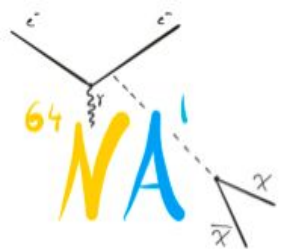
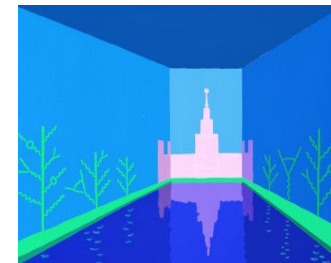


Reconstruction of tracks in the na64 experiment



NA64



The NA64 experiment (known as P348 at the proposal stage) is a fixed-target experiment at the CERN SPS combining the active beam dump and missing energy techniques to search for rare events. The experiment will build and operate a fully hermetic detector placed on the H4 beam line with the primary goal to search for light dark bosons (Z') from dark sector that are coupled to photons, e.g. dark photons (A'), or sub-GeV Z' coupled only to quarks. In some cases the Z' is coupled only to μ or tau, so we call the Z' the dark leptonic gauge boson. The experiment is also capable to search for $K_L \rightarrow$ invisible decay, which is complementary to $K^+ \rightarrow \pi^+ + \nu \bar{\nu}$, and invisible decays of π^0 , η , η' , K_S mesons.

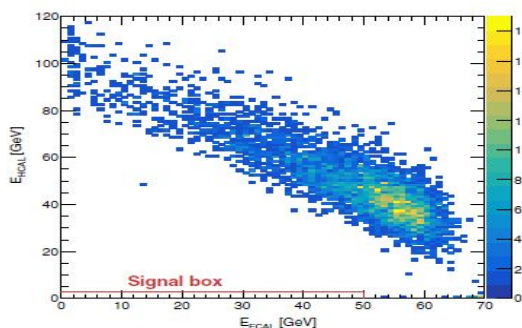
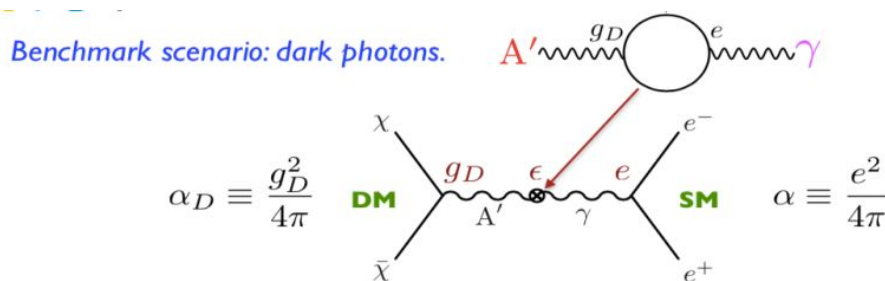


FIG. 2. The unblinded ECAL vs HCAL energy distribution for events satisfying all analysis cuts. The unblinded signal region is also reported—for better visualization, it has been expanded by a factor $\times 3$ along the vertical axis.

NA64e-, NA64e+ (50-150 GeV \pm): dark photon A'
 LDM NA64 μ (100-160 GeV μ^+): BSM: Z' (L_μ - L_τ ;
 B-L; ...)

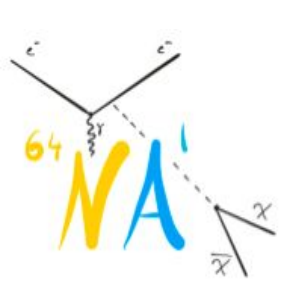
[JHEP07\(2024\)212](#)

[PhysRevD.109.L031103](#)

