

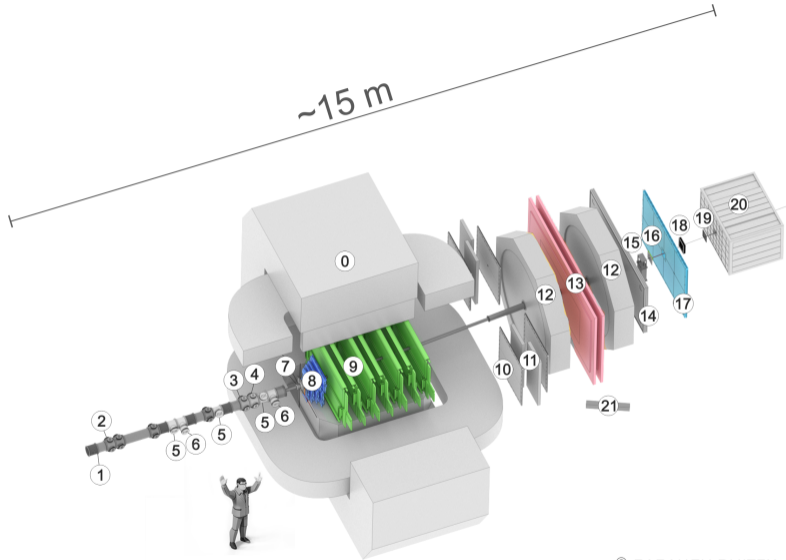


Performance of ToF-700 and LCSC

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12th Collaboration Meeting of the BM@N Experiment at the NICA Facility
Satbayev University, Almaty, Kazakhstan

14/05/24



- 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 m² (10)
- TOF 400 (11)
- DCH (12)
- TOF 700 (13)
- ScWall (14)
- FD (15)
- Small GEM (16)
- CSC 2x1.5 m² (17)
- Beam Profilometer (18)
- FQH (19)
- FHCAL (20)
- HGN (21)

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Time correction

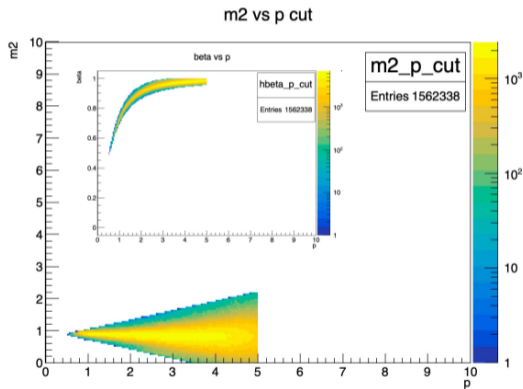
- Select protons by mass
- For each selected proton calculate theoretical time of flight by length (L) and momentum (ρ)

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

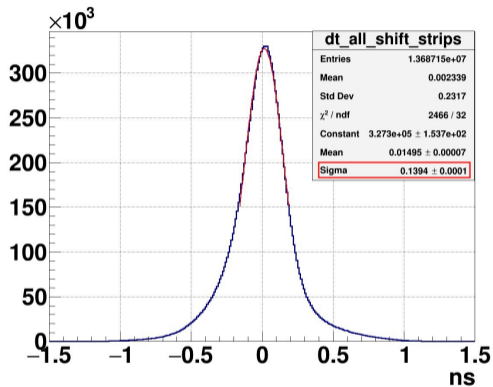
- Calculate time correction
- $dT = T_{\text{theor}} - T_{\text{TOF}}$
- Use dT to correct T_{TOF} for each particles

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

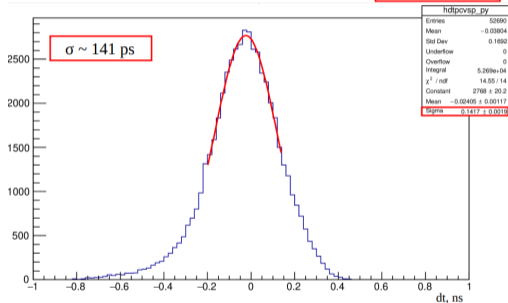
Used statistics: $1e6$ events



Time resolution

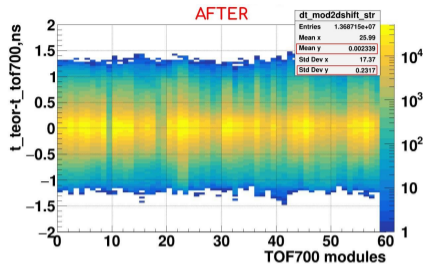
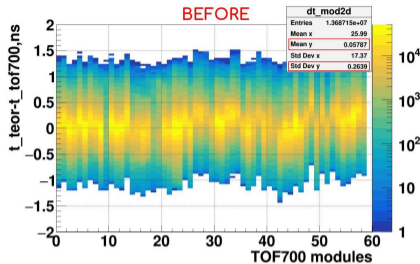


