Track Finder, “Track–Life” (first step)

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ILC–Software meeting. Cambridge, 3–6 April, 2006

Copy of this talk can be found at http://www.desy.de/~morgunov

Plan

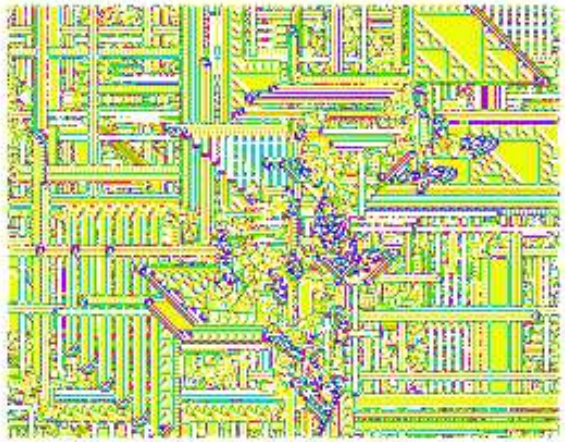
1. Introduction: cellular automata and what can it do for imaging reconstruction
2. Algorithms
3. Conditions for efficiency estimation
4. Results

Cellular automata – Life

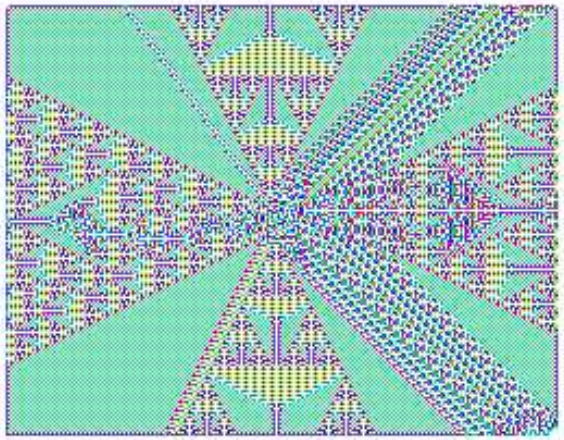
Modern Cellular Automata

Modern CA Entrance

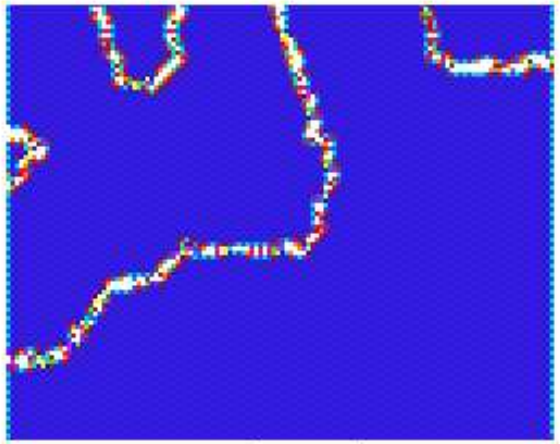
Traditional Rules



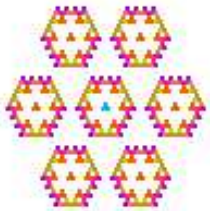
August Addition



Out Of It Rule Mix Lab



Some Other Rules



Hexagonal Extension

Map / News / Words / Author

Algorithm

1. All set of TPC hits goes through the nearest neighbor procedure
   using ANN (Approximate Nearest Neighbor) library, downloaded from http://www.cs.umd.edu/ mount/ANN.
2. Life–like rules applied for each TPC hit (3–D point) using nearest neighbors set from the first step.
   The rules are simple, pure topological, and empirical.
   The idea is: each point to be alive should belongs to “some” curve in 3–D space.
3. All survived hits (points) connected into clusters (track segments) using nearest neighbors set from the first step.
4. Helix parameters calculate for each found track segment.
5. Merge track segments into track using nearest neighbors set from the first step and helix parameters.
6. Collect points (are not survived) to some track segment using helix hypothesis approximation.
7. Repeat 4,5,6 two more times with a bit different conditions to be merged.

Fit of track parameters does not exist yet.

How to compare?

We are talking about effi ciency more than 99 % – so, each particle in each event give us about one percent accuracy;
(ttbar at 500 GeV event consists of about one hundred charged particles).

The recursive procedure which goes along all MC particles and its daughters and started at the particle which has std–HEP status = 1 was applied to get all candidates for true tracks.

Problem 1: MCParticle collection in LCIO file (ttbar 500 GeV, Mokka 5–4) consists of about 7– 8 thousands entries, many of them are backscattered neutrons (we are not interesting in it now).

Cut by kinetic energy at the 20 MeV was chosen to remove neutrons.

It leads sometimes to the unknown MC particle for some reconstructed tracks; which is not a fakes; but – misleading.

Problem 2: Many particles with std–HEP status = 1 has no an origin point at exactly (0,0,0) but near by, due to the complex decay of initial heavy mesons.