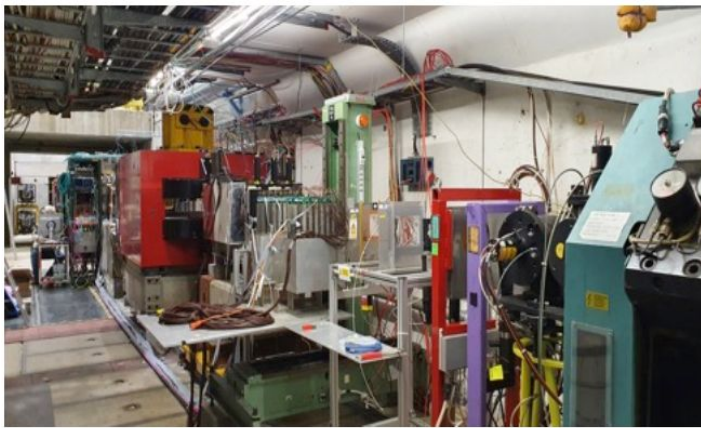
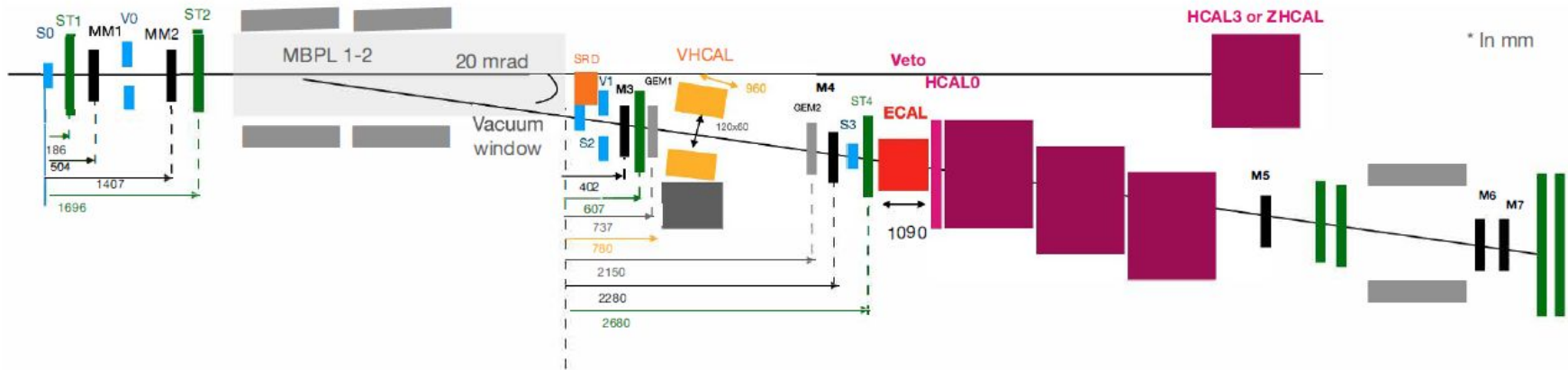


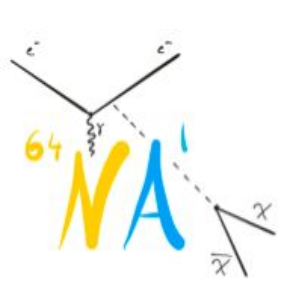
The $L_\mu - L_\tau$ model can also explain the Dark Matter relic abundance, by assuming that the Z' boson acts as a “portal” to a new Dark Sector of particles in Nature, not charged under known interactions

[JHEP06\(2025\)256](#)

