Performance evaluation of the upgraded BM@N setup for the strangeness production studies

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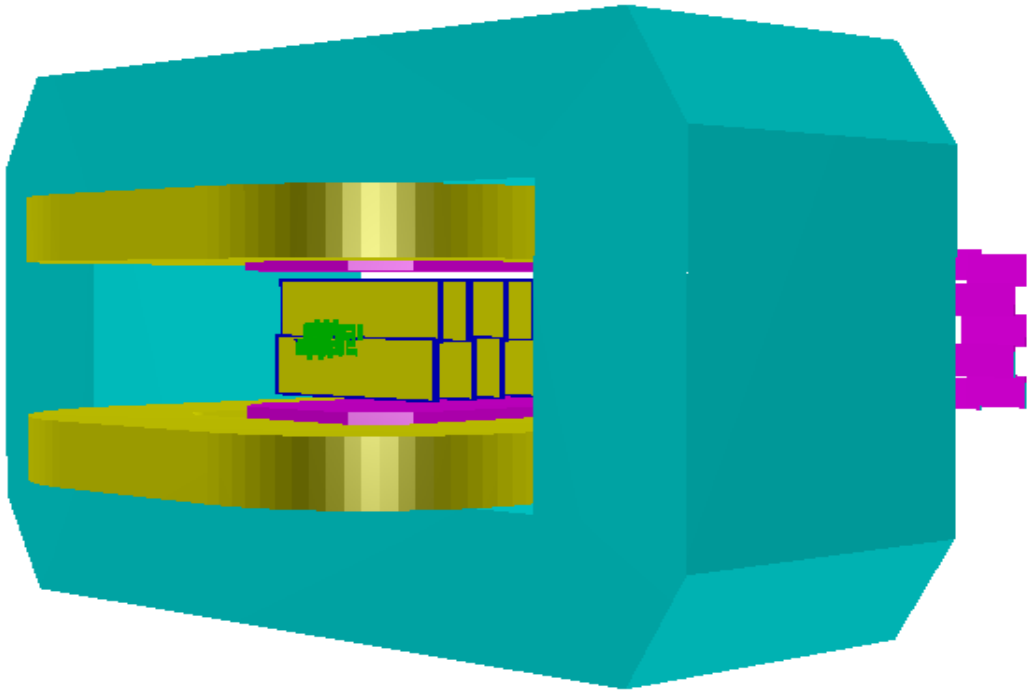
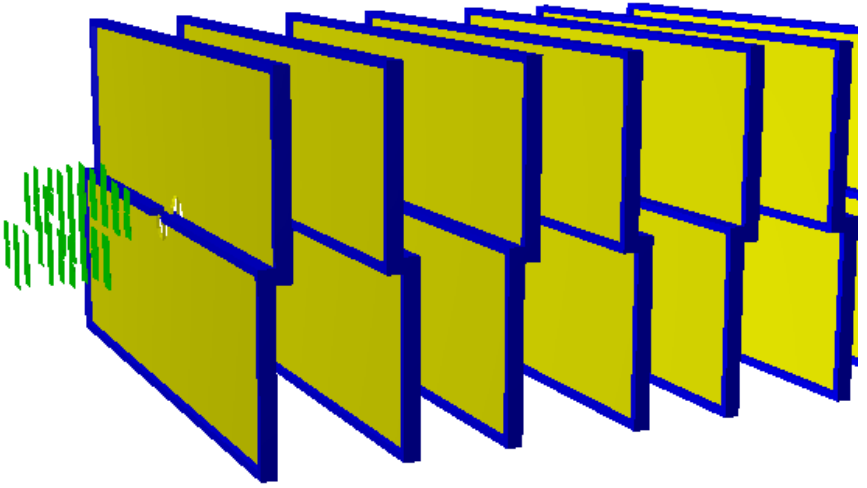
Outline

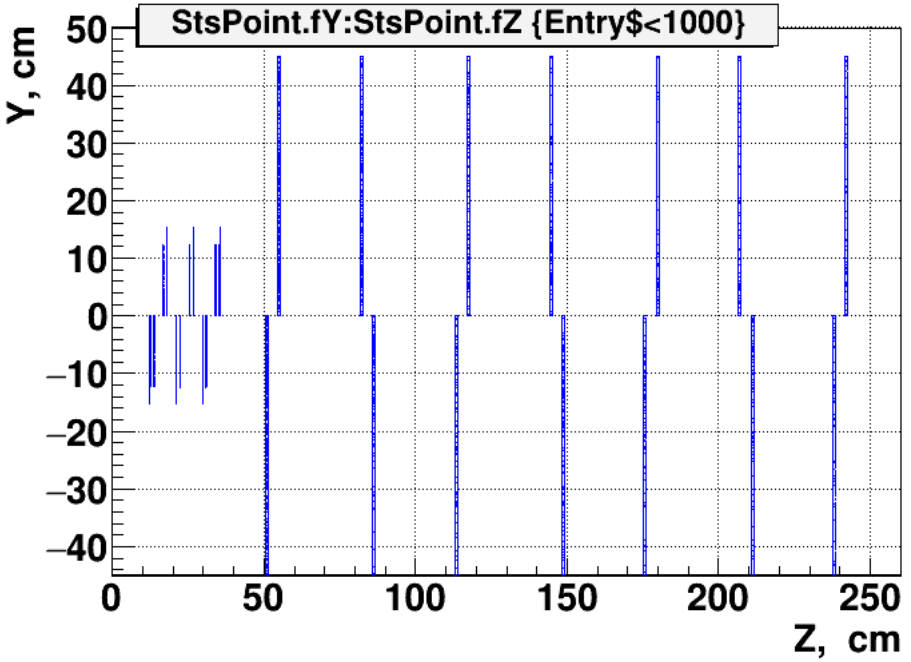
1. **BM@N tracker performance in future run 8 on *Kr* beam**
   - ✓ BM@N geometry and Tracker performance
   - ✓ Shifted configuration and Λ reconstruction
2. **BM@N tracker performance with large-acceptance STS**
   - ✓ BM@N configuration
   - ✓ Slow and fast digitizers in GEMs and Λ reconstruction
   - ✓ Matching GEMs with TOF
   - ✓ PID in TOF
   - ✓ Ξ^- and ${}_{\Lambda}H^3$ reconstruction and phase space

BM@N tracker performance in future run 8 on Kr beam

Detector geometry



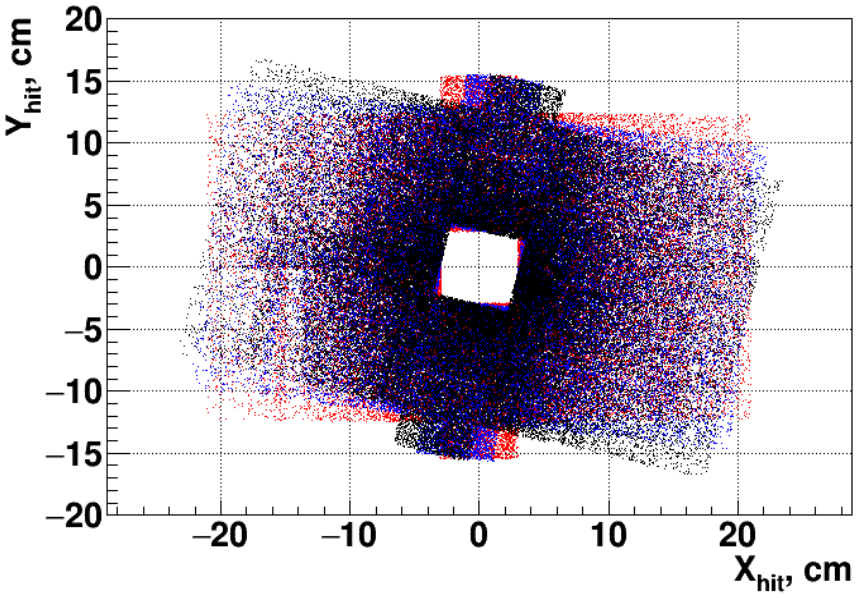




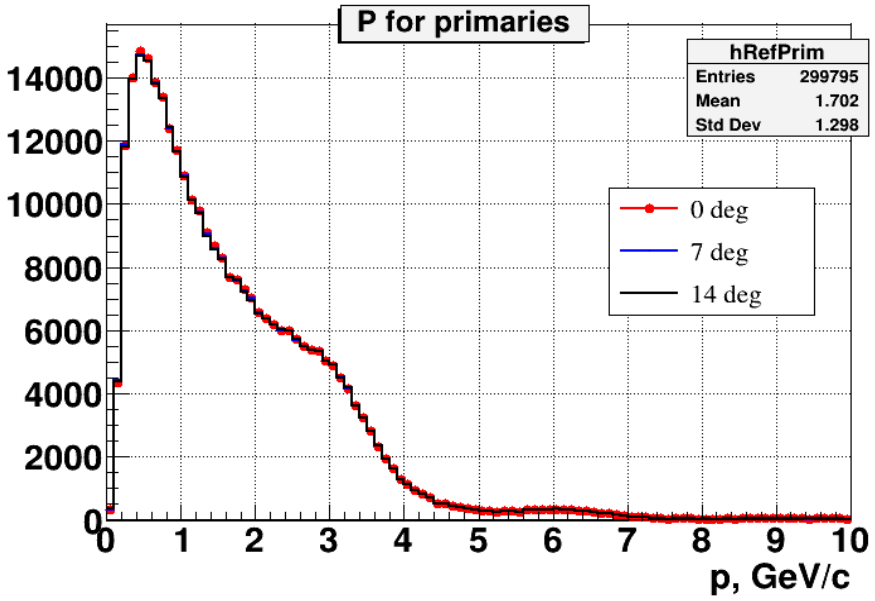
Data set

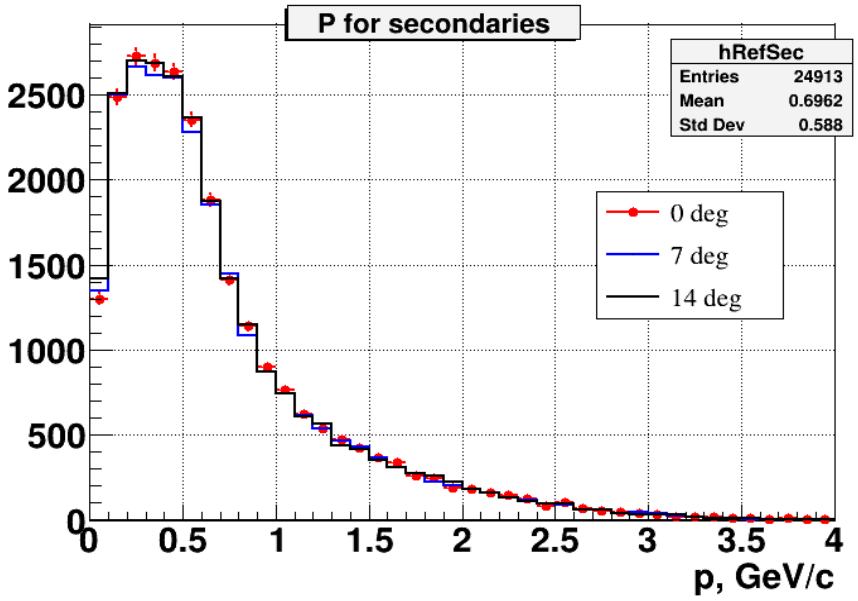
Detectors:	Si (3 stations) + GEMs (7 stations)
Generator:	DCM-QGSM, Kr+Pb at T_0 = 2.36A GeV, min. Bias
Magnetic field:	B = 0.57 T
Production rate:	Λ – 4883 within 50 cm of primary vertex, Ξ^- – 30 (10k events)