The sphere with radius 30 mm was chosen to distinguish between cases: is particle at “IP” or it is not at “IP”.

Problem 3: The power of the track finding algorithm depends on the number of points at the track.

The true track should has of at least 10 points at TPC to be a candidate to compare with reconstructed tracks.

Problem 4: Kinks: for MCParticle any decay creates a new entry. If the angle of the daughter is small in compare with mother direction. Reconstruction cannot resolve this kink. It leads to an additional “not reconstructed particle”.

The biggest amount of none–reconstructed particles presented here are kinks.

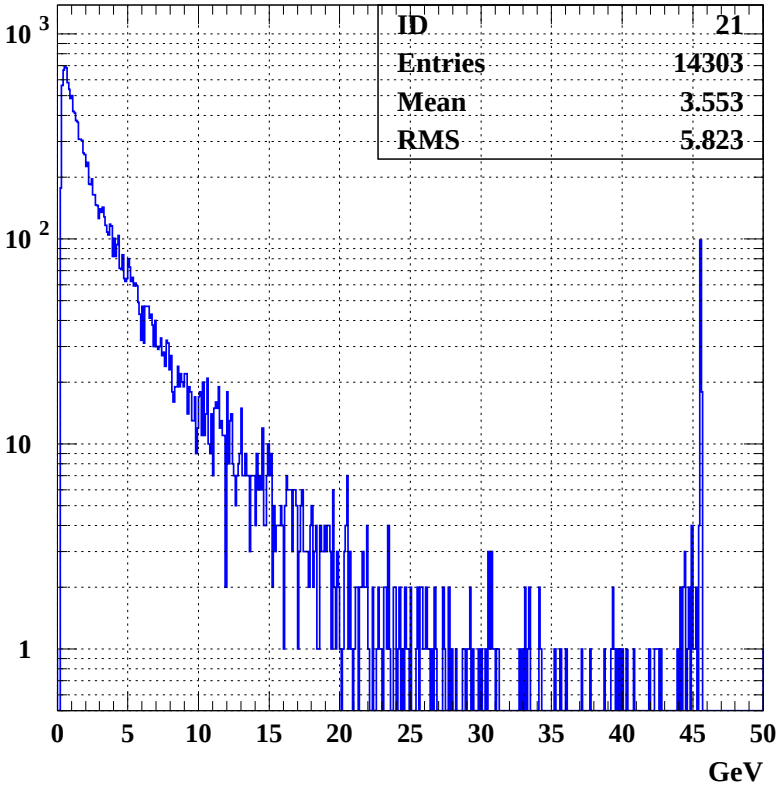
Problem 5: Curlings: Tracks with small longitudinal momentum.

The cut was applied for small transversal momentum (less than 100 MeV), to remove curlings with very small radius.

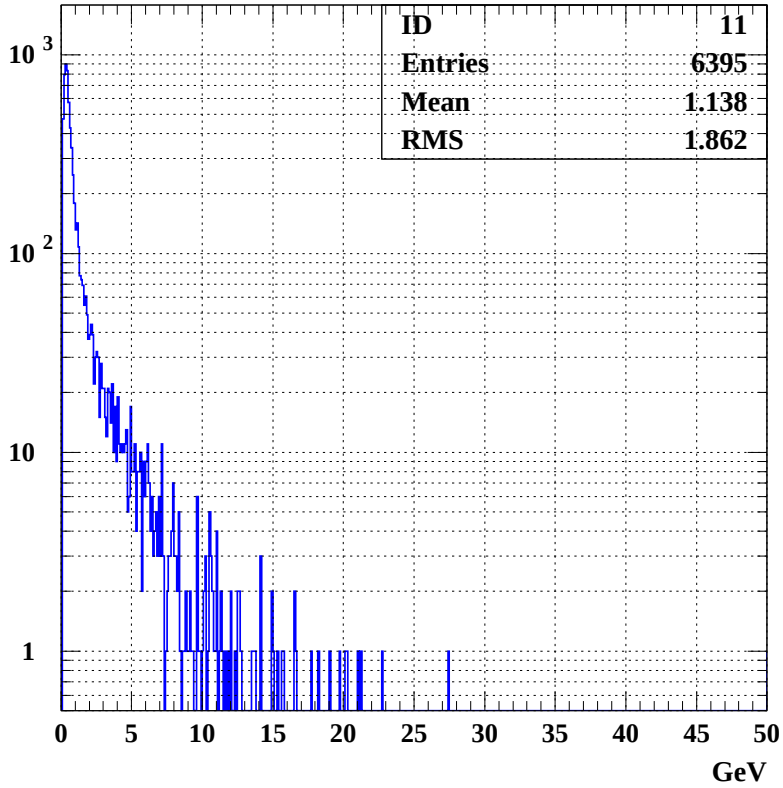
All other curlings algorithm is attended to find.