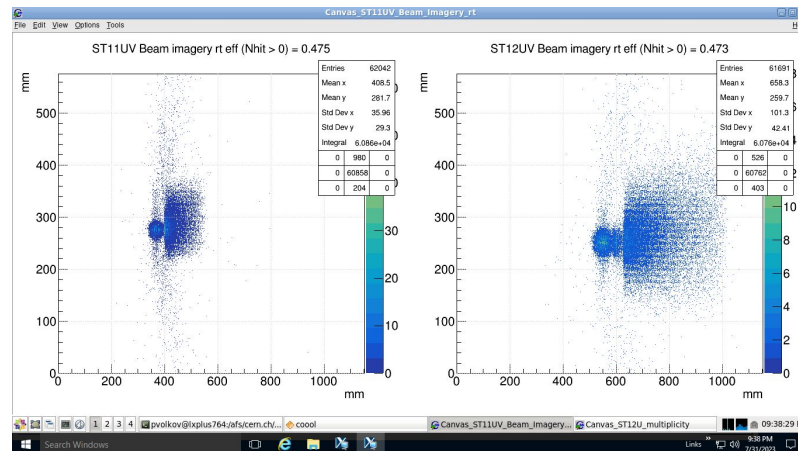
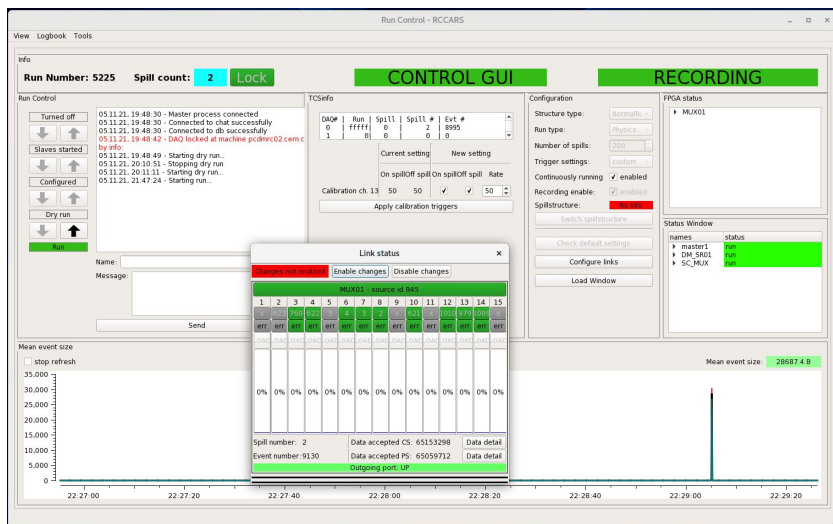
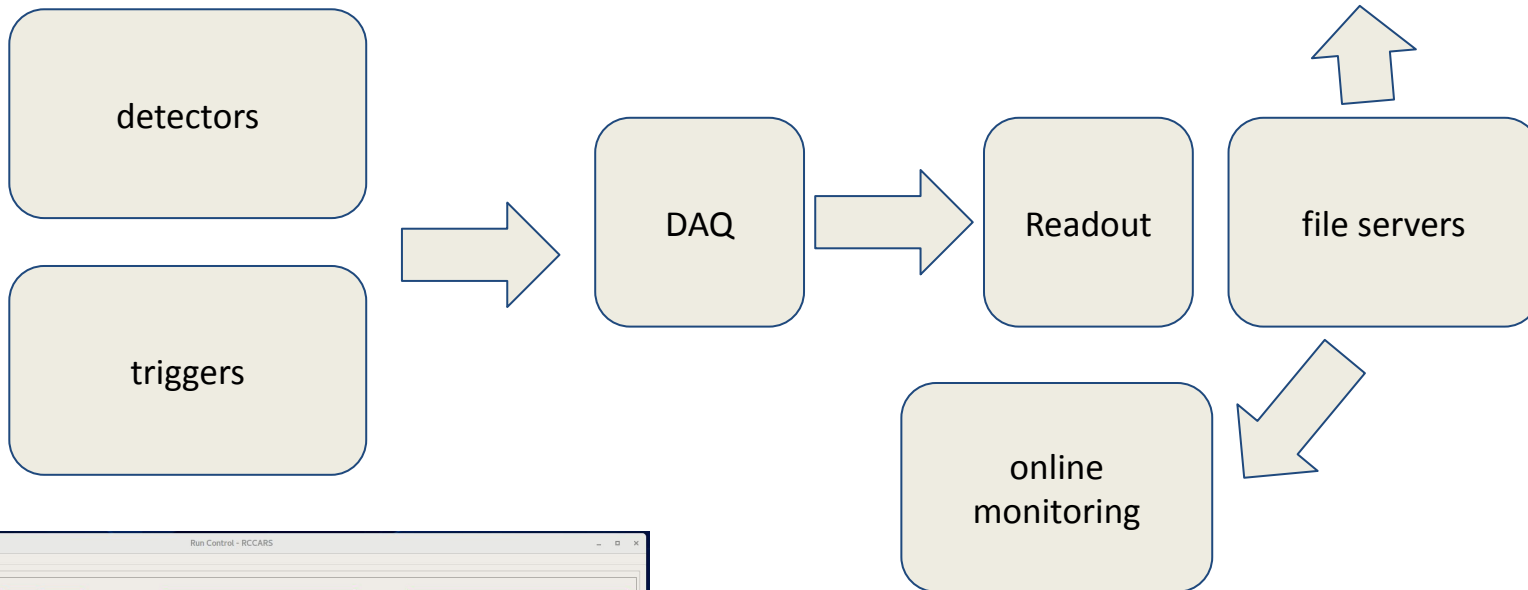


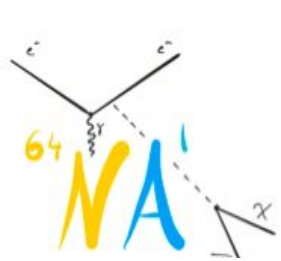
NA64 Detectors



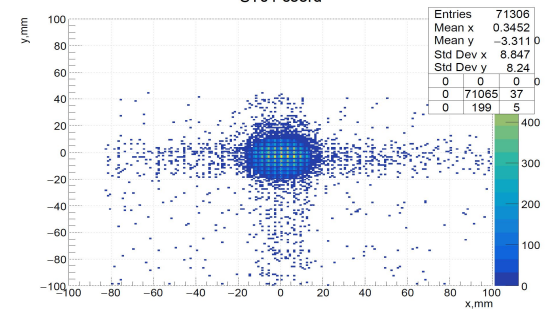
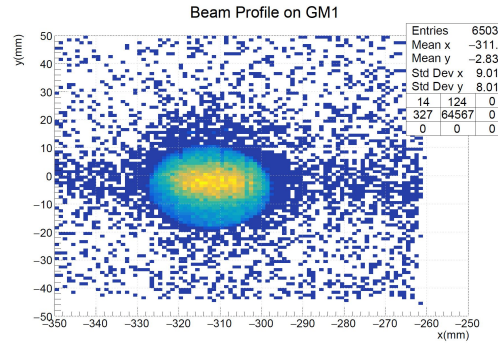
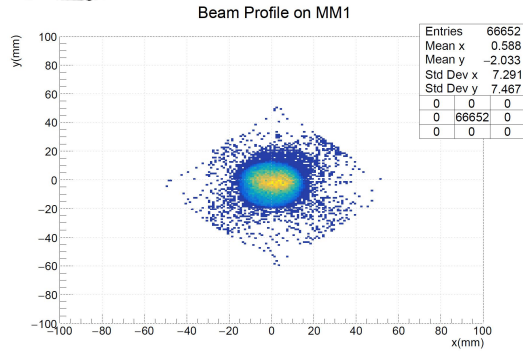