Tracker performance

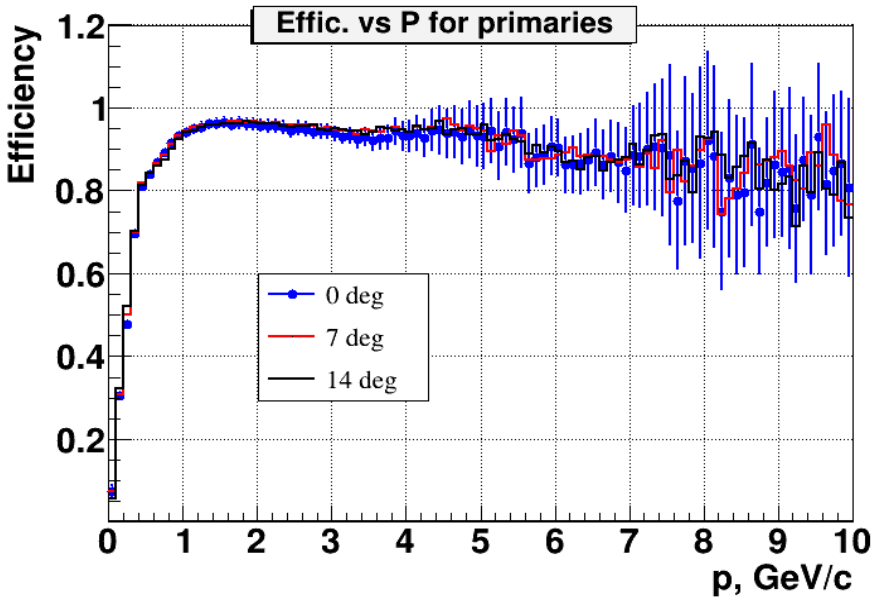


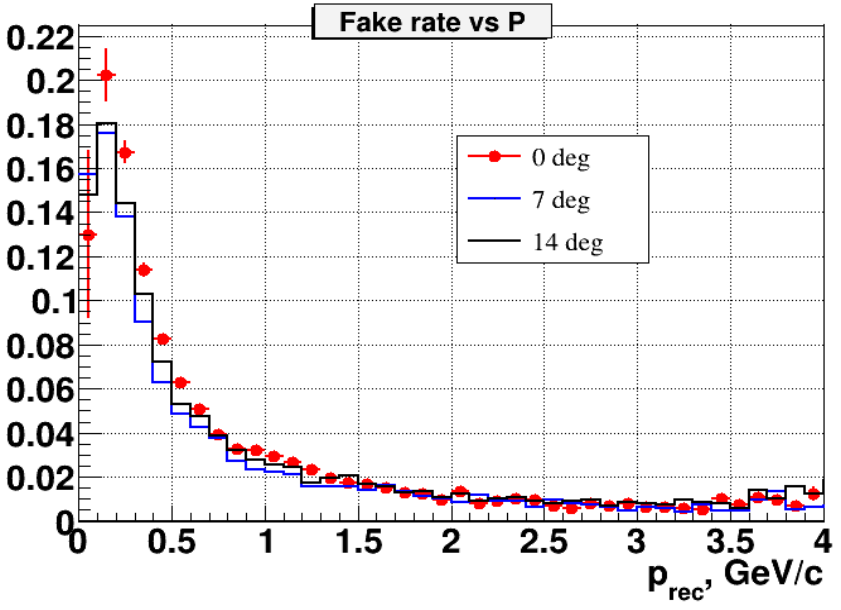
Reconstructable tracks: ≥ 4 hits in sequence





Tracker performance

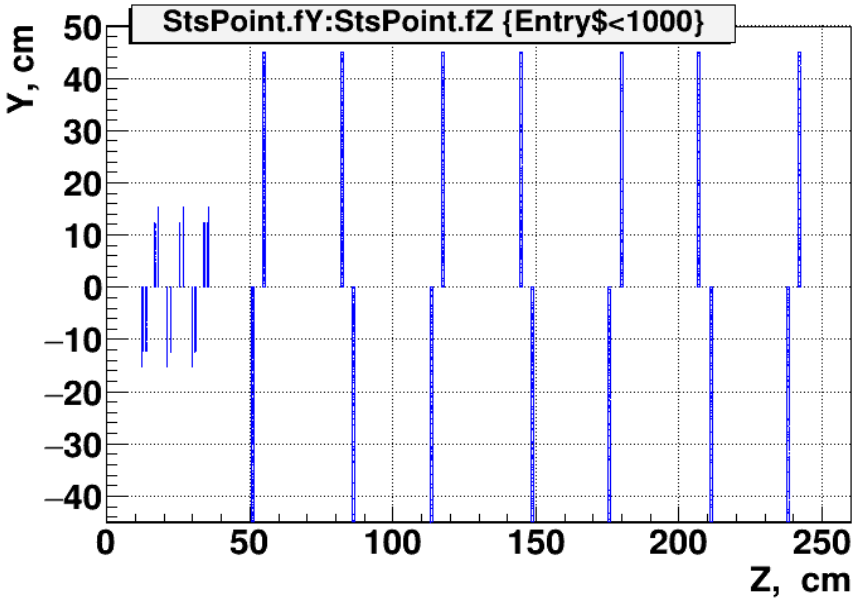


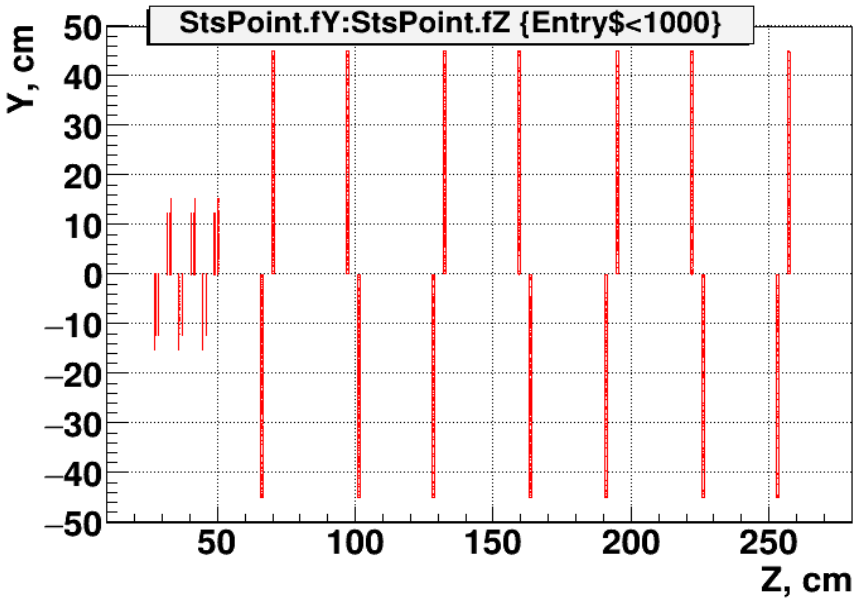


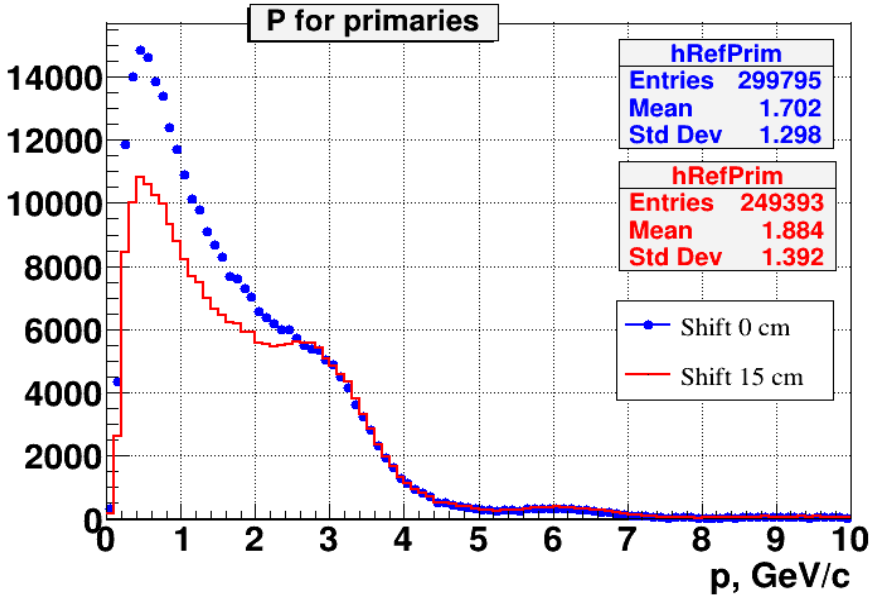
Reconstructable tracks: ≥ 4 hits in sequence