Z pole, 4 Tesla

Momentum for MC particles near by IP

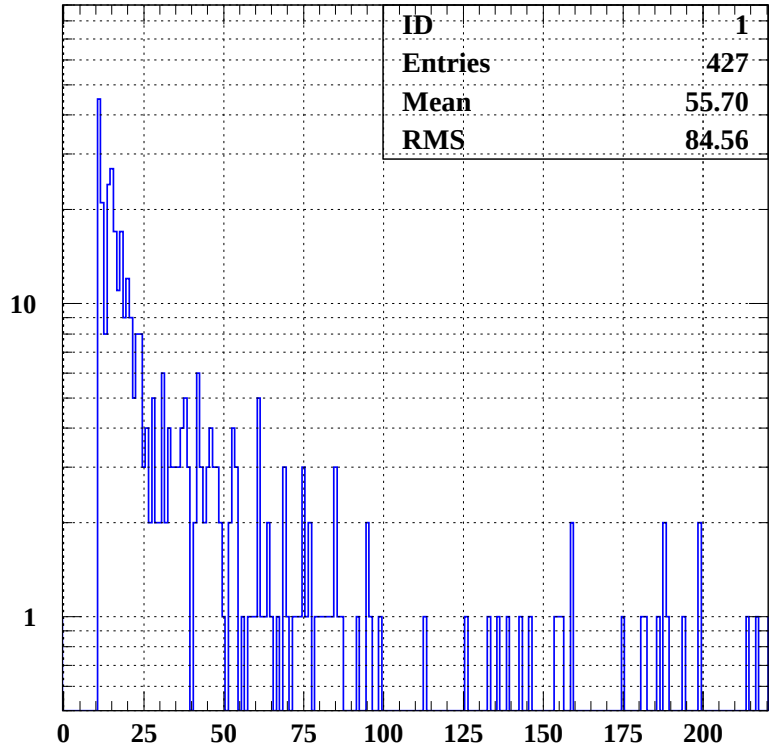


Momentum for MC particles far from IP

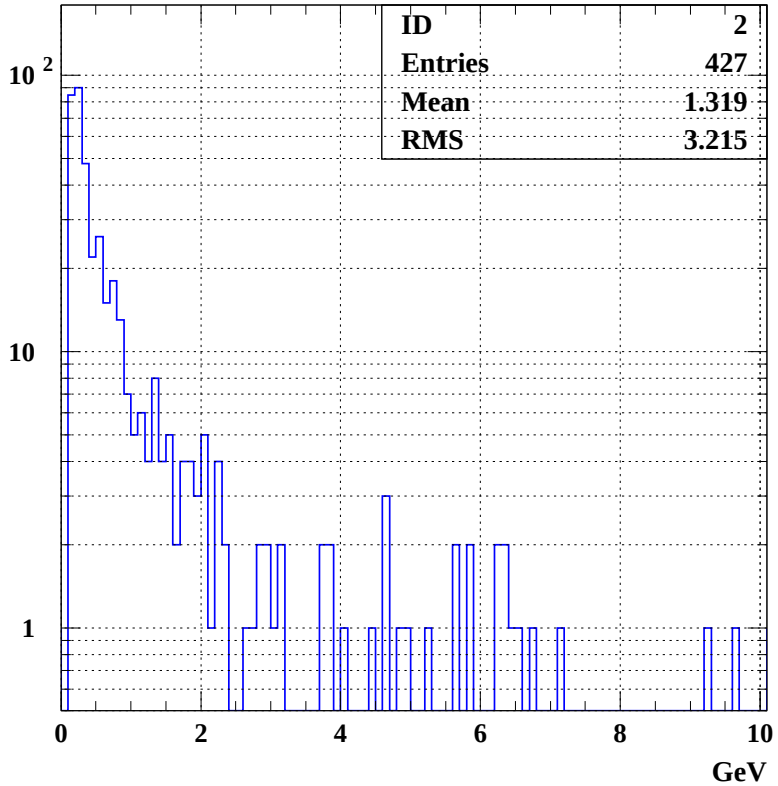


Z pole, 4 Tesla