NA64 data tacking





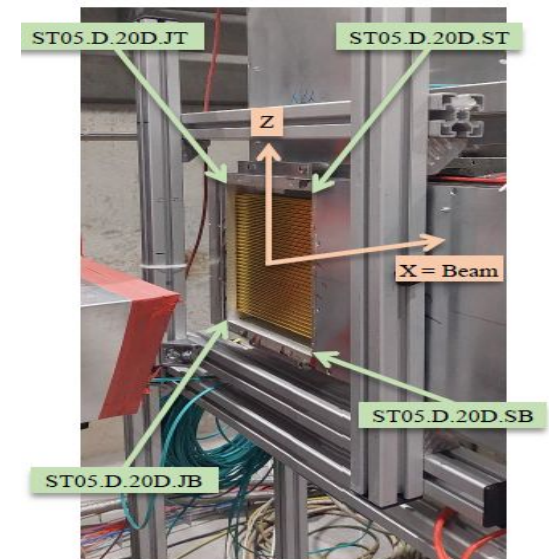
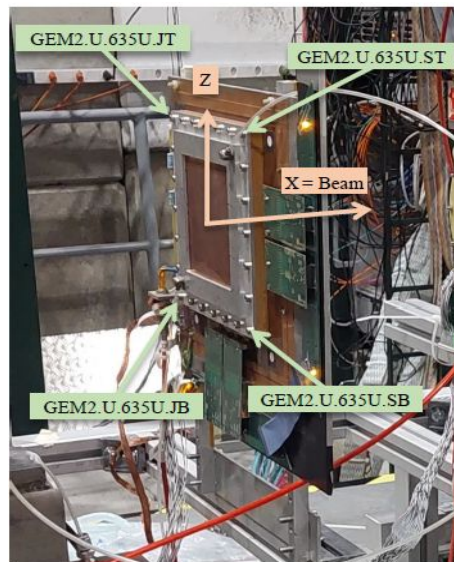
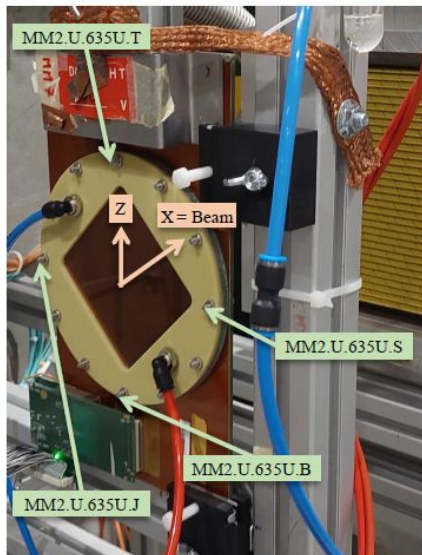
NA64 Track detectors

