Application of the Vector Finder toolkit for track reconstruction in BM@N

A.Zinchenko[1], D.Zinchenko[1], R.Zinchenko[2], E.Nikonov[3]   **BM@N**

[1] VBLHEP, JINR, Dubna, Russia
[2] MEPhi, Moscow
[3] LIT, JINR, Dubna

Motivation

1. **CBM L1 (CAT) code is mainly used for track reconstruction at BM@N.**

2. **It is designed to be run on-line – might not be the most optimal for tracking efficiency.**

3. **It has been optimized (?) for the CBM STS configuration – might require extra tuning for different geometries.**

4. **It is not quite clear how to do the optimization – "grey box" for external user.**

The track finding method is based on the combinatorial search for detector hit combinations which can potentially belong to the same particle. Possible hit combinations are selected on each detector layer using prior constraints defined by the detector geometry and event characteristics, such as momentum and angular spectra of particles to be reconstructed – "Human shallow learning"

The collected hit combinations, forming sequences of vectors connecting pairs of hits on different detector layers, are further fitted by the Kalman filter to verify hit-to-track associations via the track quality values defined by the χ^2-metrics, and to obtain track parameters.

COMPUTER TECHNOLOGIES IN PHYSICS

Vector Finder—A Toolkit for Track Finding in the MPD Experiment

Dmitrii Zinchenko[a, *], Alexander Zinchenko[a], and Eduard Nikonov[b]

[a]VBLHEP, Joint Institute for Nuclear Research, Dubna, Moscow oblast, 141980 Russia
[b]LIT, Joint Institute for Nuclear Research, Dubna, Moscow oblast, 141980 Russia
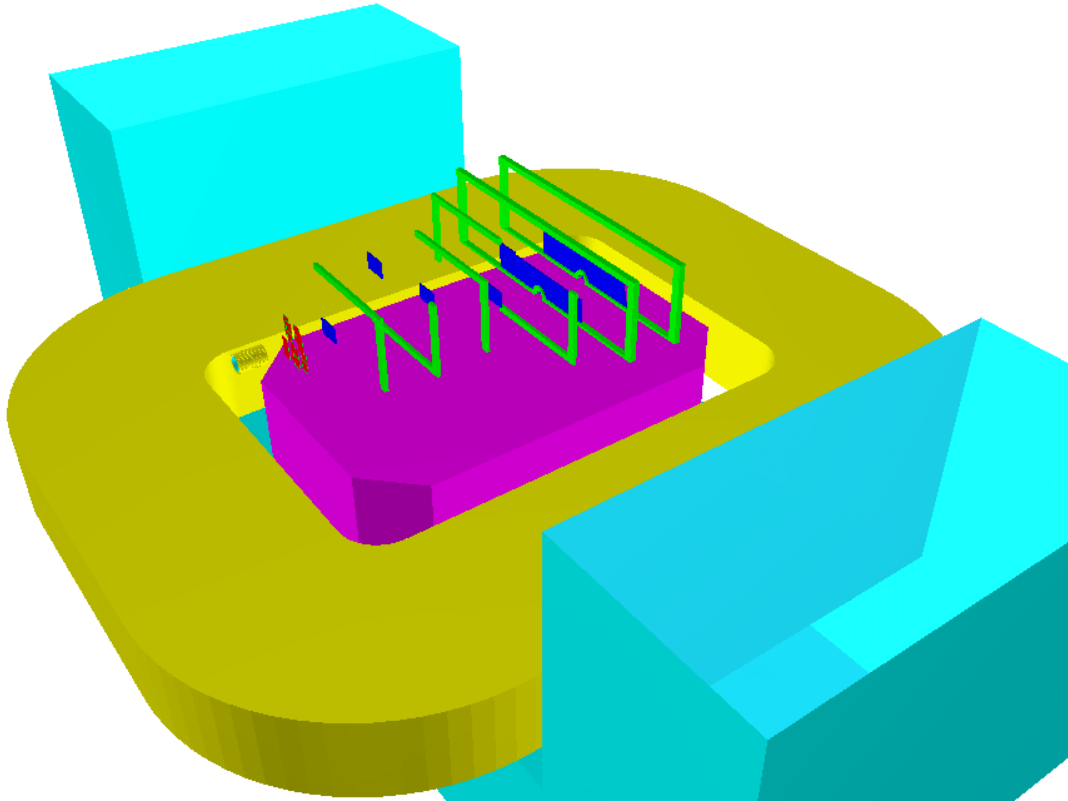*e-mail: zinchenk1994@gmail.com