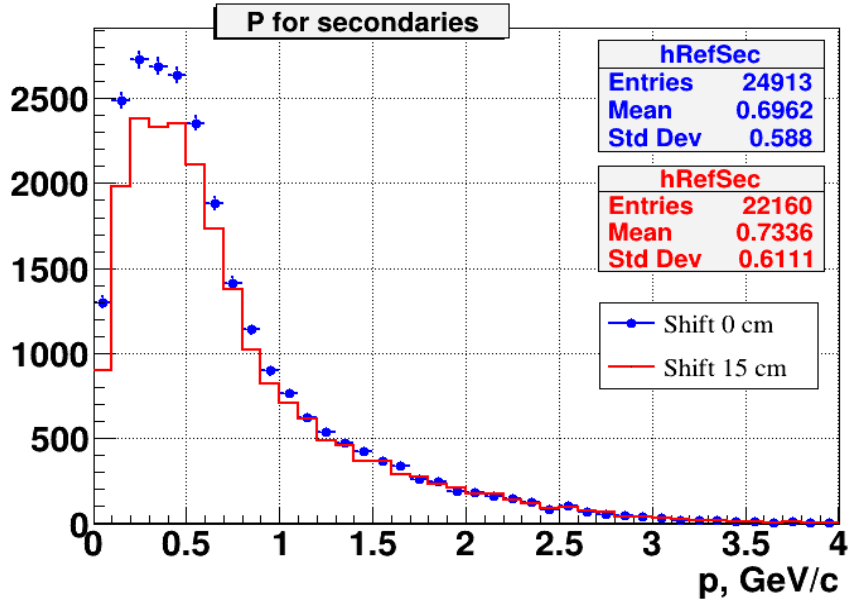
Shifted configuration

Reconstructable tracks: ≥ 4 hits in sequence



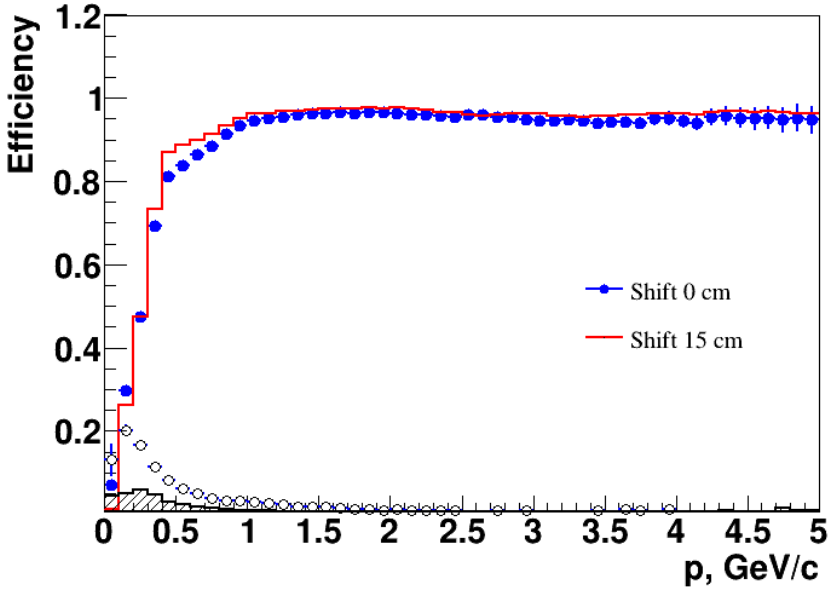


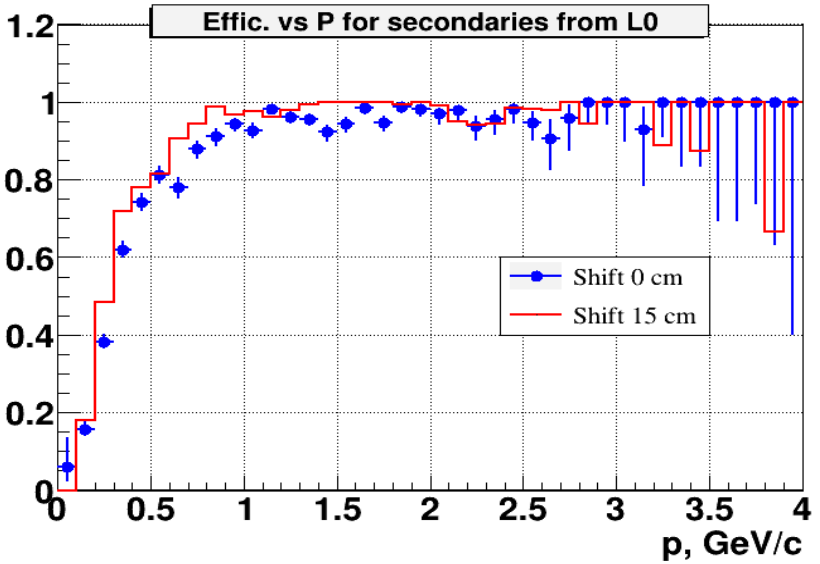


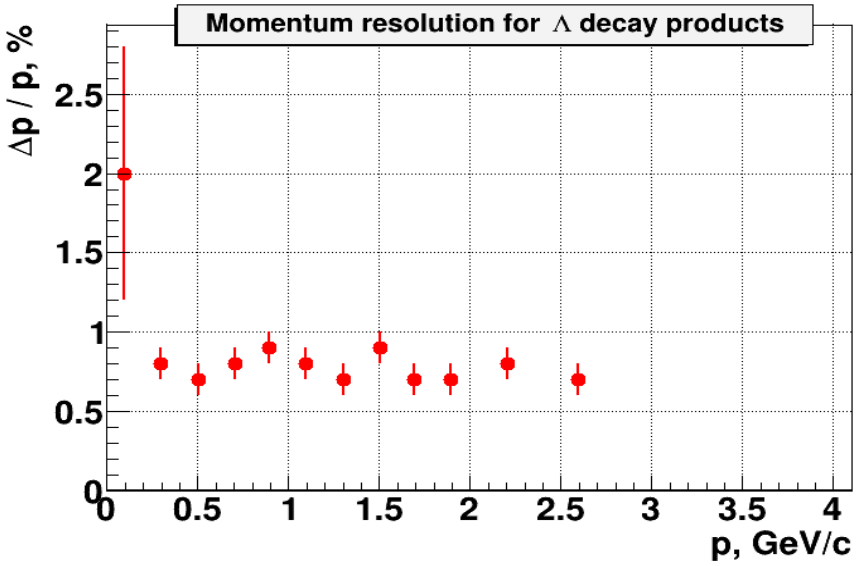


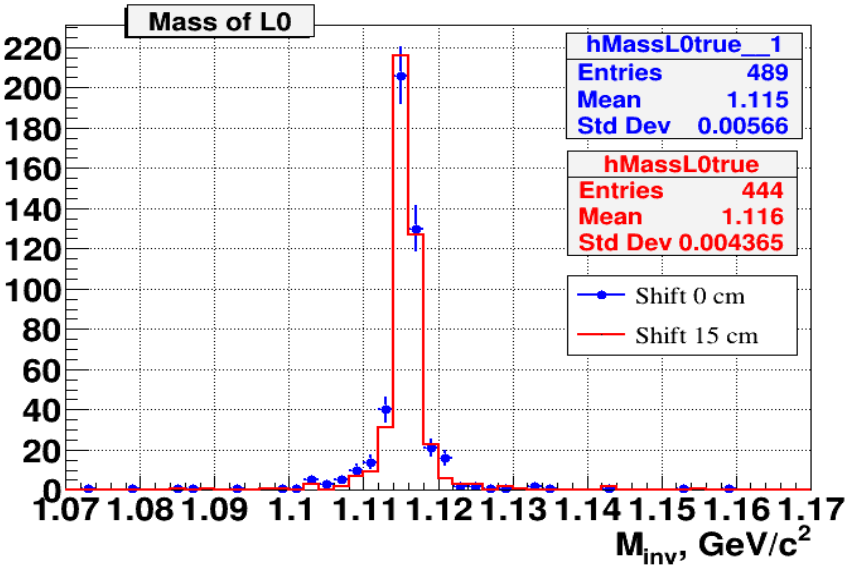
Shifted configuration

Reconstructable tracks: ≥ 4 hits in sequence



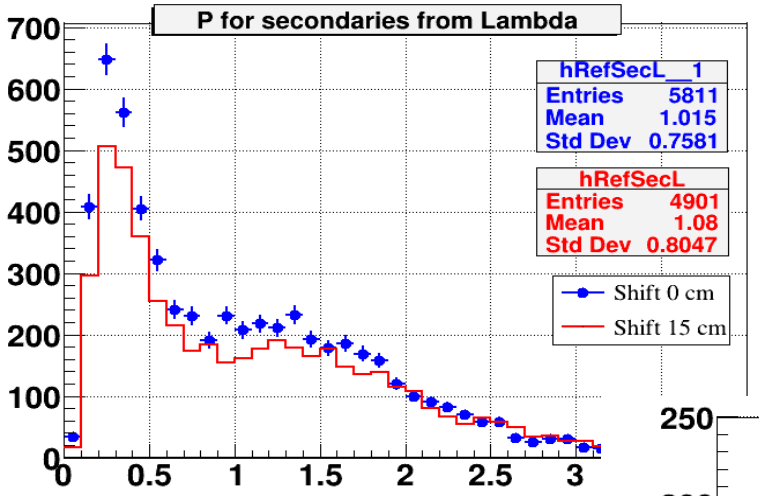


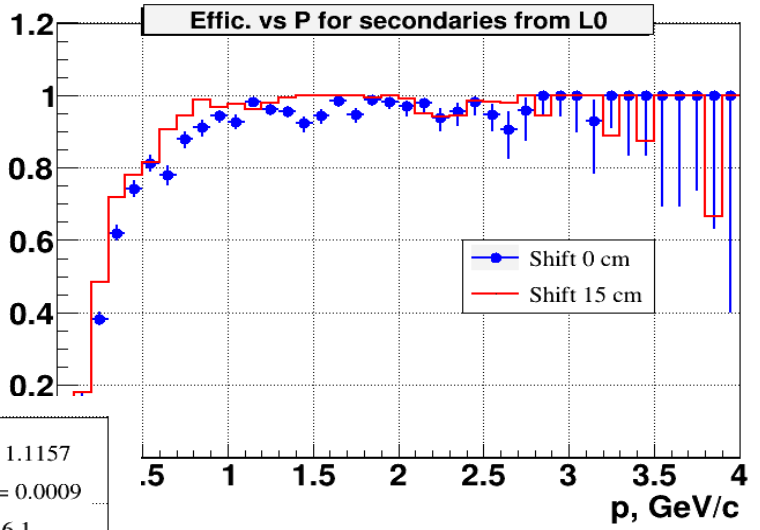


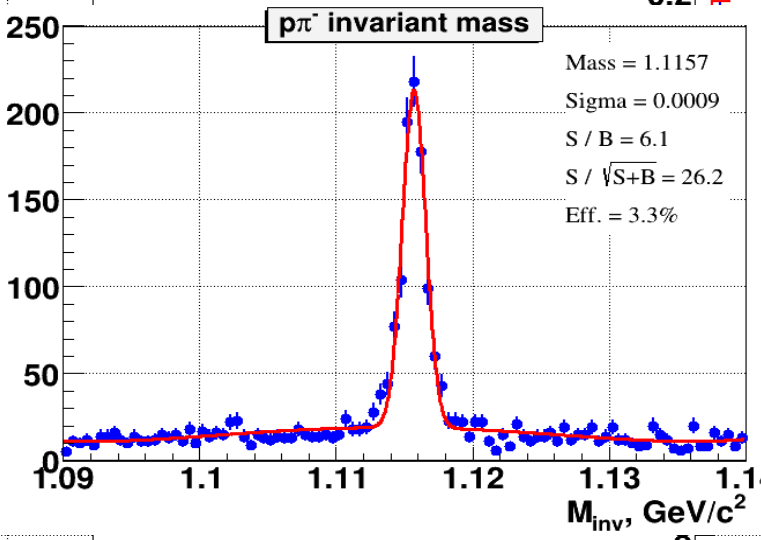


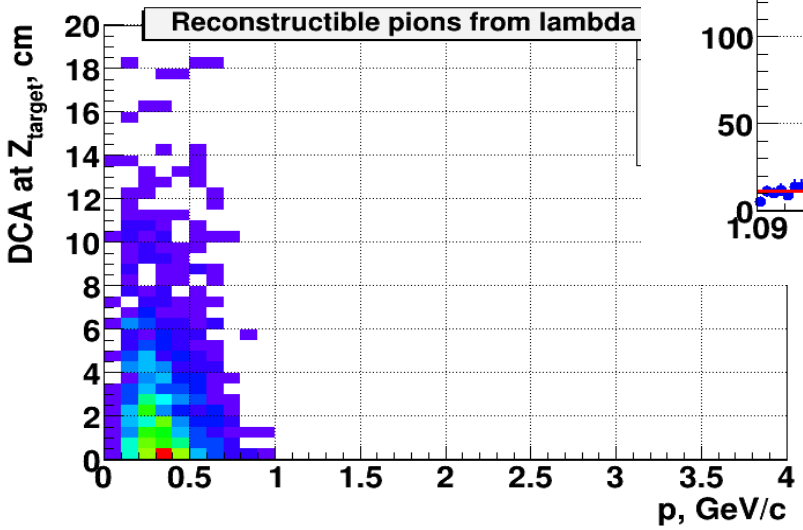
Shifted configuration

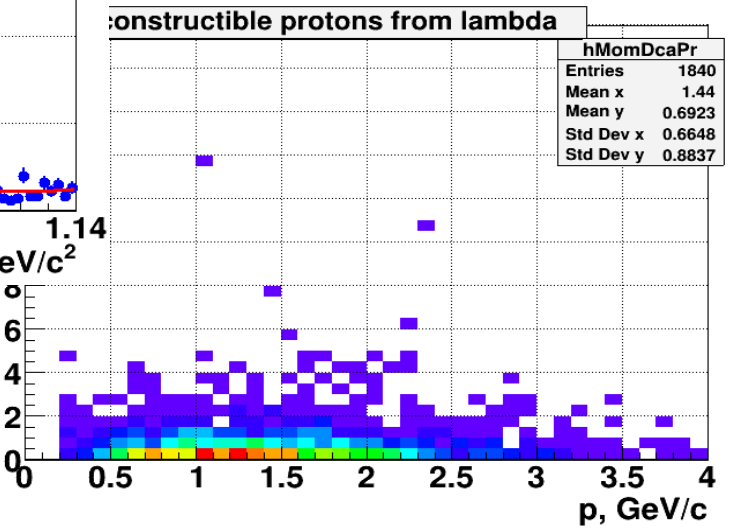
Reconstructable tracks from Λ: ≥ 4 hits in sequence