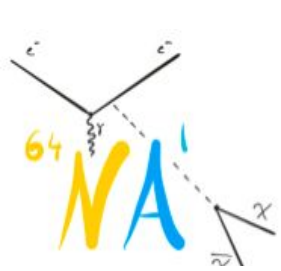


Micromega
chip: ADC
precision: ~150 um

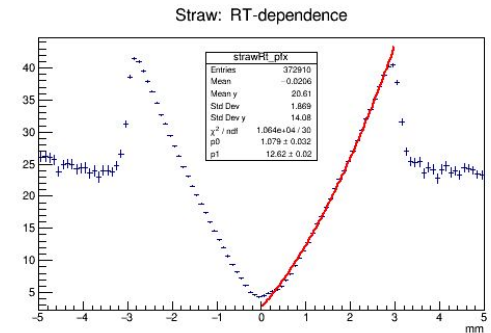
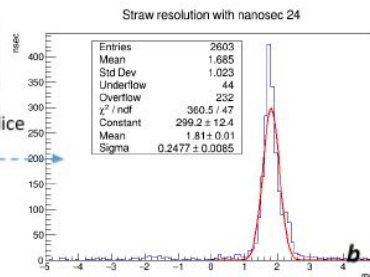
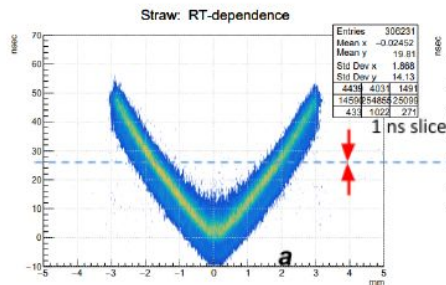
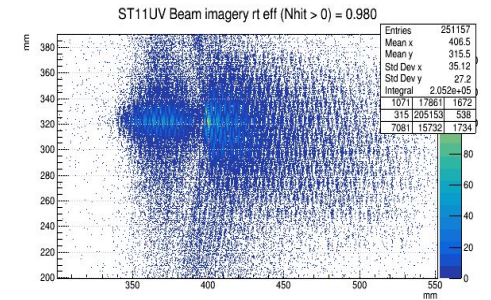
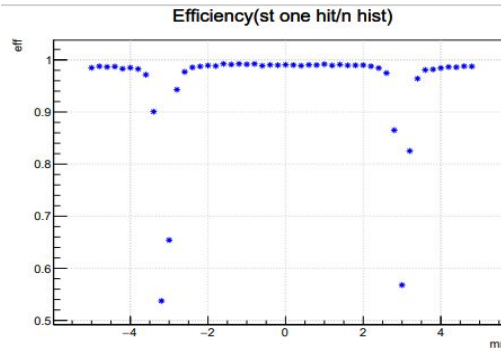
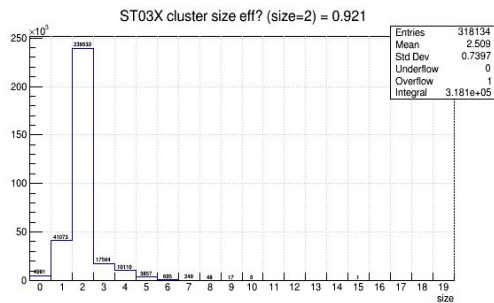
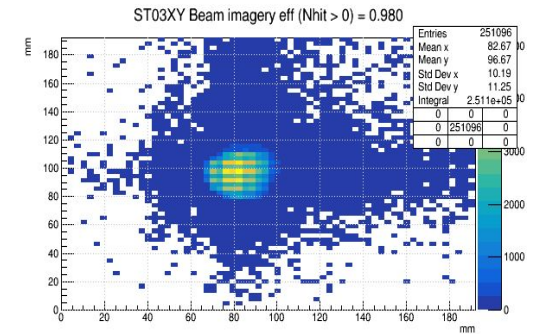
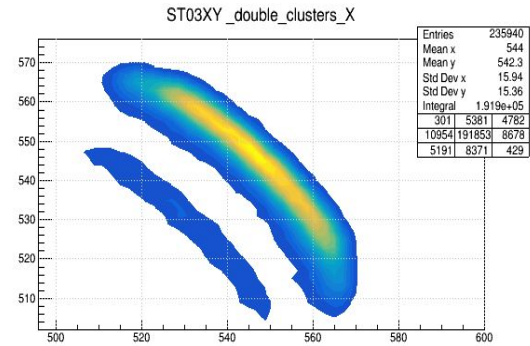
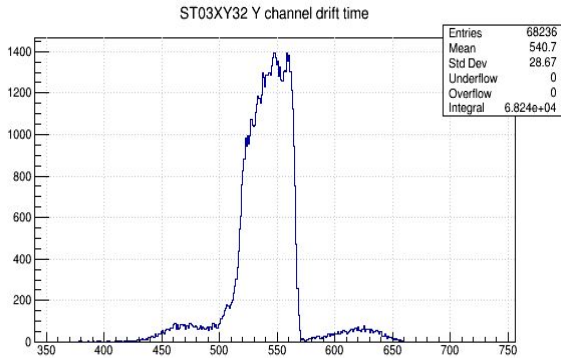
GEM
chip: adc
precision: ~100 um

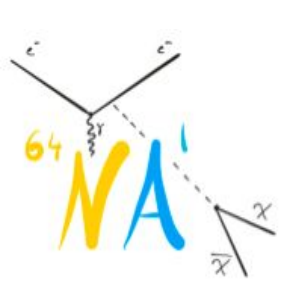
Straw
chip: tdc
precision: ~200 um





straw reconstruction





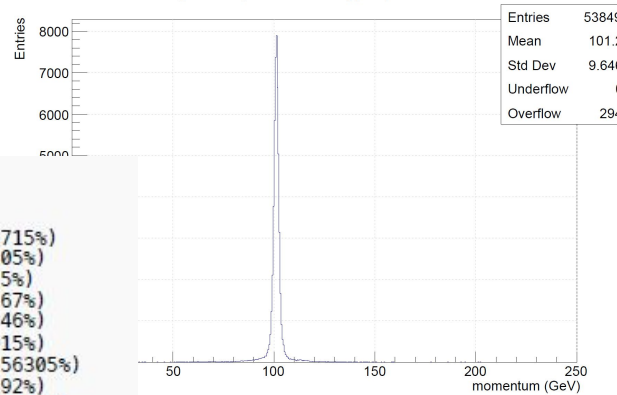
Instrumentation

The genFit package is used to reconstruct tracks, in particular, the Deterministic Annealing Filter algorithm shows the best results. (*J.Phys.Conf.Ser.* 608 (2015) 1, 012042)