Abstract—A track reconstruction method based on a constrained combinatorial search for track candidates, i.e. combinations of detector hits possibly belonging to a track, is presented. The algorithm has been implemented as a Vector Finder software toolkit containing a track reconstruction procedure and tools to determine hit acceptance windows (a priori constraints) for the track search. Track reconstruction results for high multiplicity simulated events (~1000 particles in the detector acceptance) are shown demonstrating good performance of the approach proposed.
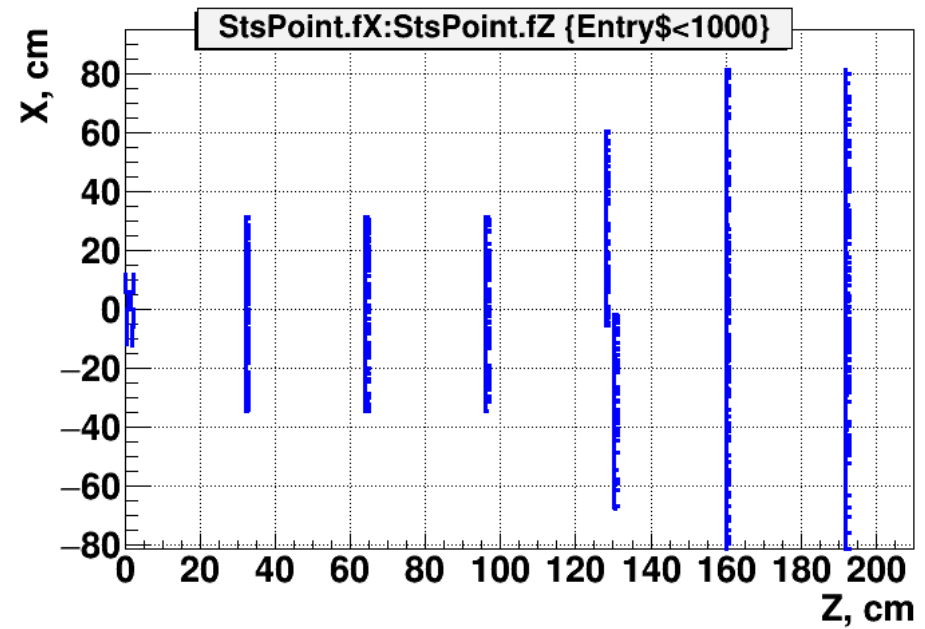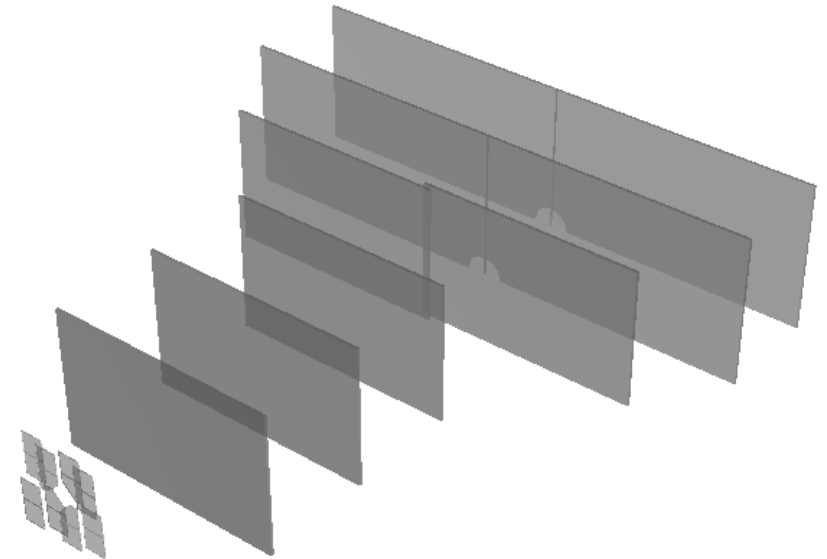
106 accesses for 2 months