Number of points if track not found



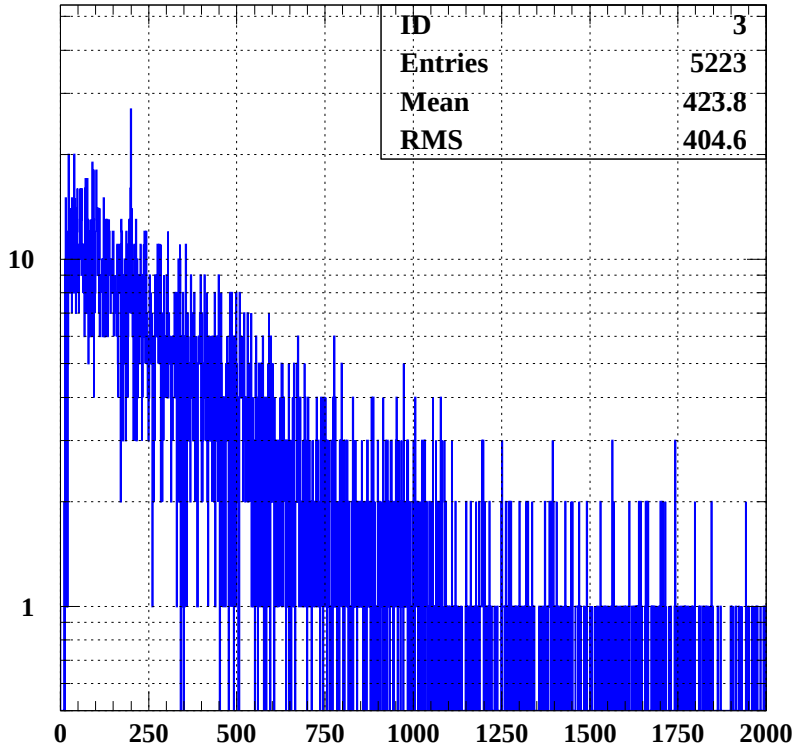
Momentum if track not found



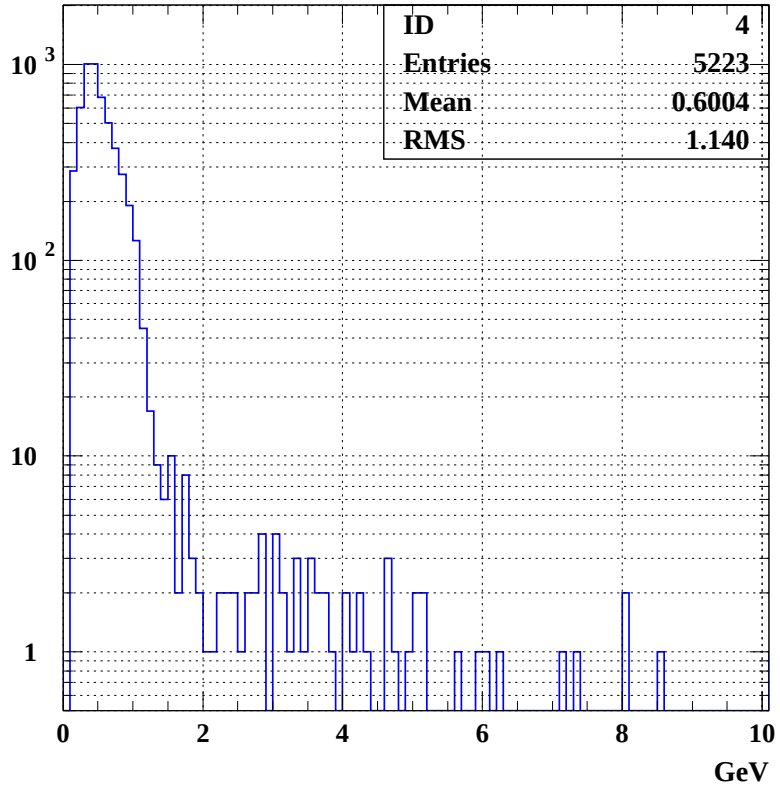
Overall efficiency = 98 % (on 20 698 True tracks)