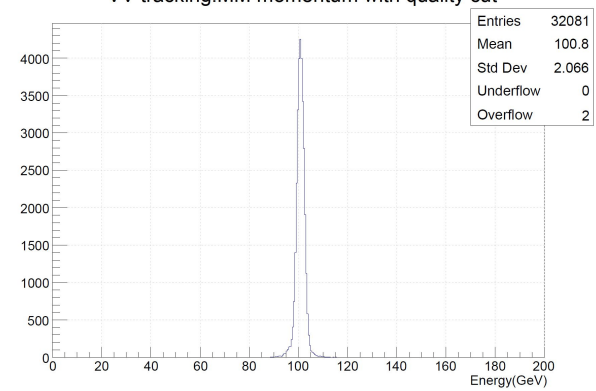
Also, for the primary measurements of the track, a simple algorithm for drawing a line through 4 fixed detectors is used. And in the same way, V. Volkov was written at Moscow State University and developed his own algorithm for building tracks to compare the results.

TotalEvents	=	92121790
1. cutTRGtime	=	91846608 (0.298715%)
2. cutSTRAW	=	82587936 (10.0505%)
3. cutEC(2,2)	=	80278906 (2.5065%)
4. cutSRD	=	74252599 (6.54167%)
5. cutVETO	=	65750255 (9.22946%)
6. cutEcalBadEnergy	=	63576043 (2.36015%)
7. cutHcalBadEnergy	=	63569997 (0.00656305%)
8. cutMMgoodTrack	=	55226601 (9.05692%)
9. cutShowerChiSQ	=	55152982 (0.0799149%)
10. ECratioCut	=	55150519 (0.00267363%)
11. cutECrph	=	46065552 (9.86191%)
12. cutHC12ratio	=	38375182 (8.34805%)
13. cutMMmomentum	=	26598460 (12.7839%)
14. cutHCpass1&2	=	25739418 (0.932507%)
15. cutSRDsum	=	25667702 (0.0778491%)
16. cutHC3	=	24389817 (1.38717%)
17. cutVHcal	=	24384636 (0.00562408%)
Efficiency	=	26.47%

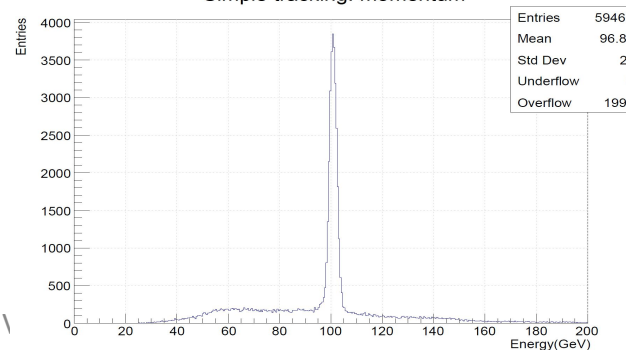
Tracking Tools (best track only): Upstream momentum