Field: ~0.6 T

StsPoint.fX:StsPoint.fZ {Entry$<1000}
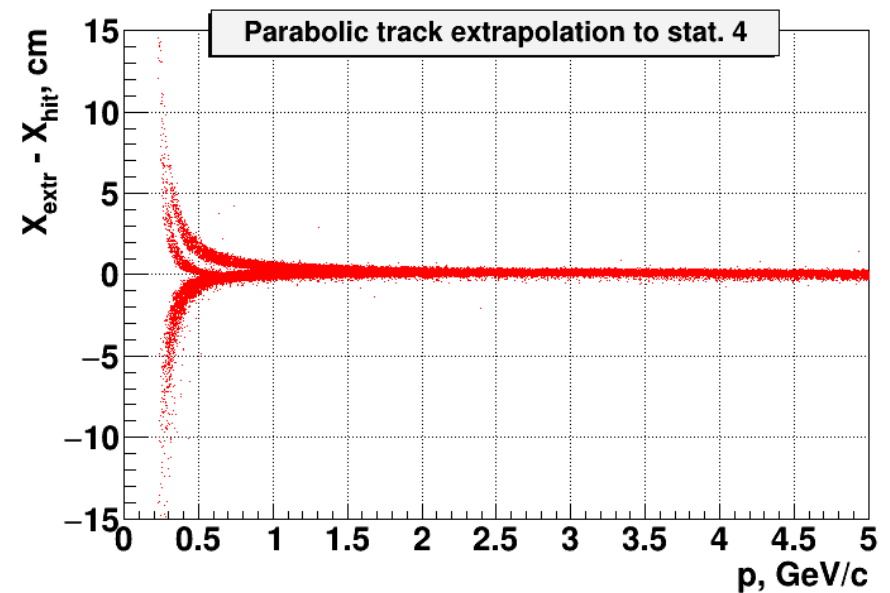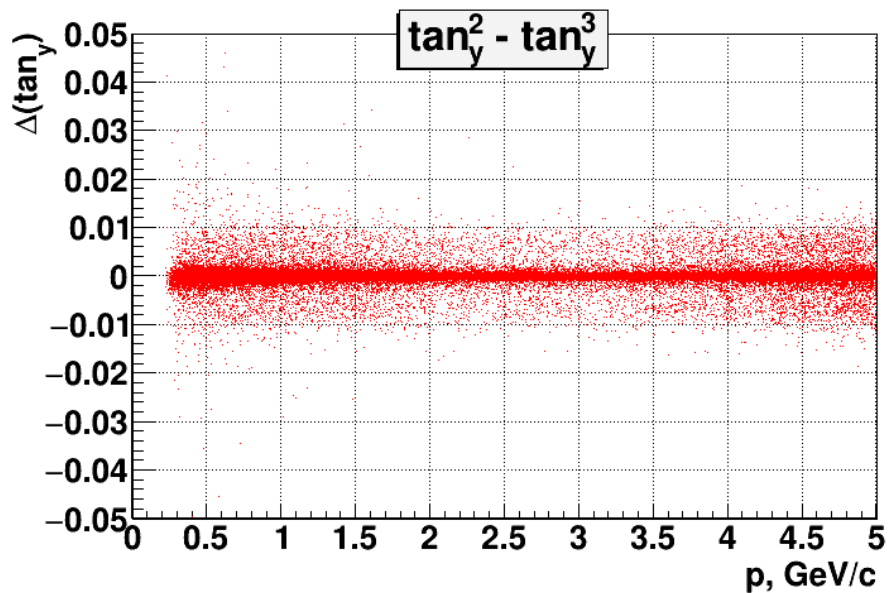
X, cm

Z, cm

Data set

Detectors: Si (1 station) + GEMs (6 stations)