Time resolution estimation protons, $2 < p q < 5$, chamber correction, argon run 7

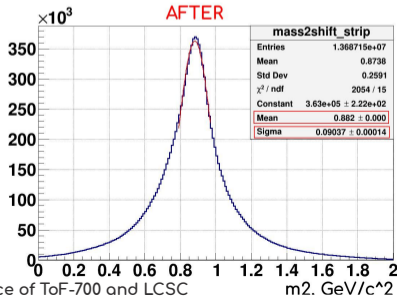
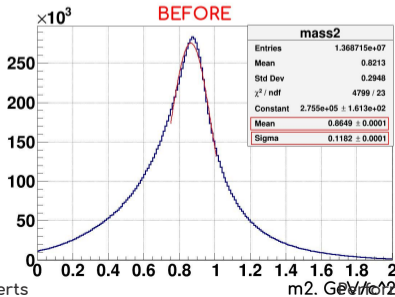


Time resolution is about 140 ps

Time difference for protons by modules



Mass for protons



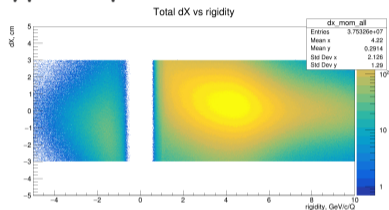
Coordinate correction

Event/track selection

- $\approx 22e6$ 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
- Z position of **TrackParamLast** more than **200 cm** (last two GEM stations)
- **Impact factor** of track less than 1 cm
- Time corrections implemented

Momentum dependence

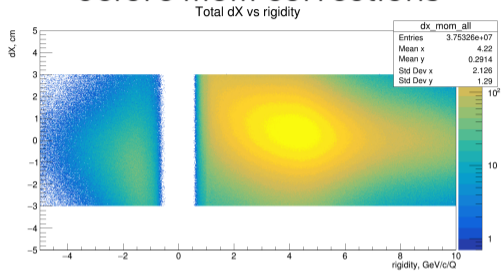
- Typical plot



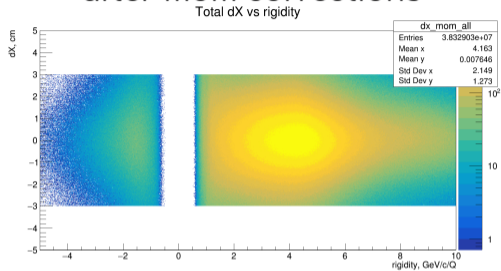
- Plot divided by momentum slices
- Spectrum in each slice fitted by “**gaus+pol2**” function
- **Mean value** of fit used as coordinate correction
- **Sigma** of fit used as range for matching