Z pole, 4 Tesla

Number of points if many segments

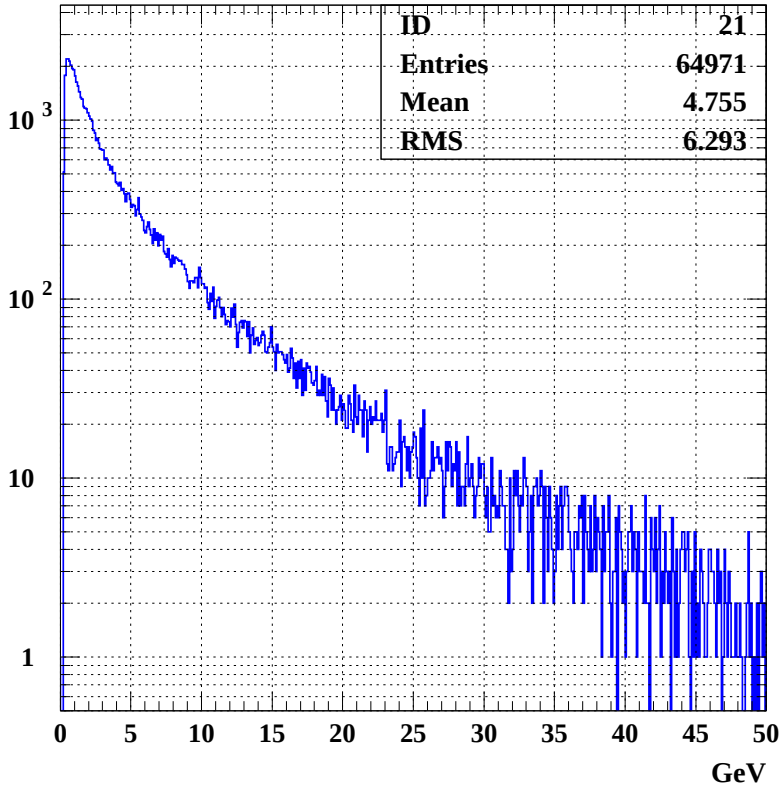


Momentum if many segments

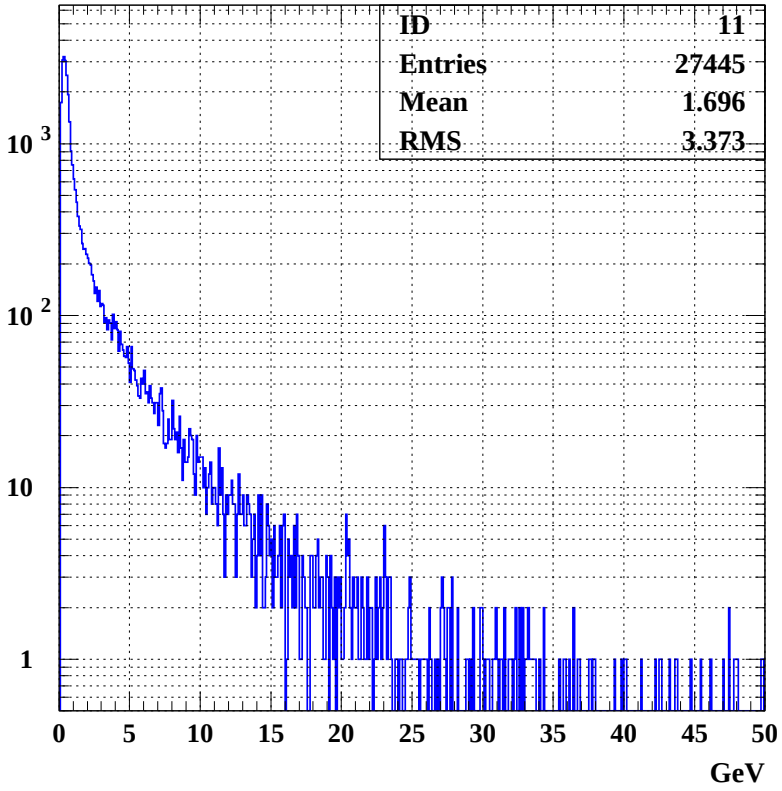


t tbar 500 GeV 4 Tesla

Momentum for MC particles near by IP

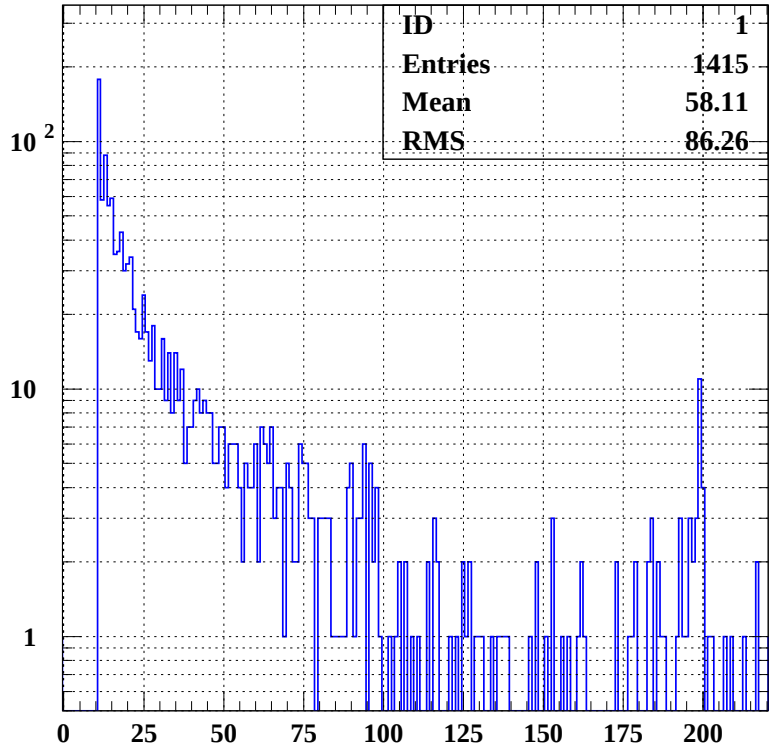


Momentum for MC particles far from IP