Generator: DCM-QGSM, 50 k C+Cu at $T_0 = 4.0A$ GeV, min. Bias

Magnetic field: B = 0.6 T

D(tan_y) on consecutive stations
Parabolic extrapolation in X-Z plane

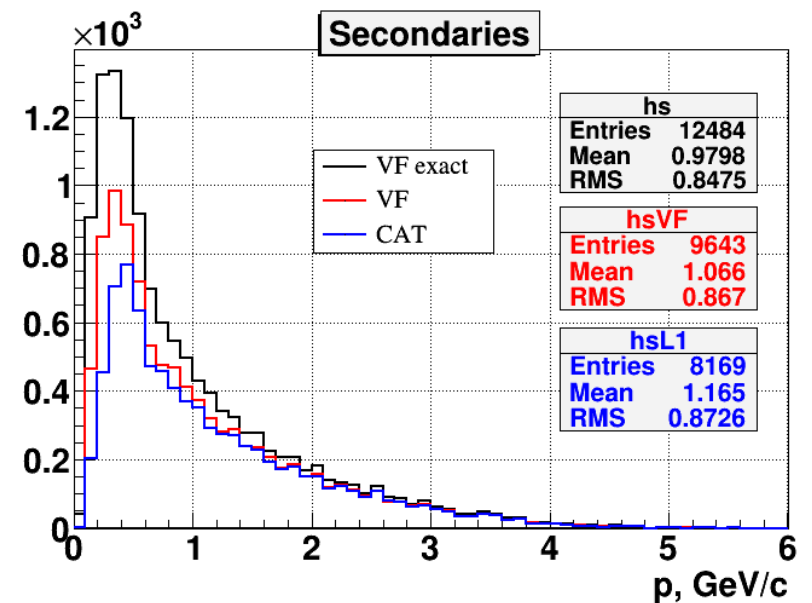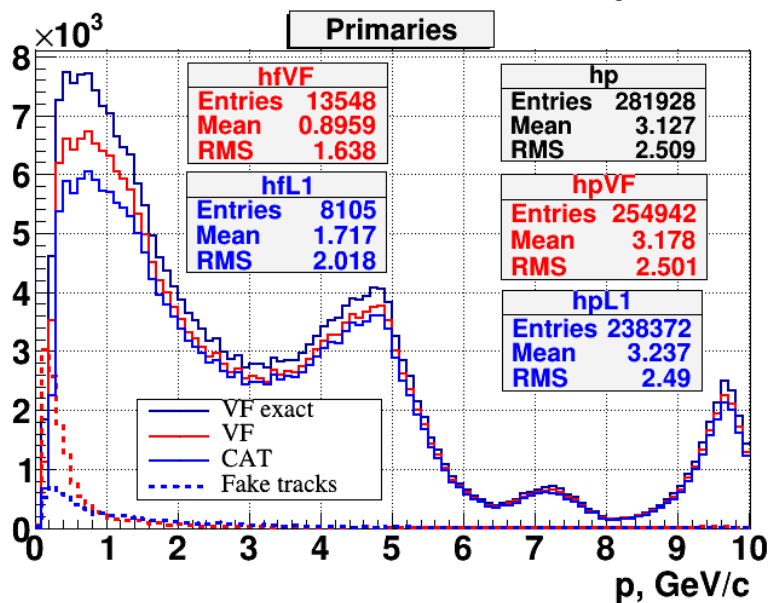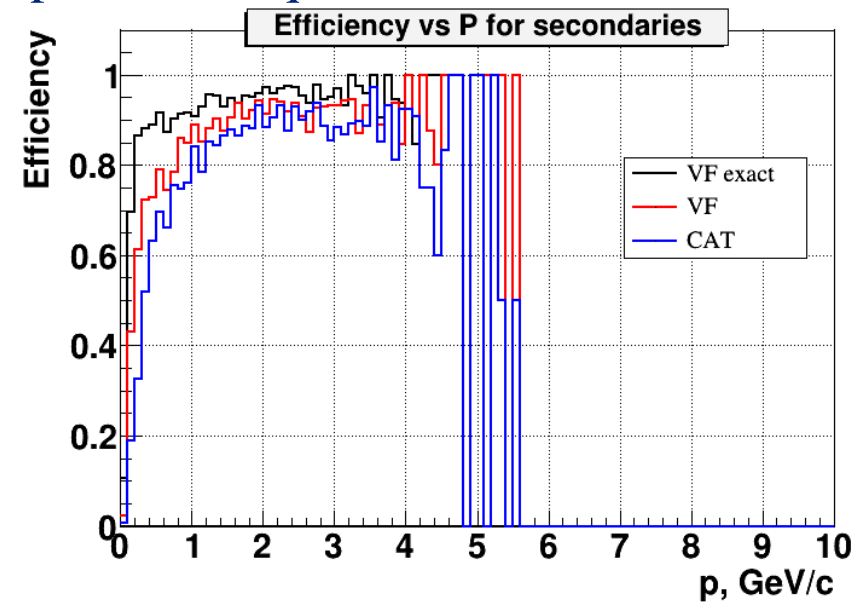Start from the last station and go upstream.
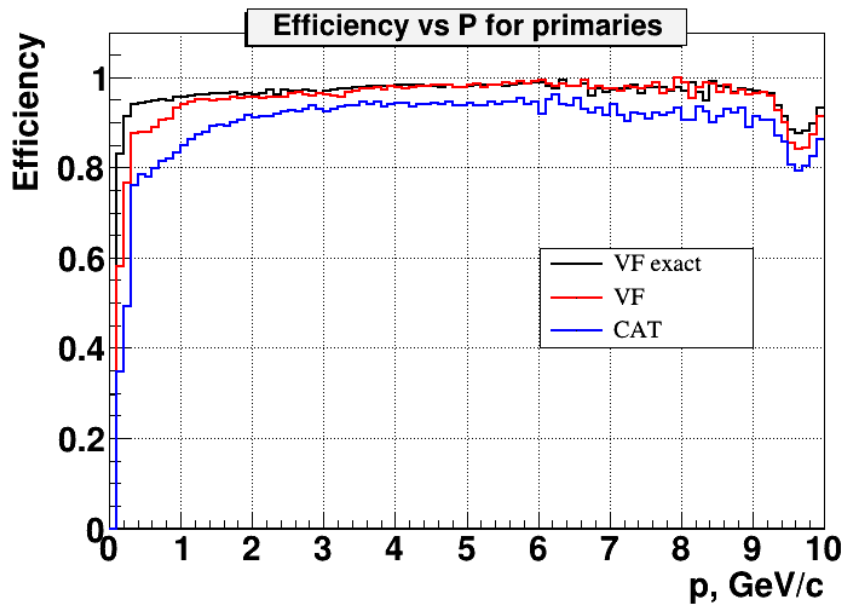 Start from the last but one, etc.