TOF-700

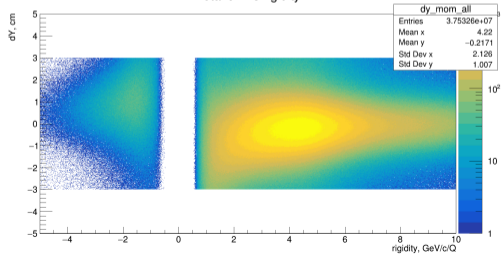
before mom corrections



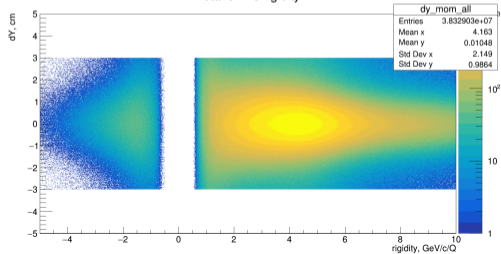
after mom corrections



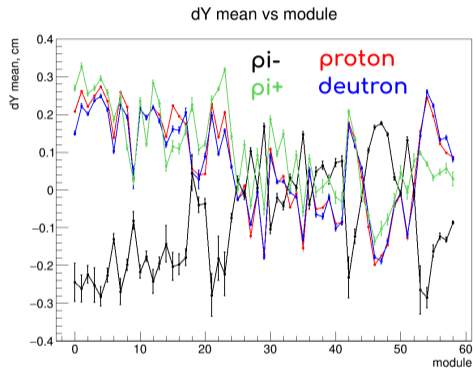
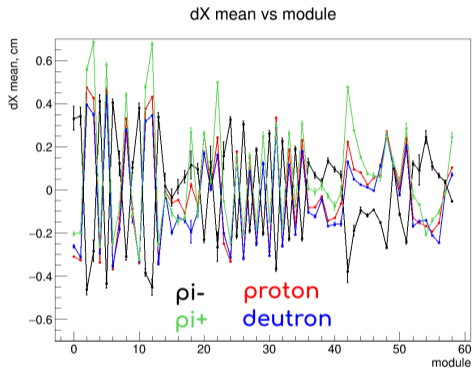
Total dY vs rigidity



Total dY vs rigidity



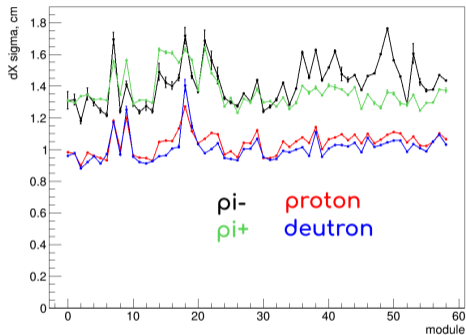
TOF-700



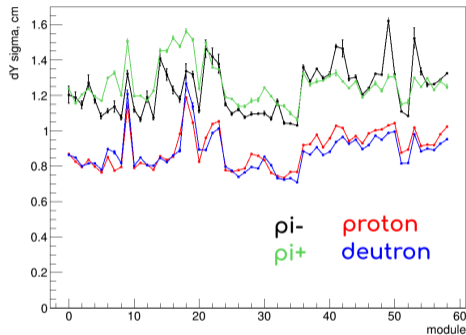
Rest inalignment is about 2-4 mm

TOF-700

dX sigma vs module

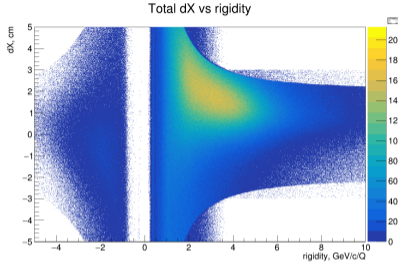


dY sigma vs module

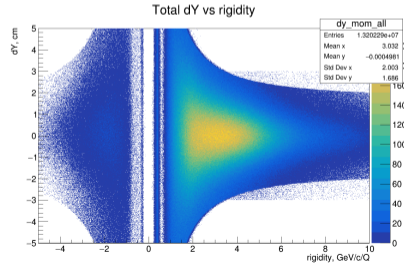
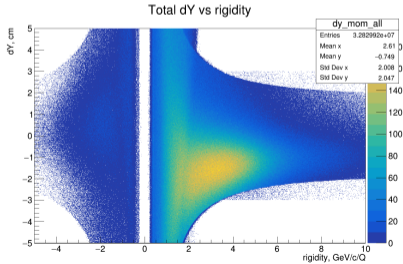
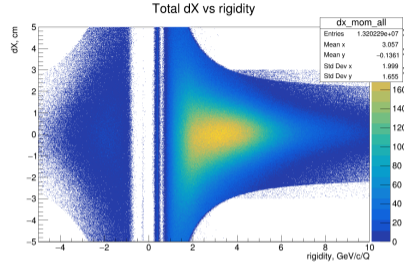


Average X resolution is about 1.0-1.5 cm
Average Y resolution is about 0.8-1.4 cm