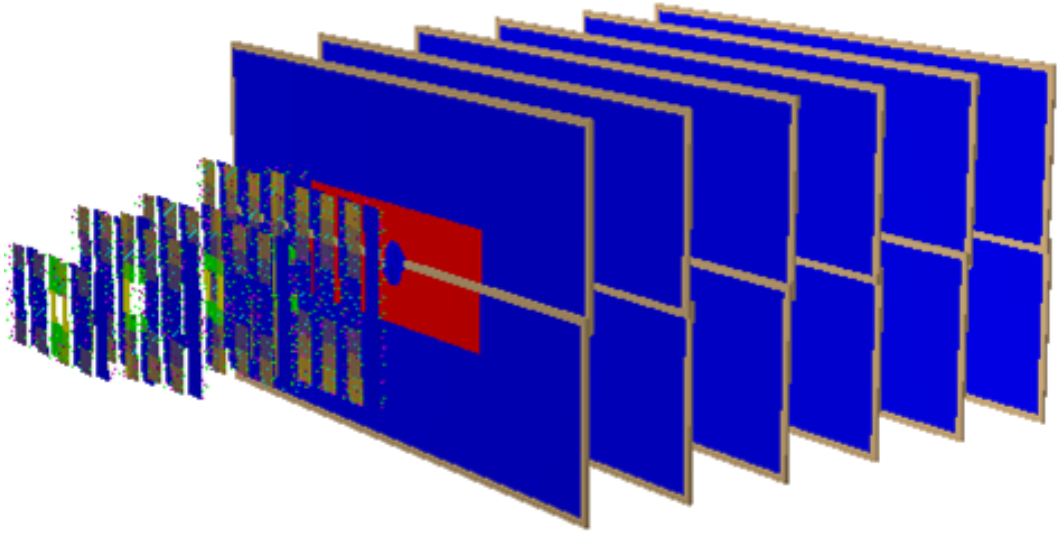


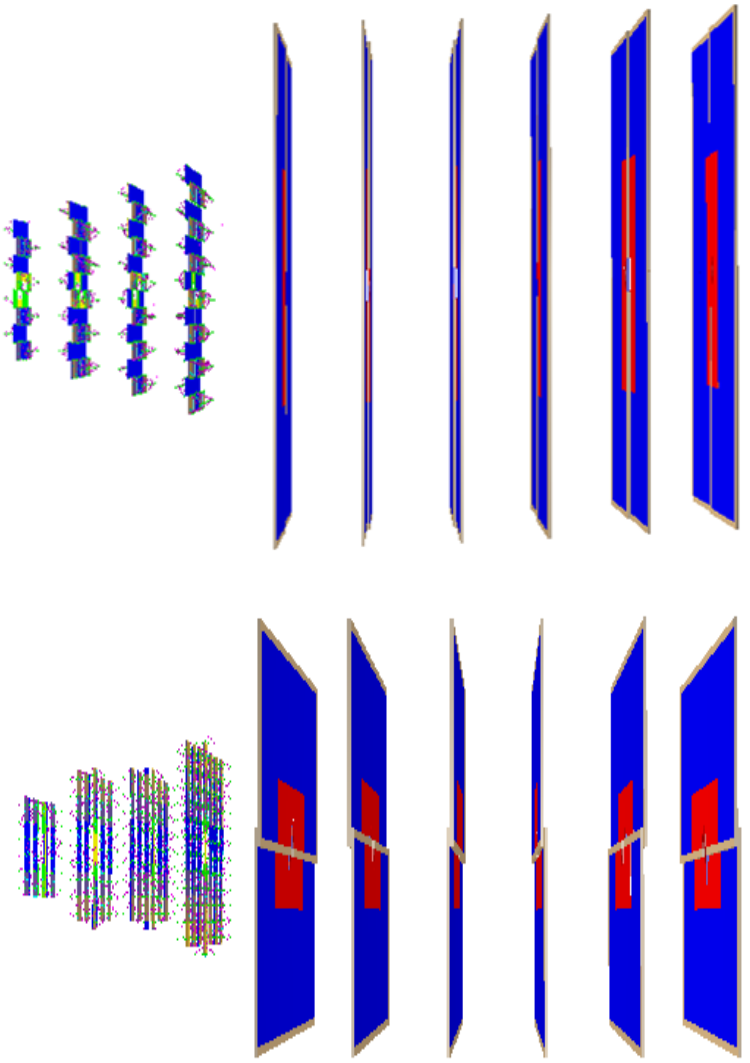




BM@N tracker performance: future configuration with large-acceptance STS

Central detector: STS+GEMs



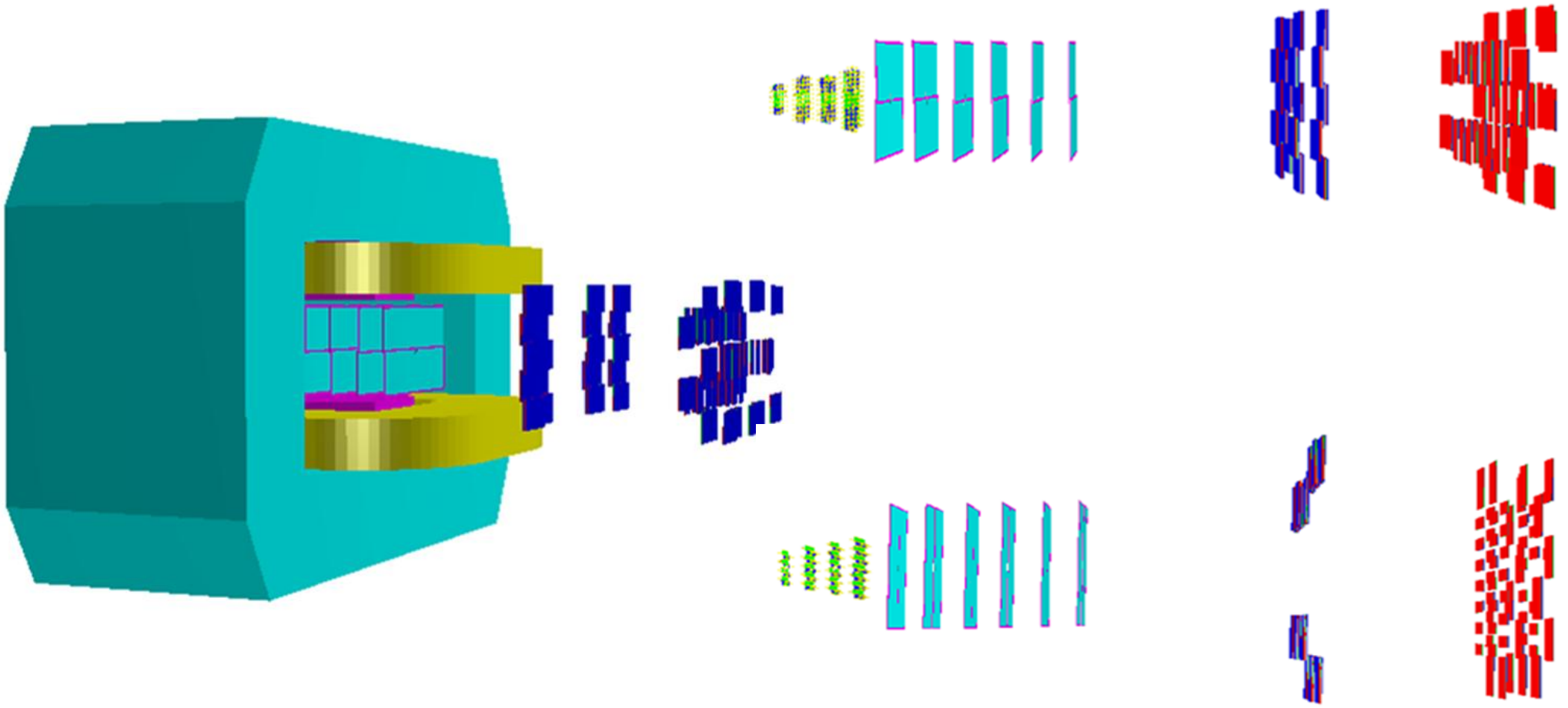


Field: ~0.8 T

Stations (target at 0):

Si	30 cm	50 cm	70 cm	90 cm	(version “f” from E.Lavrik)		Beam hole 6x8 cm
GEMs	120 cm	150 cm	180 cm	210 cm	240 cm	270 cm	Beam hole R = 5.75 cm

Detector geometry with TOF



Stations (target at 0):

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GEMs	120 cm	150 cm	180 cm	210 cm	240 cm 270 cm	Beam hole R = 5.75 cm