Allow missing station (jump over one station).
Perform 6 passes:
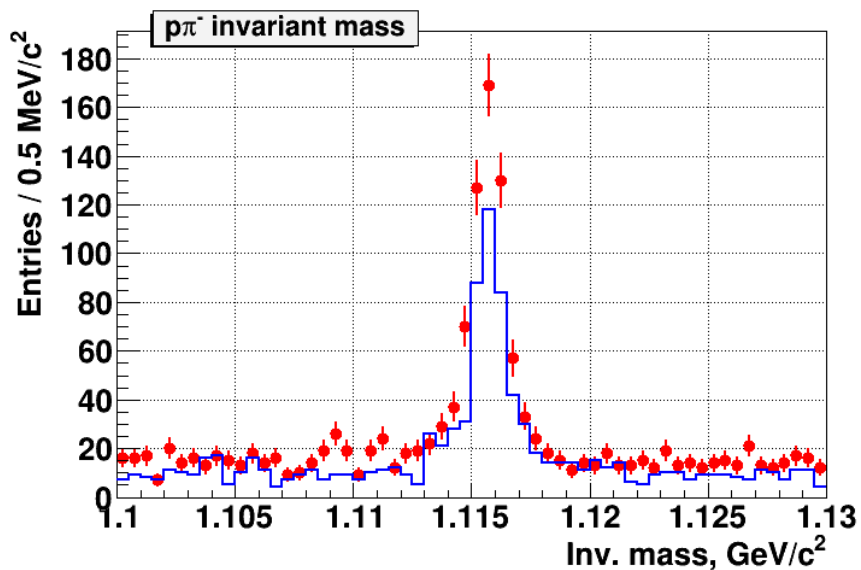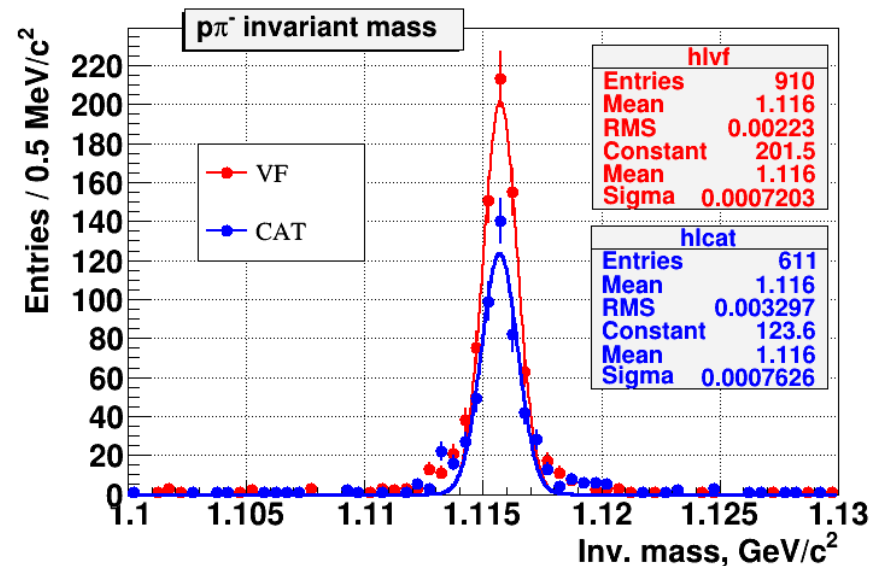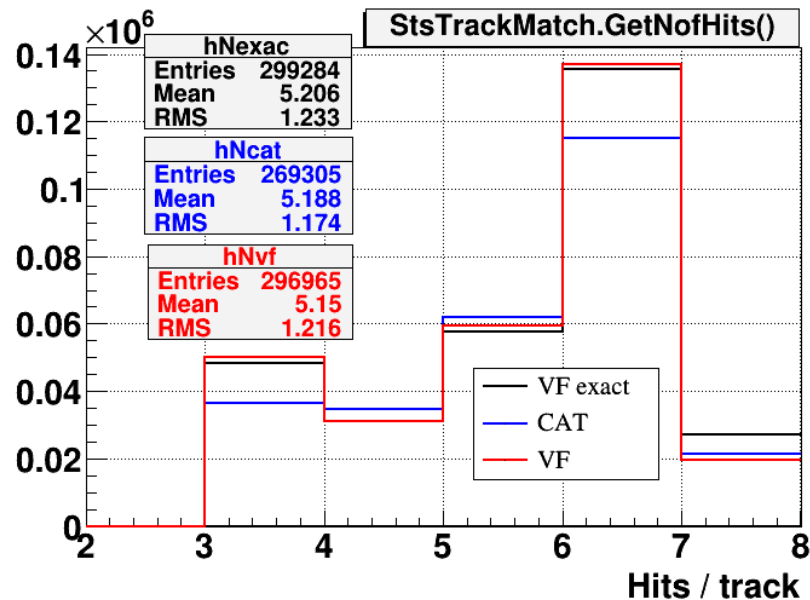1. Narrow windows, >= 6 hits
2. Narrow windows, >= 5 hits
3. Wide windows, >= 6 hits
4. Wide windows, >= 5 hits
5. Wide windows, >= 4 hits
6. Wide windows, >= 3 hits

Tracking performance

Reconstructible tracks: ≥ 3 points in sequence

Λ reconsruction

Cuts: $\chi^2_p > 1$, $\chi^2_\pi > 2$, path > 1 cm, $\chi^2_\Lambda < 20$, angle$_\Lambda < 0.2$

Summary and outlook

- ✓ Vector Finder toolkit has been adapted to BM@N central tracker configuration in run6.

- ✓ It demonstrates some improvement over the CAT package.

- ✓ The plan is to try to adapt VF to configurations of runs 7 and 8 as well as to use more realistic detector geometries with passive material.