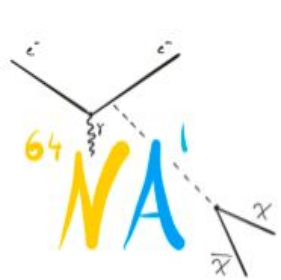


VV tracking:MM momentum with quality cut

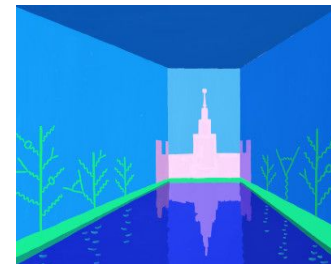


Simple tracking: momentum

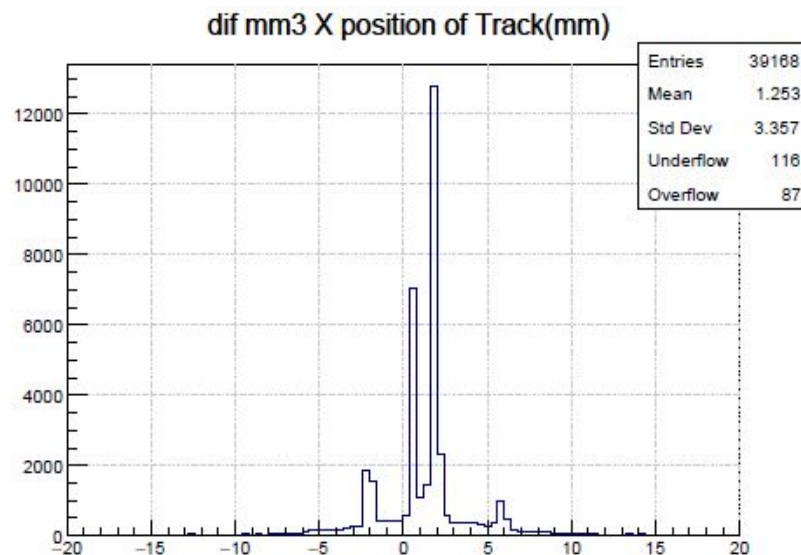
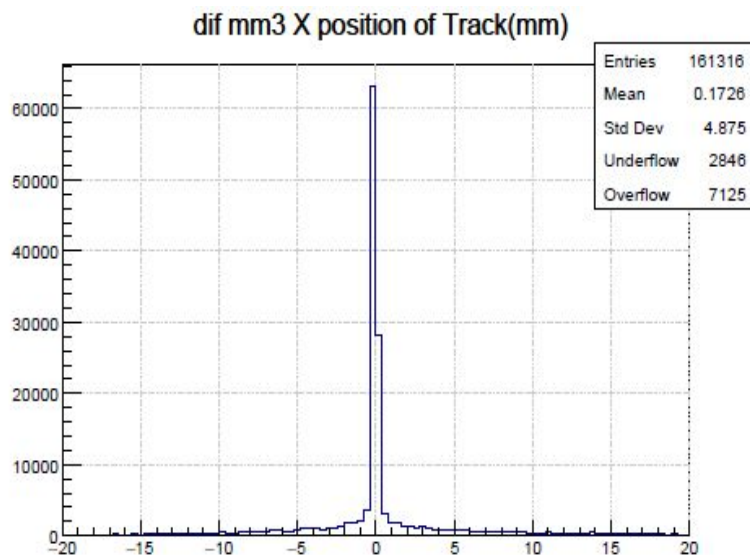


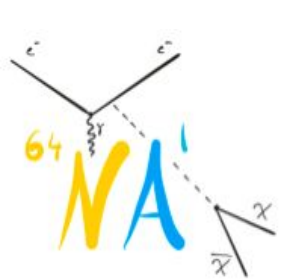


alignment



The detector location data is taken from the report of the surveyors who take measurements each session. However, this report has a number of inaccuracies and needs to be clarified by track. The figures below show a track drawn through calibrated detectors (left) and uncalibrated (right)