before mom corrections

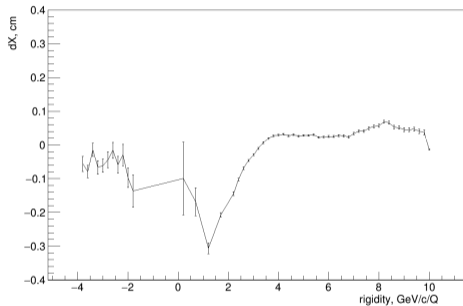


after mom corrections

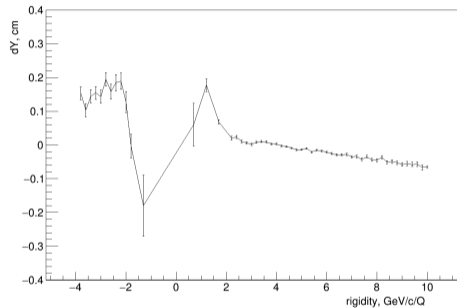


LCSC

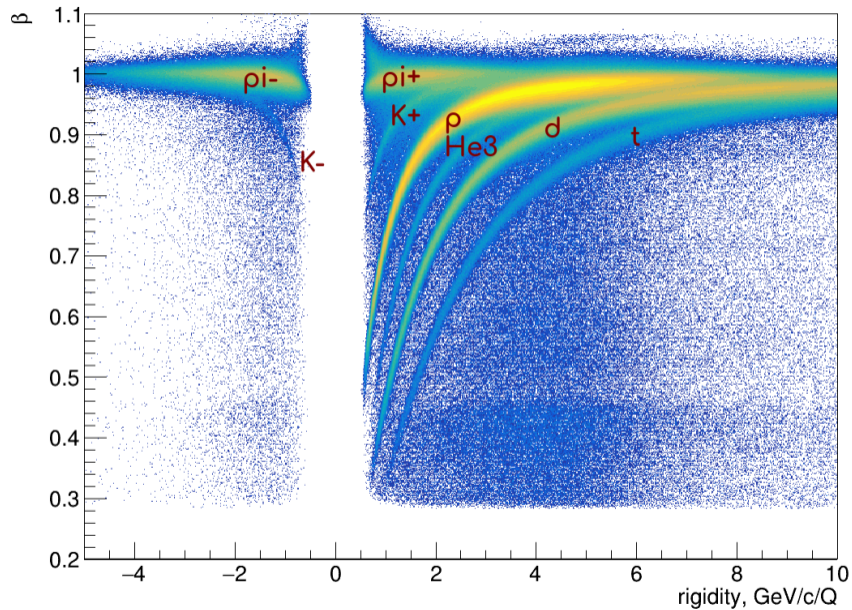
Mean Total dX vs rigidity



Mean Total dY vs rigidity



Rest inalignment is about 1-3 mm



Efficiency

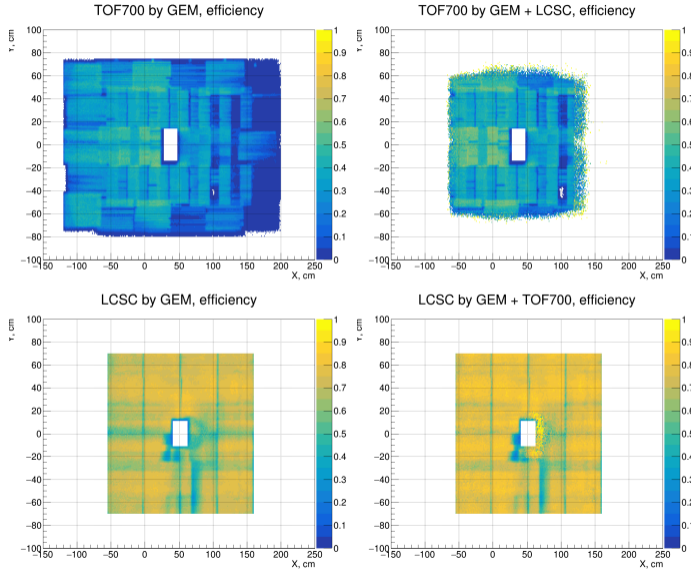
Soft conditions

- Selected good track extrapolated to TOF-700
- If track is in TOF-700 acceptance, denominator++
- If track has TOF-700 hit in $\pm 3 \cdot \sigma(\rho)$ range, numerator++

Hard conditions

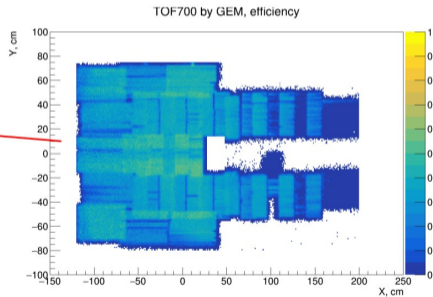
- Selected good track extrapolated to TOF-700
- If track is in TOF-700 acceptance, denominator++
- Track extrapolated to LCSC
- If track has LCSC hit in $\pm 3 \cdot \sigma(\rho)$ range and TOF-700 hit in $\pm 3 \cdot \sigma(\rho)$ range, numerator++