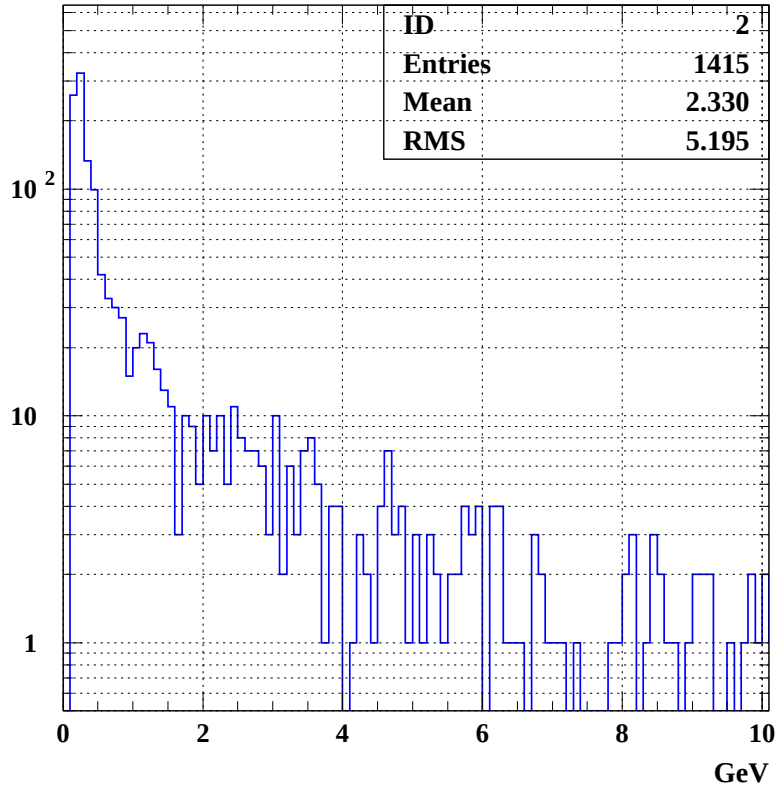


t tbar 500 GeV 4 Tesla

Number of points if track not found



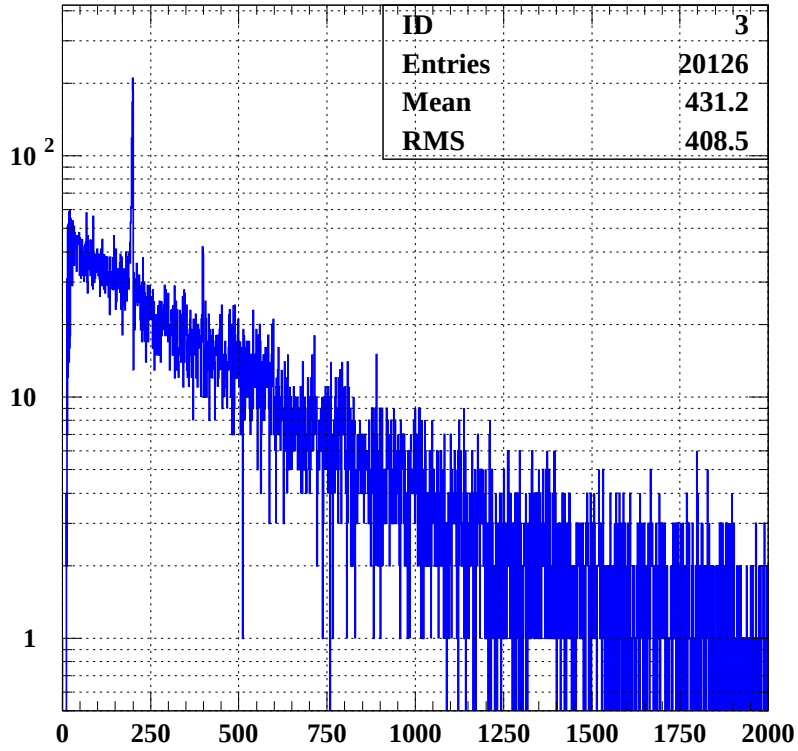
Momentum if track not found



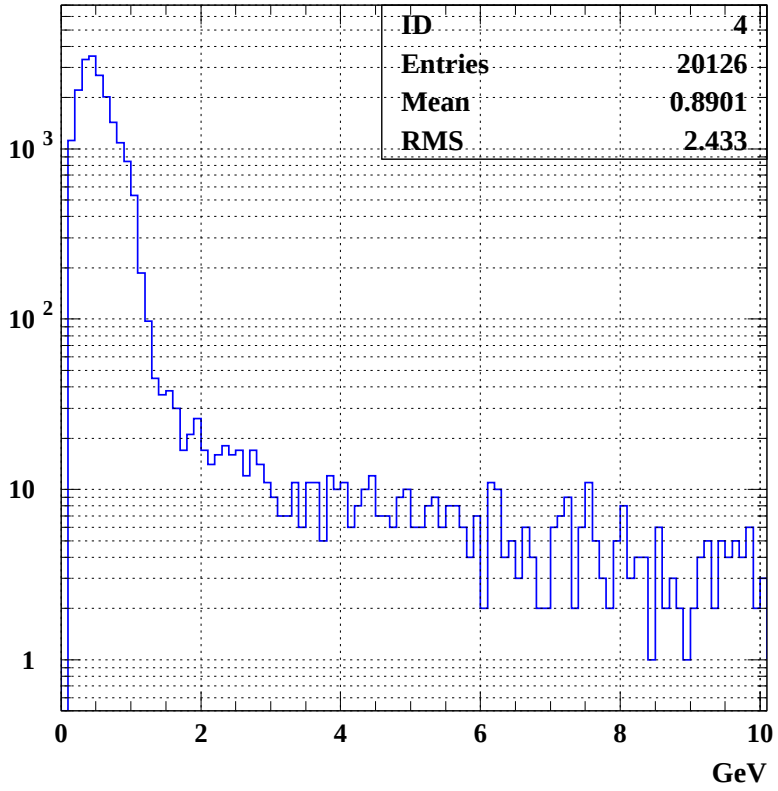
Overall efficiency = 98.5 % (on 92 416 True tracks)

t tbar 500 GeV 4 Tesla