First results are published

particles

MDPI

Article

Upgrading the Baryonic Matter at the Nuclotron Experiment at NICA for Studies of Dense Nuclear Matter

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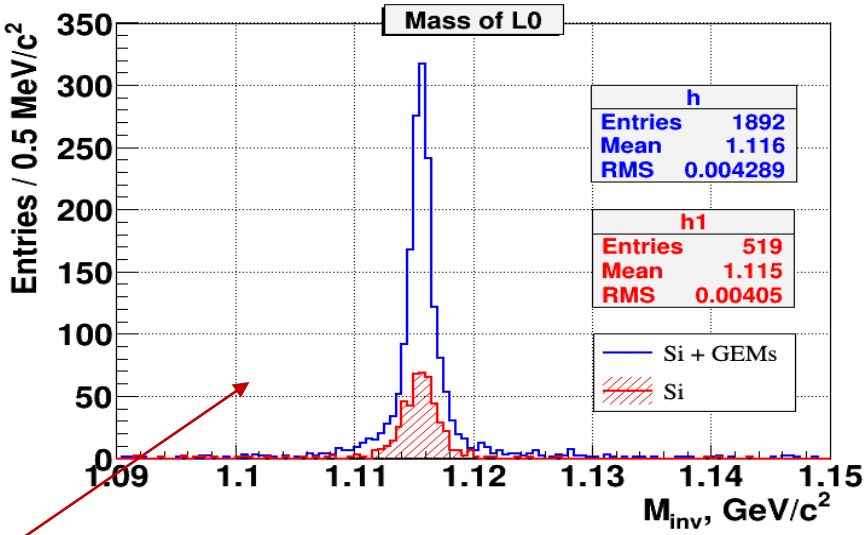
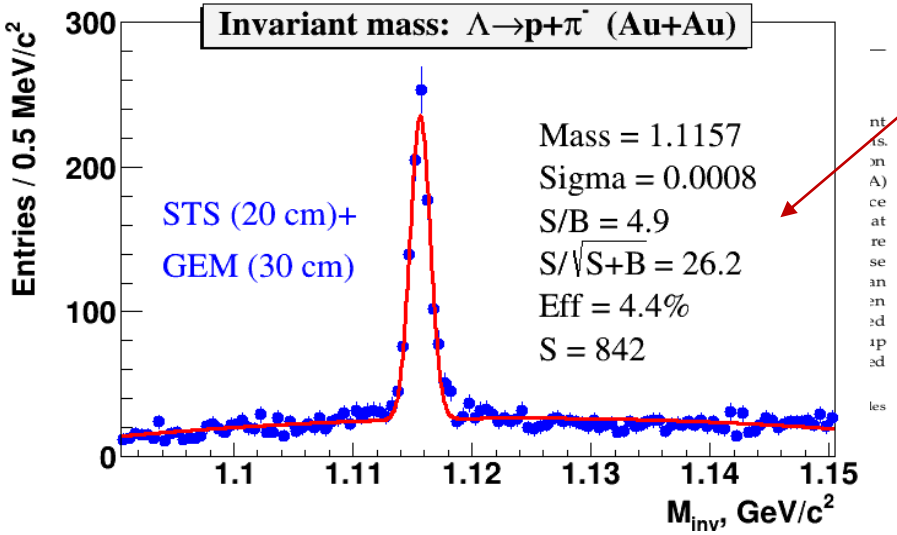
check for updates

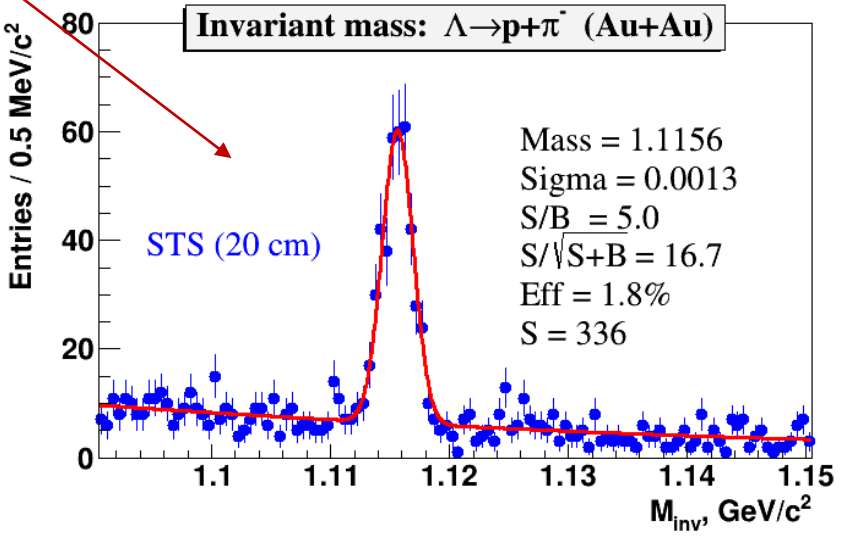
Abstract: The Nuclotron at the Joint Institute for Nuclear Research in Dubna can deliver gold beams with kinetic energies between 2 and 4.5 A GeV. In heavy-ion collisions at these energies, it is expected that the nuclear fireball will be compressed by up to approximately four times the saturation density. This offers the opportunity to study the high-density equation-of-state (EOS) of nuclear matter in the laboratory, which is needed for our understanding of the structure of neutron stars and the dynamics of neutron star mergers. The Baryonic Matter at the Nuclotron (BM@N) experiment will be upgraded to perform multi-differential measurements of hadrons including (multi-) strange hyperons, which are promising probes of the high-density EOS, and of new phases of quantum chromodynamic (QCD) matter. The layout of the upgraded BM@N experiment and the results of feasibility studies are presented.



Reconstructed Λ

Selected Λ (maximum significance)





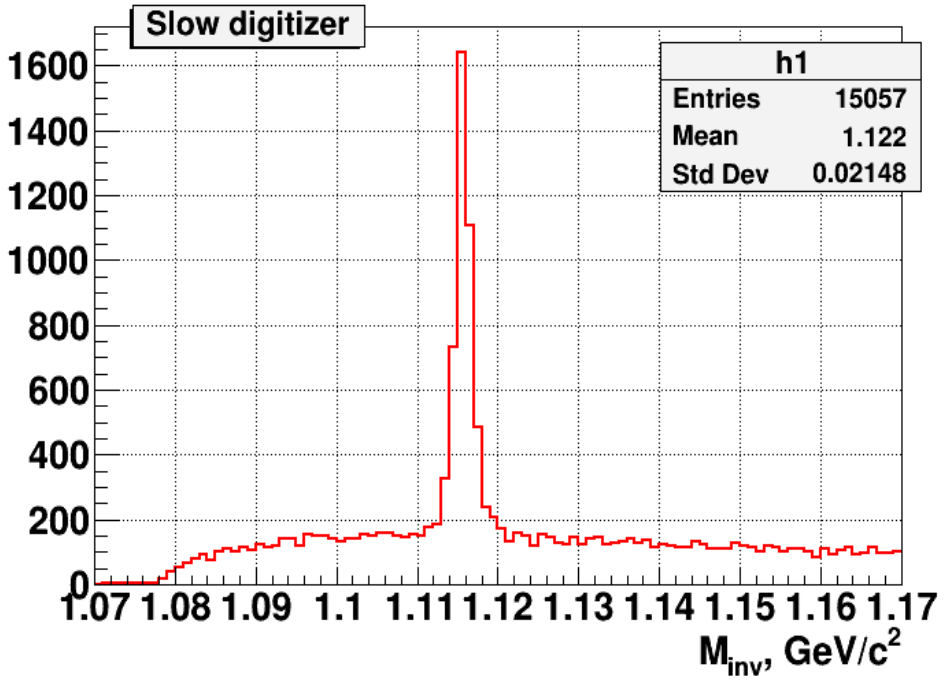
Data set

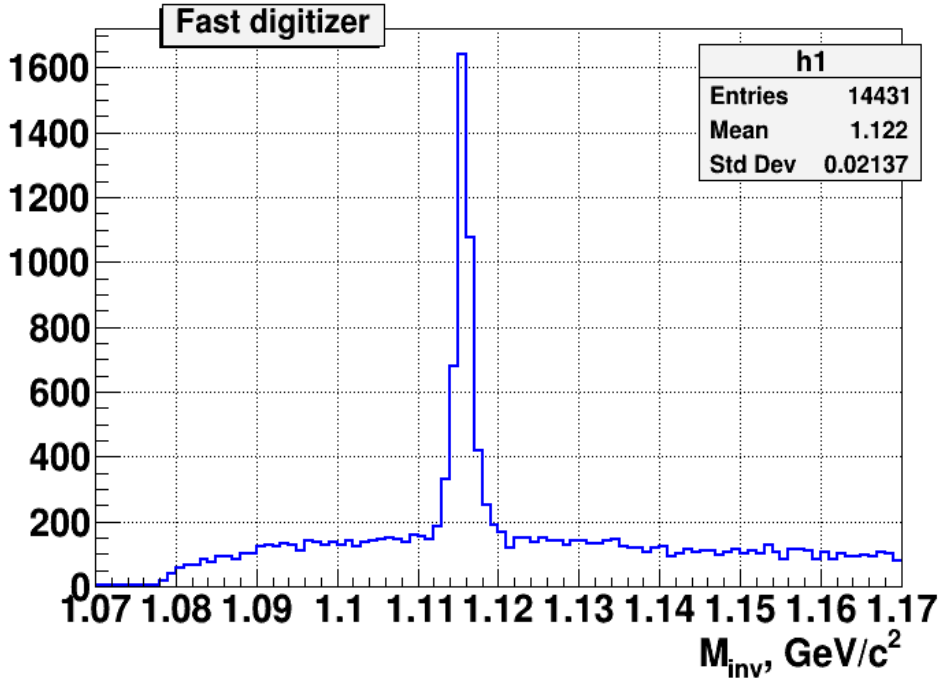
Detectors:	STS + GEMs + TOF
Magnetic field:	B = 0.8 T
PID:	*beta* in TOF
Generator:	PHQMD (from V.Kireyeu), 0.5M events, Au+Au at T_0 = 4A GeV, b = 0-5 fm
Production rate :	Ξ^- – 529, ${}_{\Lambda}H^3$ – 1689 (per 10k events)
	Ω^- - 59 (per 1M)