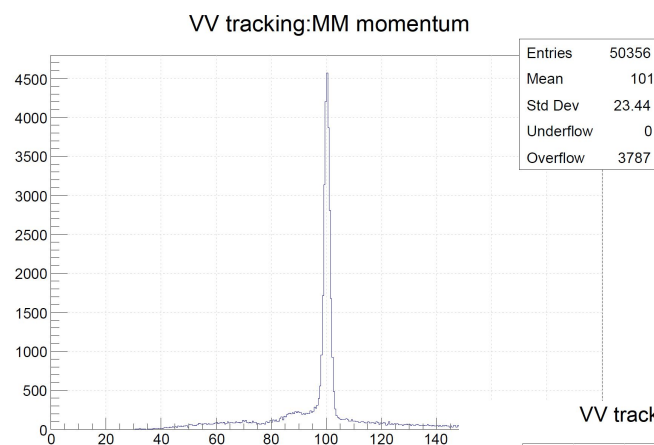




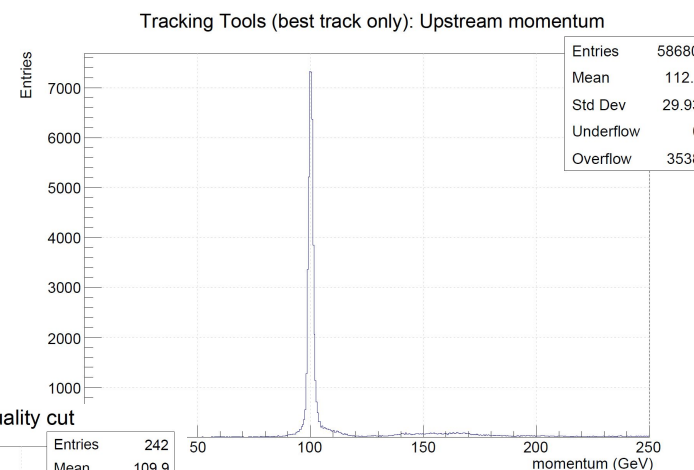
Run 2024e



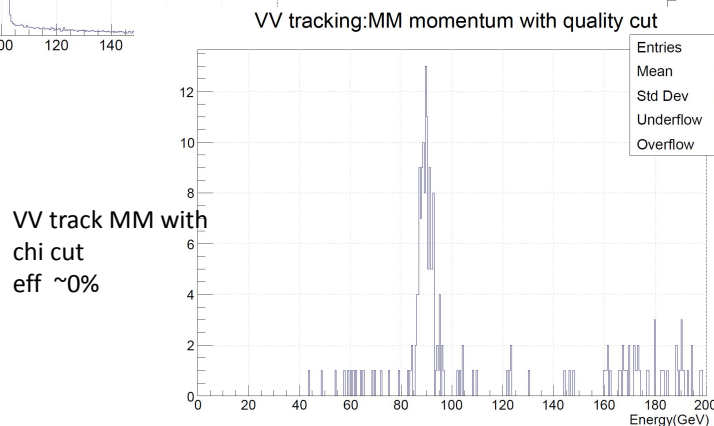
In each new run, when reconstructing tracks, it is necessary to take into account many external parameters, such as the location of the detectors, their calibrations, changes in the magnetic field, trigger time, and so on.



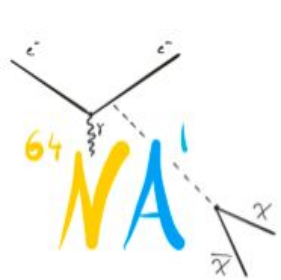
VV track MM
eff ~69%



GenFit
eff ~80%



VV track MM with
chi cut
eff ~0%

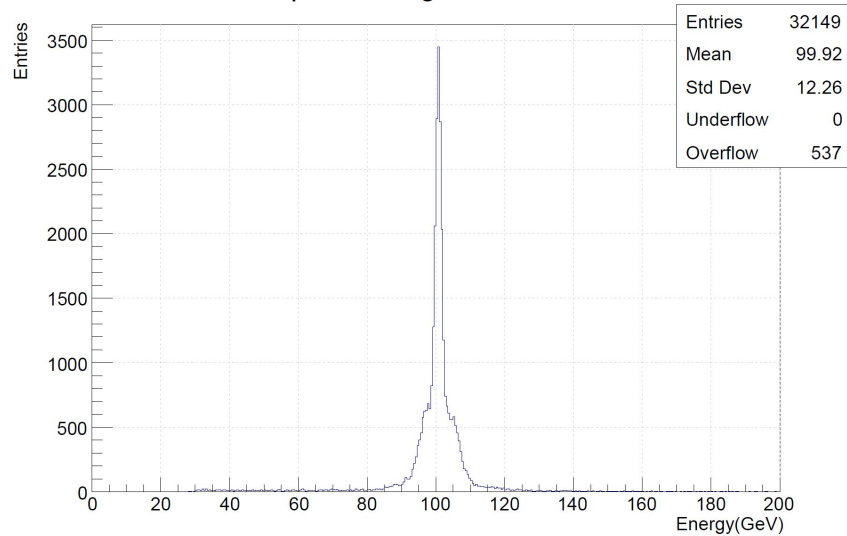


Run 2025e

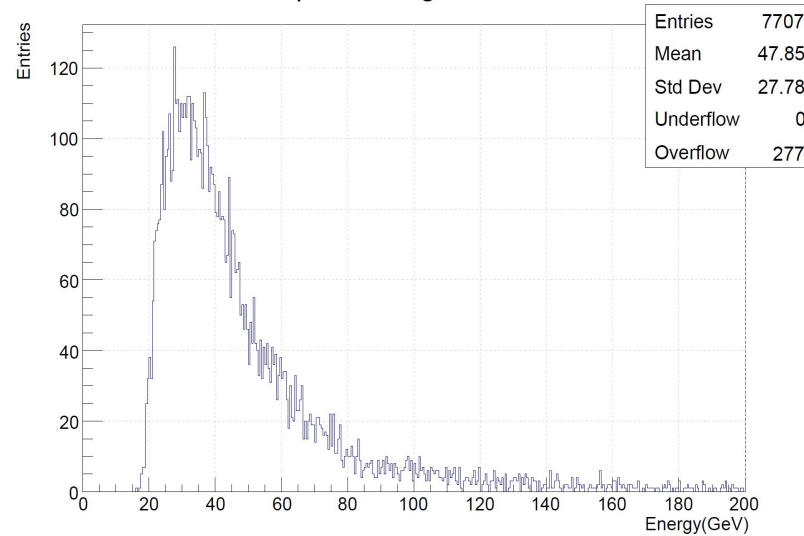


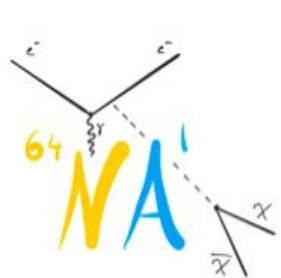
The first results of the reconstruction of the track through straw for the run 2025e.

Simple tracking ST: momentum



Simple tracking: momentum





Summary



The installation and operation of the na64 experiment is a complex process that requires the coordinated work of many groups from several countries.

Due to the re-installation of detectors every session, constant calibration is required.

The collaboration has the tools to reconstruction tracks, however, it is a laborious task for each new run.

Thanks for your attention!