Number of points if many segments



Momentum if many segments



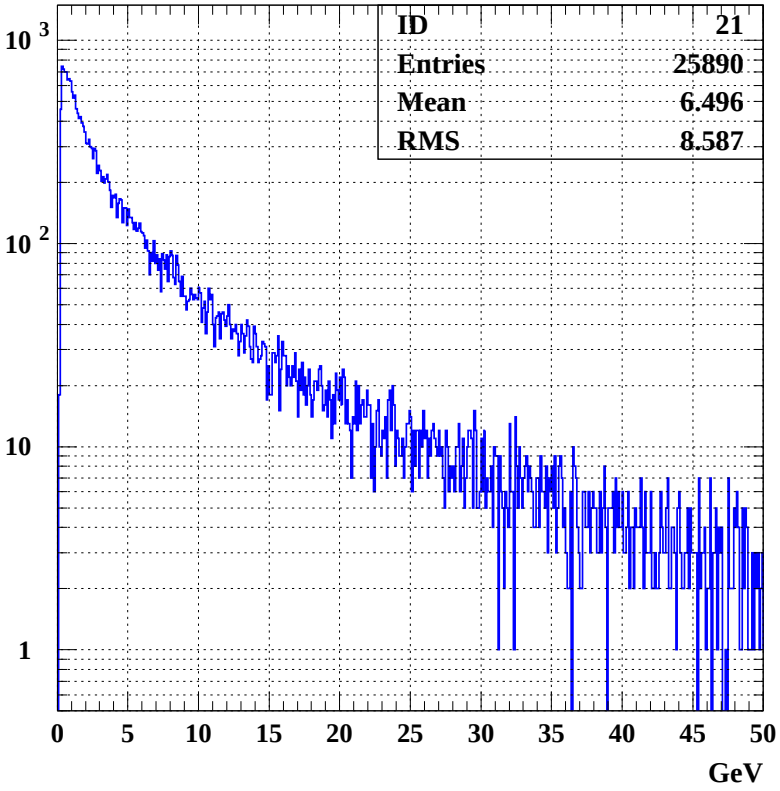
t tbar 500 GeV 4 Tesla

Overall efficiency for tracks that come from IP = 99.1 %

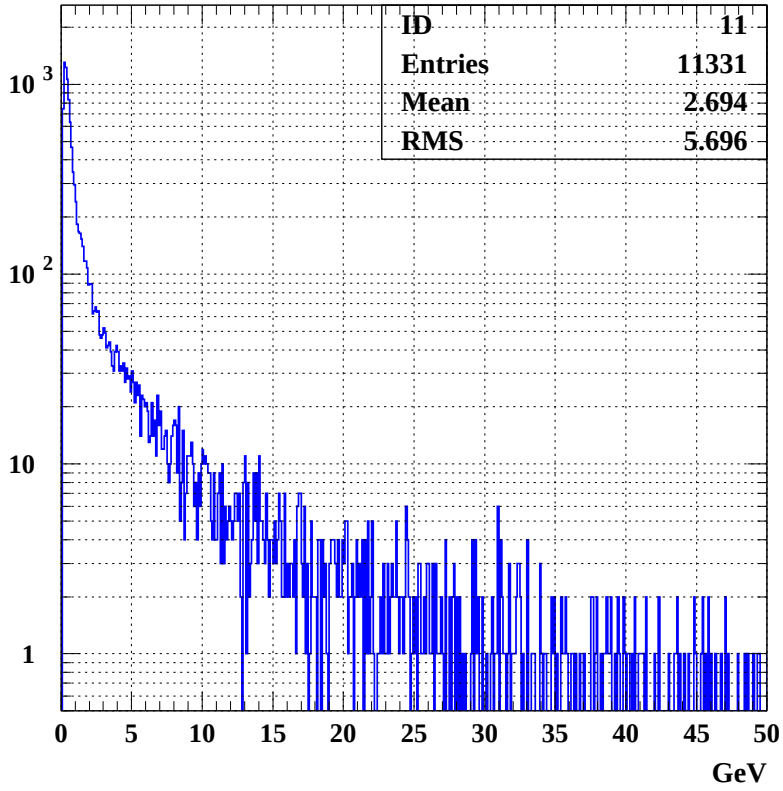
and efficiency for tracks that come far from IP = 96.1 %

