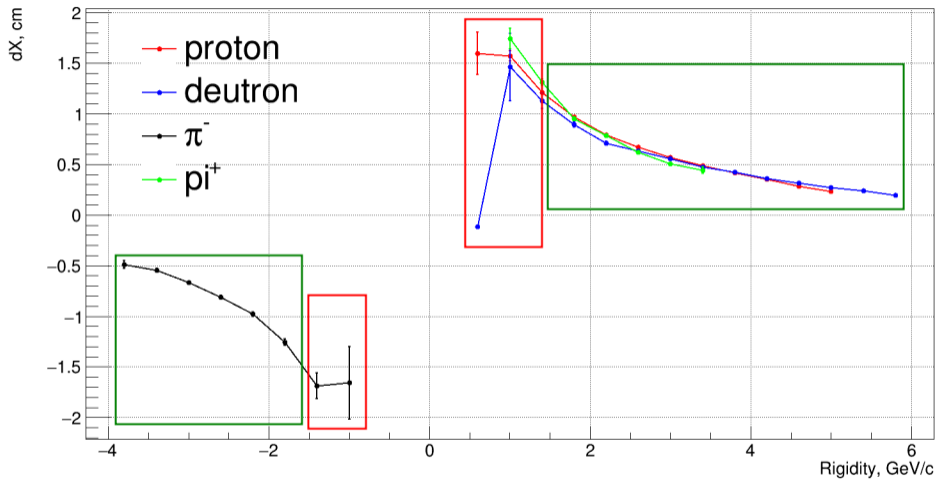


Plot was divided by slices of 0.4 GeV/c
Spectrum in slice fitted by "gaus+pol2" function and mean value used
to get momentum dependence

dX vs Rigidity

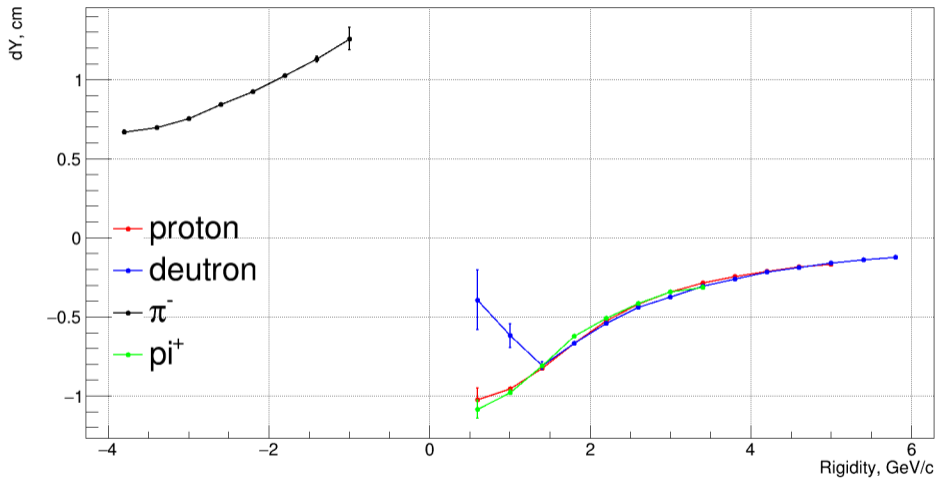


dX vs Rigidity

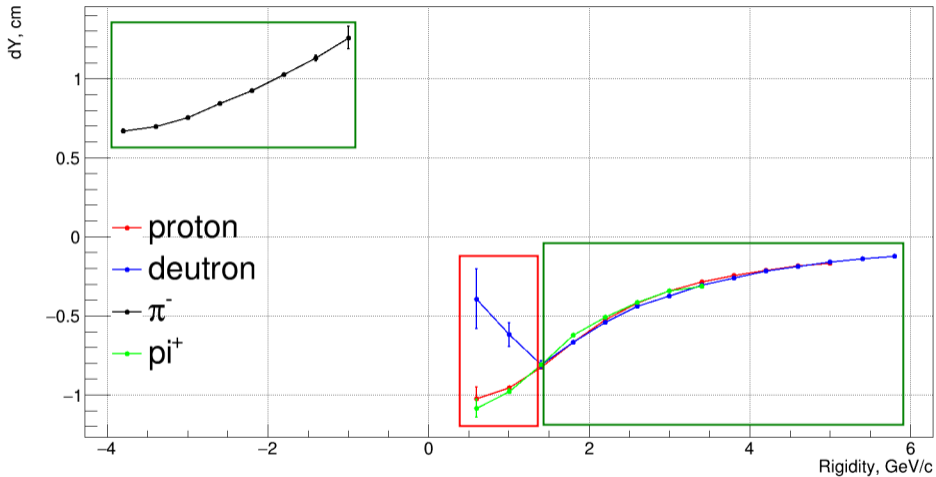


Lack of statistics for low momenta

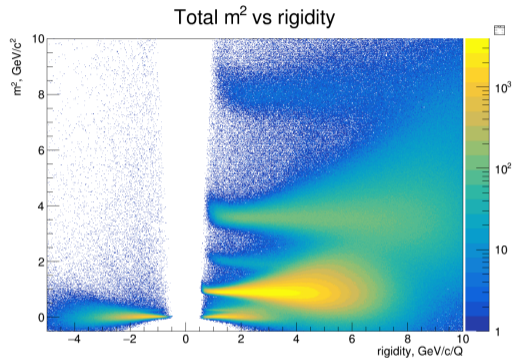
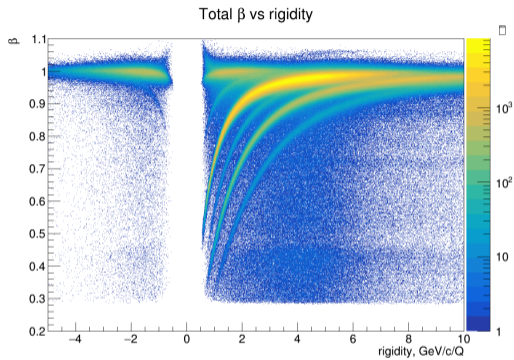
dY vs Rigidity



dY vs Rigidity



Lack of statistics for low momenta



Much better separation of fragments and presence of K^-

Next steps

- Fit momentum dependencies for dX and dY on higher statistics
- Get momentum independent shifts of modules
- Recalculate time shifts (because of track length changing)
- Implement time corrections in TOF-700 hit maker
- Implement momentum dependencies and coordinate alignment in global tracking (track to hit matching)
- Ask for new data production

Analysis teams can already start working with these corrections!
(Vasilisa and I can help)