Λ reconstruction

with slow and fast digitizers in GEMs

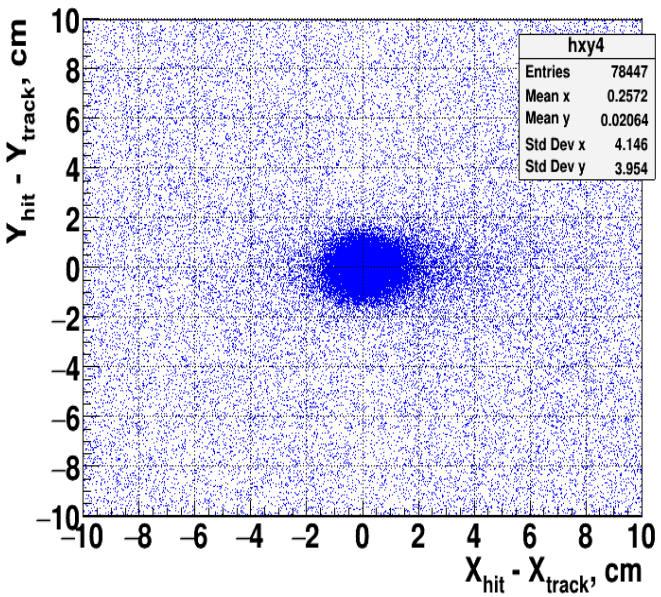
(Factor of 3.9 decrease in processing time)

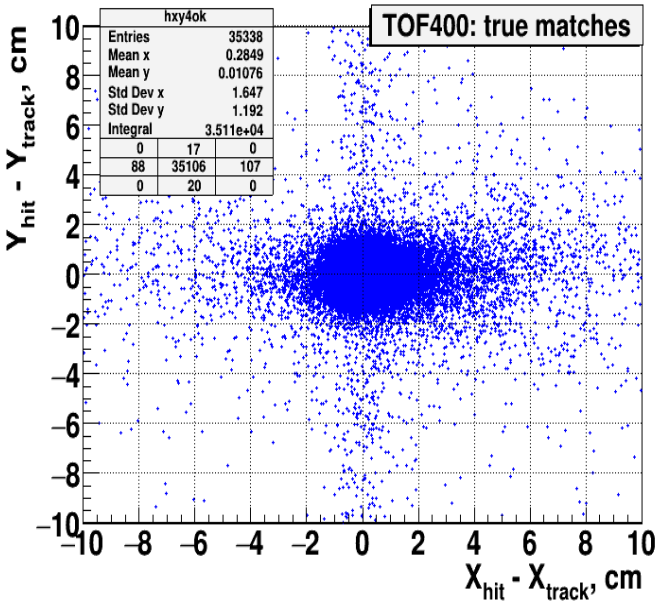


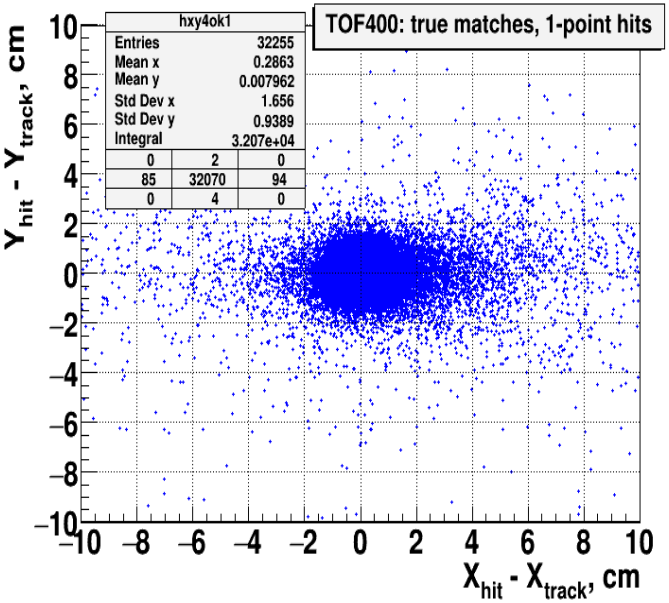


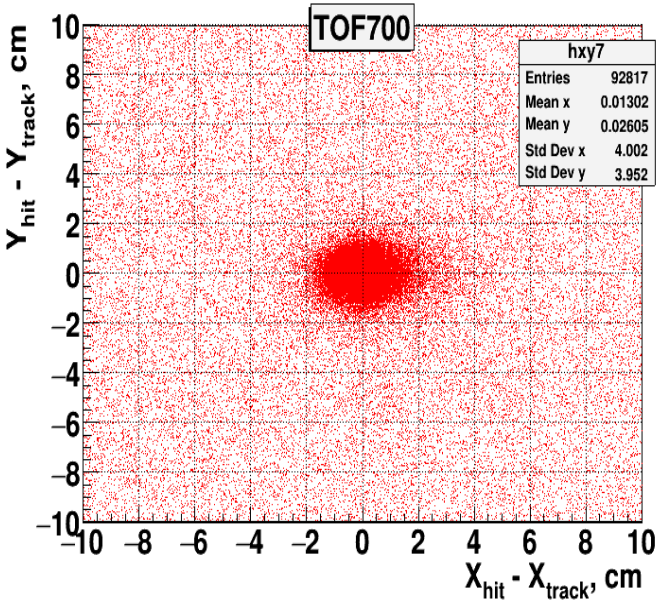
Cuts: $\chi^2_p > 5$, $\chi^2_\pi > 5$, path > 5 cm, $\chi^2_\Lambda < 20$, $\text{angle}_\Lambda < 0.1$