Efficiency



Efficiency

| | | | | | | | | |
|------------|---------------|----|-----|----------|------|---|-----|--|
| 7846 per.8 | Mixed trigger | Xe | 3.8 | CSi (2%) | 1720 | 0 | 170 | BT(1999)+CST1(229)+MBT(34)+CCT2: MBT: Before 200/After 100; Медленно поднимаем напряжение на GEM M7; Проблема с HV на ToF-700; N=995K. |
| 7870 per.8 | Mixed trigger | Xe | 3.8 | CSi (2%) | 1720 | 0 | 170 | BT(1999)+CST1(229)+MBT(34)+CCT2: MBT: Before 200/After 100; вывод ToF-700 на рабочий режим; N=878K. |



A way to prove the low efficiency of TOF-700 (very rough approach)

Number of hits per event

| Detector | Run-3800 (Ar) | Run-7900 (Xe) | Xe/Ar |
|------------------------|---------------|---------------|-------|
| GEM (per half station) | 9.51 | 75.40 | 7.9 |
| TOF-400 | 2.41 | 16.14 | 6.7 |
| TOF-700 | 8.45 | 20.62 | 2.4 |

Conclusion

- Time and coordinate corrections for **TOF-700** were done. Time resolution is about **140 ps**, coordinate resolution is about **1.0-1.5 cm**
- Coordinate corrections for **LCSC** were done. Coordinate resolution is about **1.0-1.5 cm**
- **Momentum dependence** for coordinate corrections and matching ranges evaluated for both subsystems
- Efficiency for **LCSC** estimated and it is on **quite high level**
- Efficiency for **TOF-700** estimated but it is **pretty low**
- **Problems with HV** on some modules were observed during the run on **TOF-700**

Thank you!

Backup

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 (07) HV2-24 Crate -2 ca -5 h -14 | 1 1-Б (09) π-1-23 b-1-24 | 2 1-А (13) π-2-1 b-2-2 | 3 1-Б (03) π-2-5 b-2-6 | 4 1-А (06) π-2-9 b-2-10 | 5 1-Б (08) π-2-13 b-2-14 | 6 1-А (12) π-2-17 b-2-18 | 7 1-Б (07) π-2-21 b-2-22 | 8 1-А (29) π-2-29 b-2-30 | 9 1-Б (43) π-1-19 b-1-20 | 10 1-А (13) π-1-13 b-1-14 | 11 1-Б (39) π-1-21 b-1-22 | 12 1-А (23) π-1-15 b-1-16 | 13 1-Б (27) π-1-23 b-1-24 | 14 1-А (38) π-1-17 b-1-18 | 114 1-Б (30) HV4-17 Crate -4 ca -15 h -94 |
| 115 2-А (03) HV1-17 Crate -1 ca -10 h -40 | 15 2-Б (15) π-3-7 b-3-2 | 16 2-А (16) π-3-3 b-3-4 | 17 2-Б (17) π-3-5 b-3-6 | 18 2-А (18) π-3-7 b-3-8 | 19 2-Б (19) π-3-9 b-3-10 | 20 2-А (20) π-3-11 b-3-12 | 21 2-Б (21) π-3-13 b-3-14 | 22 2-А (40) π-3-21 b-3-22 | 23 2-Б (42) π-3-15 b-3-16 | 24 2-А (23) π-3-21 b-3-22 | 25 2-Б (38) π-3-17 b-3-18 | 26 2-А (47) π-3-19 b-3-20 | 116 2-А (22) HV3-24 Crate -3 ca -9 h -86 | | |
| 117 1-А (02) HV2-23 Crate -2 ca -5 h -39 | 27 1-Б (00) π-2-27 b-2-28 | 28 1-А (02) π-2-1 b-2-8 | 29 1-Б (06) π-2-7 b-2-8 | 30 1-А (08) π-2-11 b-2-12 | 31 1-Б (07) π-2-15 b-2-16 | 32 1-А (14) π-2-19 b-2-20 | 33 1-Б (07) π-2-23 b-2-24 | 34 1-А (30) π-2-31 b-2-32 | 35 1-Б (30) π-1-3 b-1-4 | 36 1-А (27) π-1-1 b-1-2 | 37 1-Б (37) π-1-5 b-1-6 | 38 1-А (27) π-1-9 b-1-8 | 39 1-Б (28) π-1-9 b-1-10 | 40 1-А (24) π-1-11 b-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 (37) 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

$dX(dY)$ vs momentum