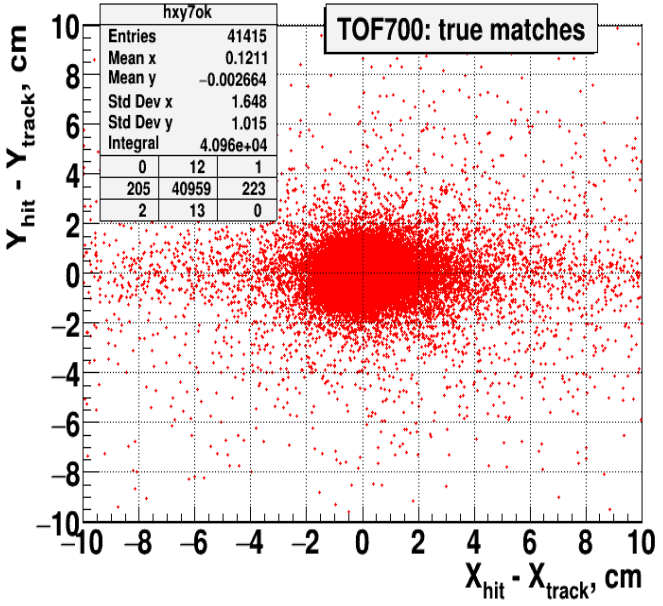
Matching with TOF



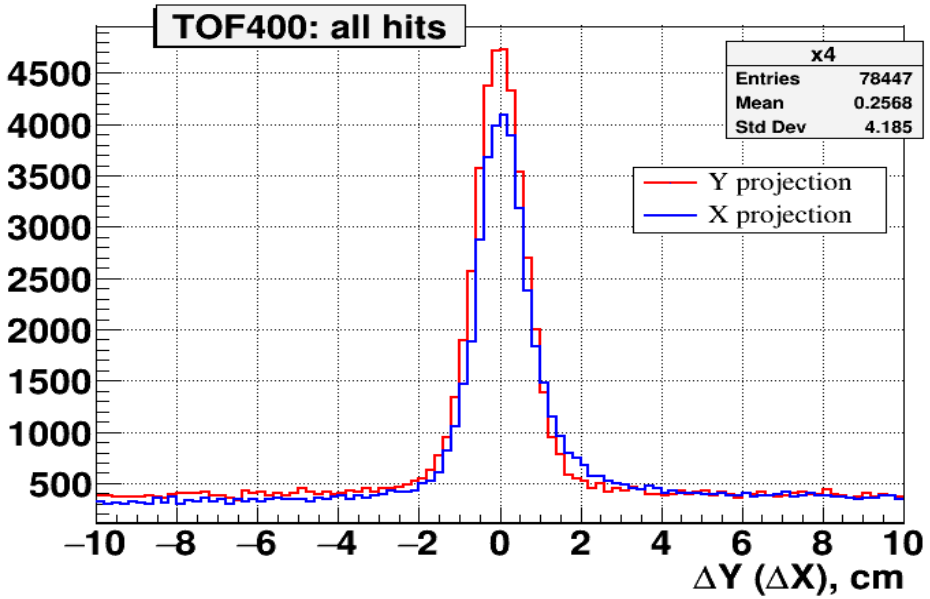


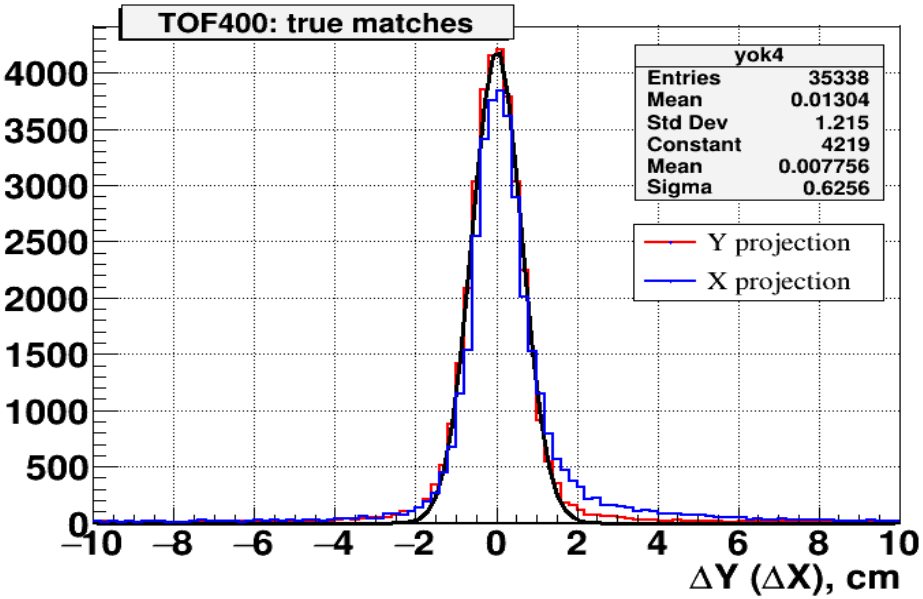


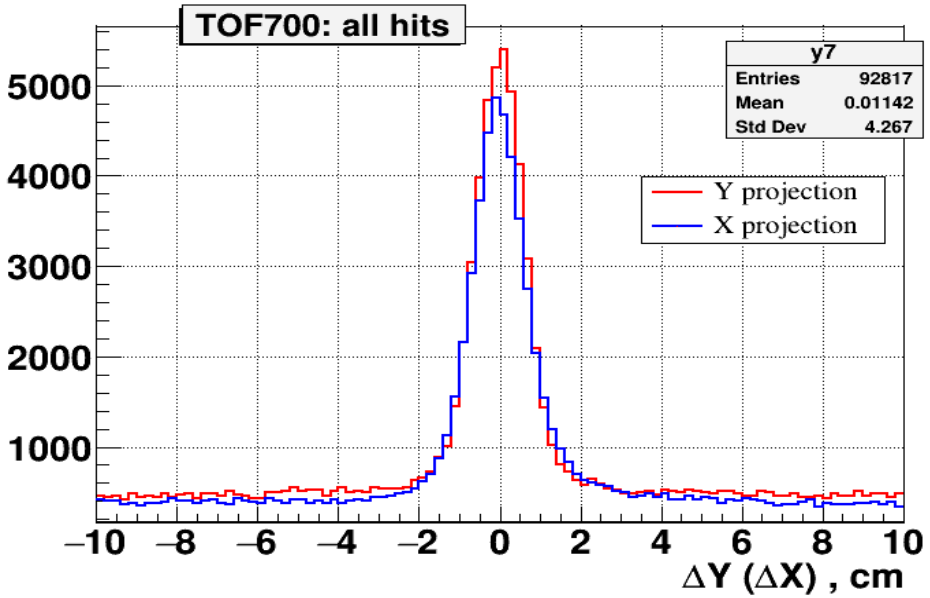


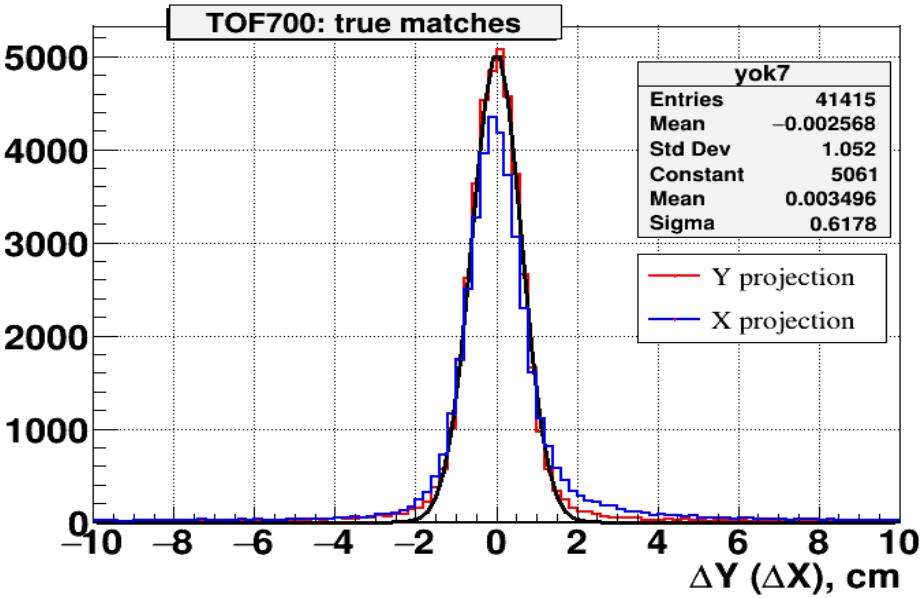


Matching with TOF

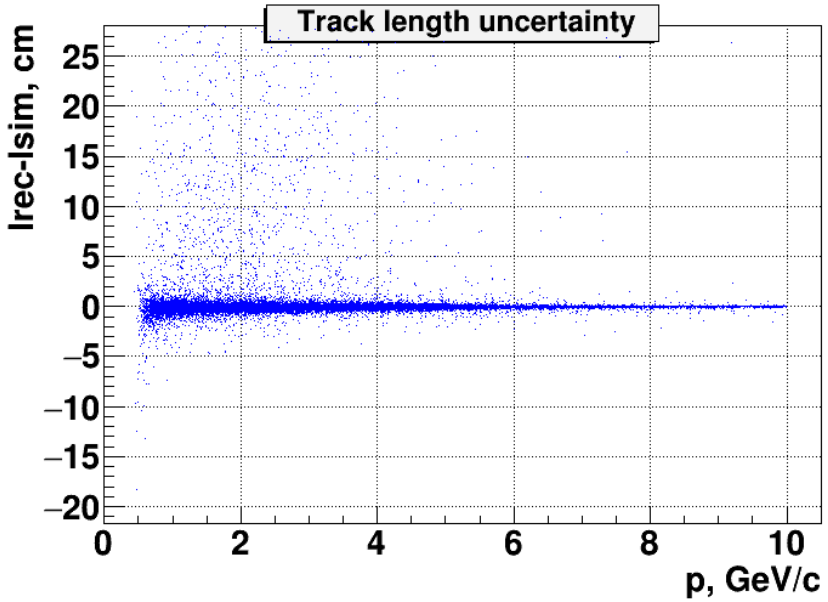


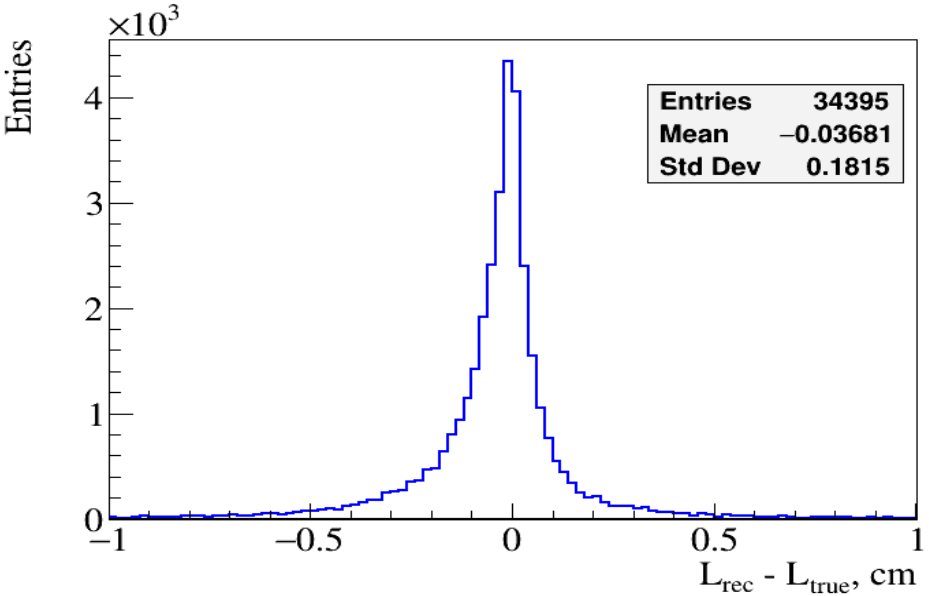


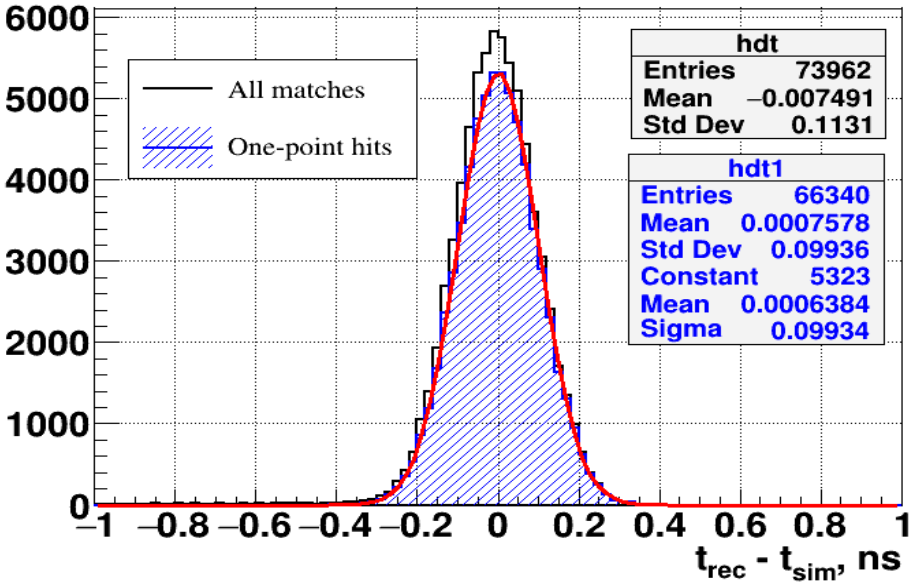


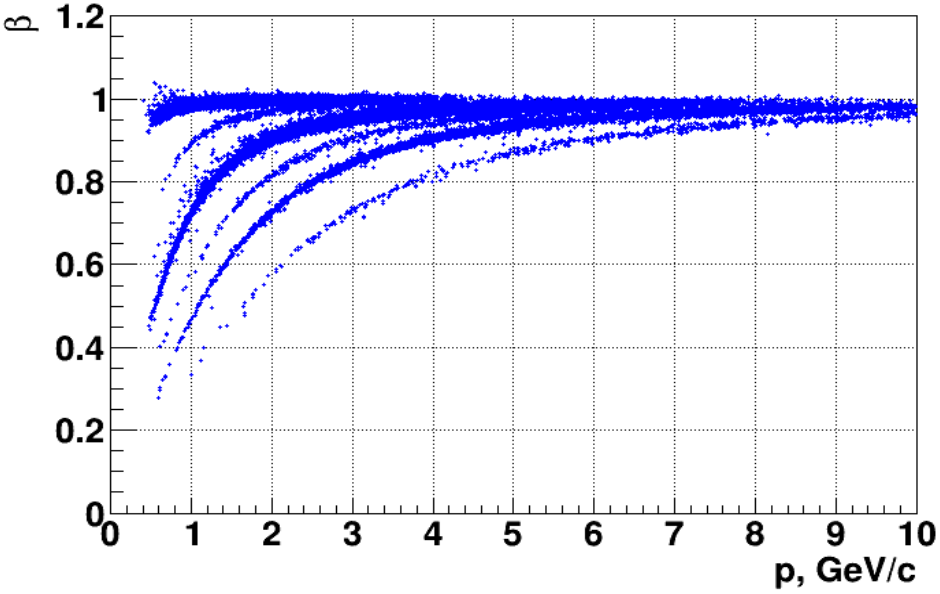


Matching with TOF

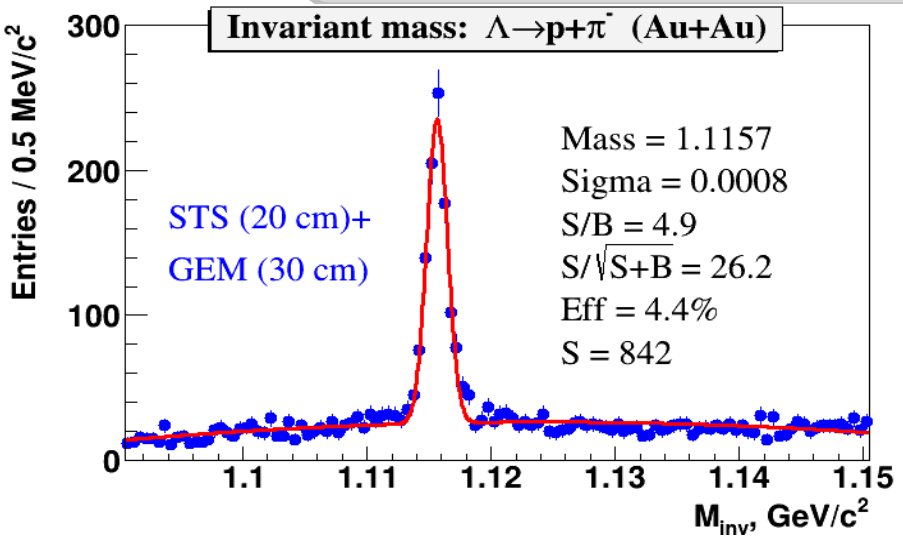


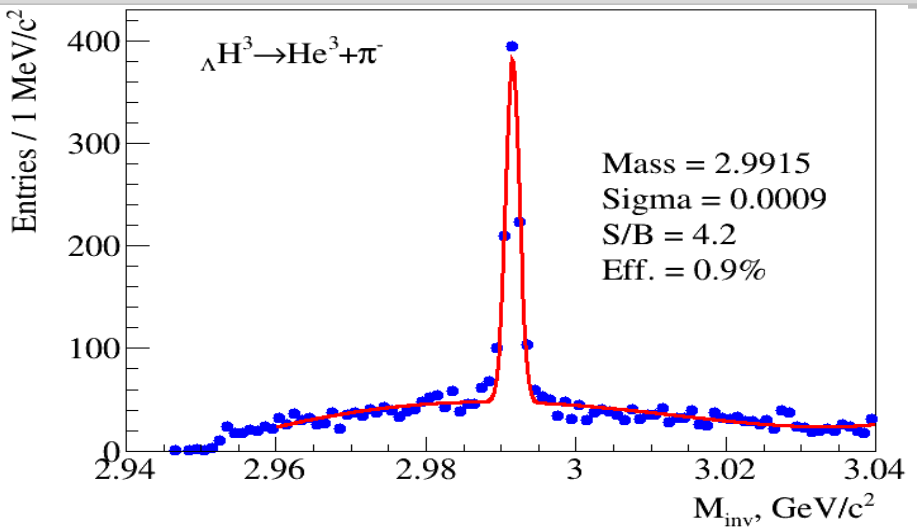


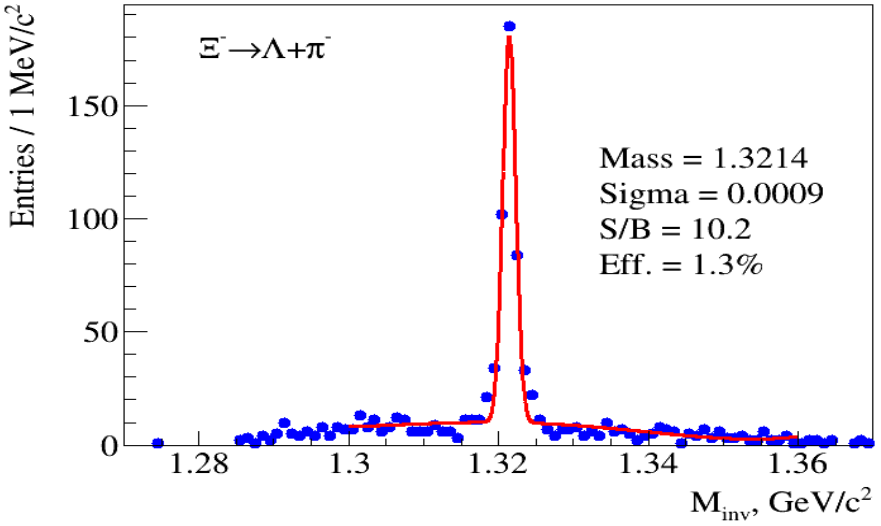


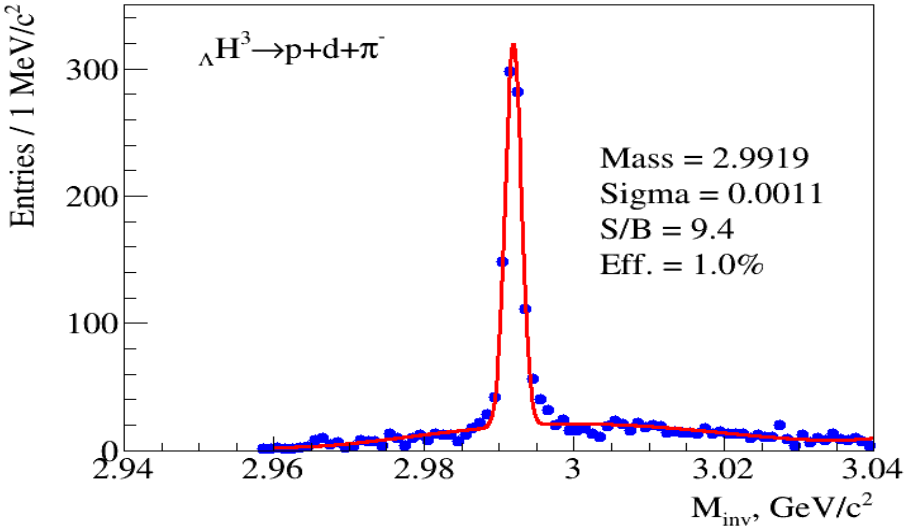


Ξ^- and ${}_{\Lambda}H^3$ reconstruction





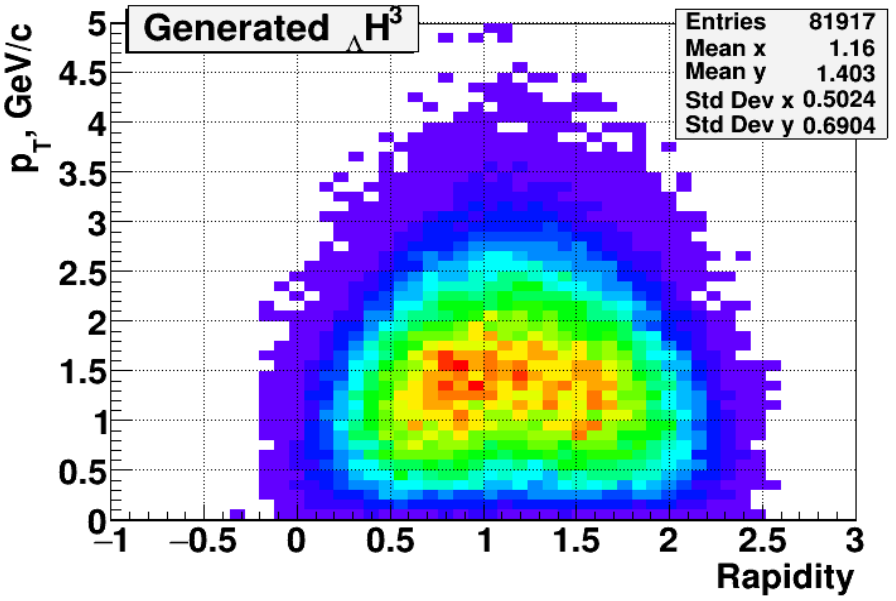


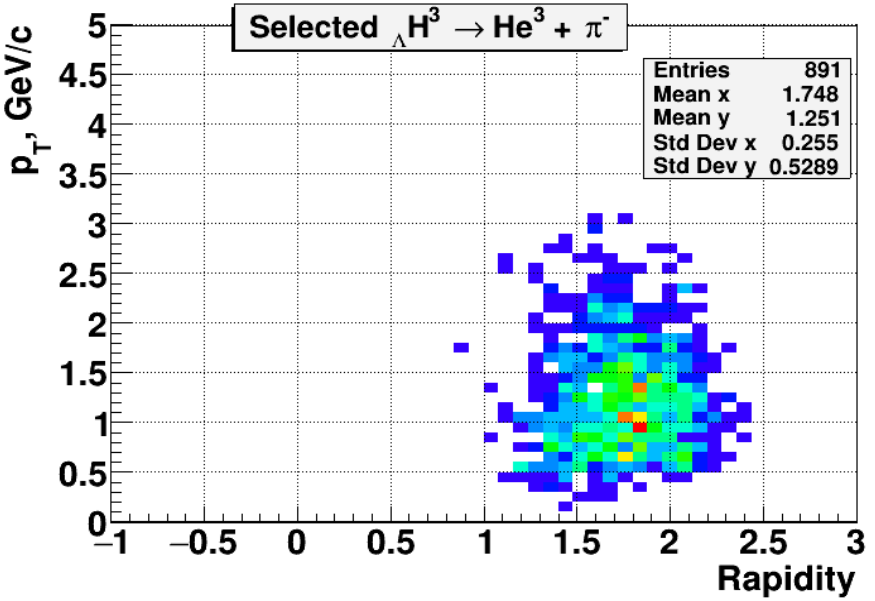


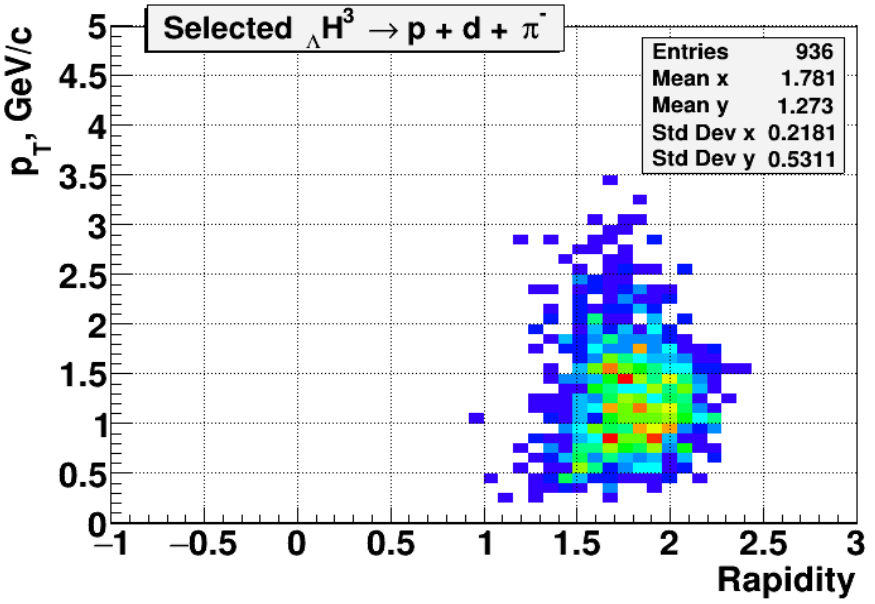
Efficiency = (reconstructed, identified and selected *Hyp*) / (all generated *Hyp* after GEANT within 50 cm of PV)

– ***includes branching ratios, detector acceptance and reconstruction efficiency***

${}_{\Lambda}H^{3}$ phase space







Summary and outlook

- ✓ BM@N central tracker configuration in future run8 was tested for simulated events in order to do some optimization.
- ✓ Up-to-date detector geometry should be checked with passive material added. Next: look for K^0s and Ξ^-.
- ✓ BM@N central tracker performance with wide-aperture silicon tracker was checked for central Au+Au simulated events in order to see its capability for rare probe reconstruction: Ξ^- and ${}_{\Lambda}H^3$. Next: look for Ω^-
- ✓ Both configurations could benefit from track reconstruction improvement for low-pt tracks.