t tbar 1000 GeV 3 Tesla

Momentum for MC particles near by IP

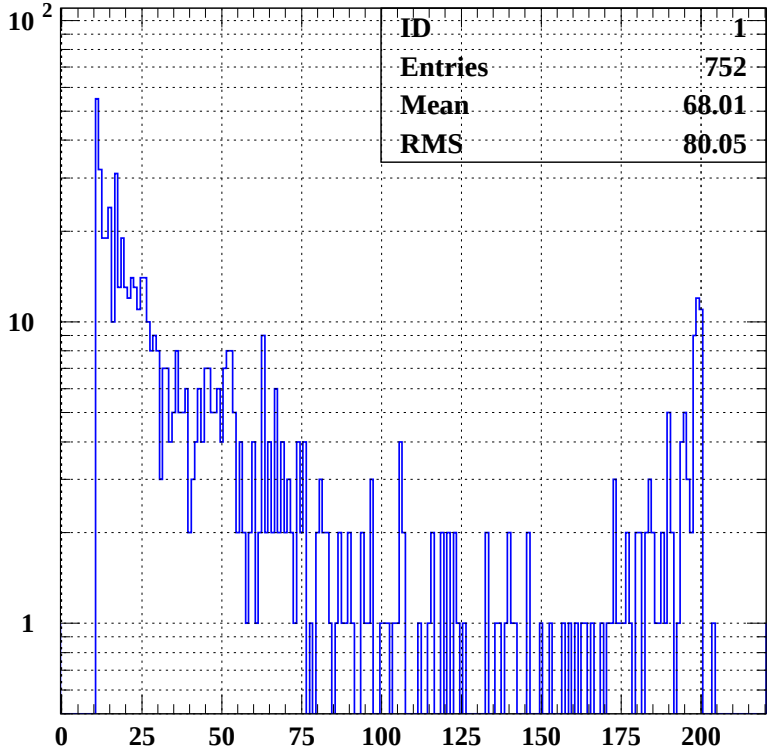


Momentum for MC particles far from IP

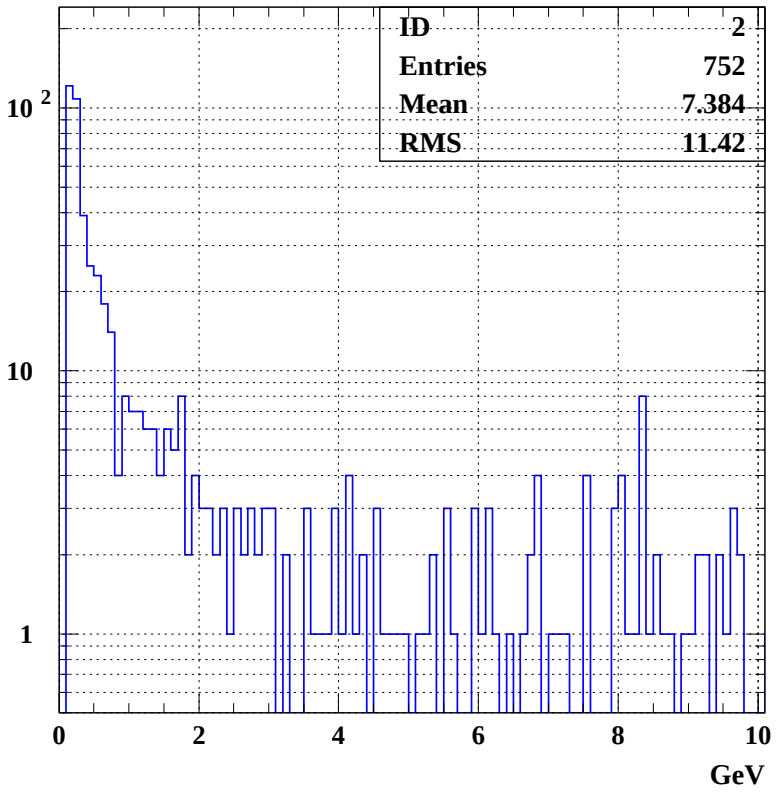


t tbar 1000 GeV 3 Tesla

Number of points if track not found



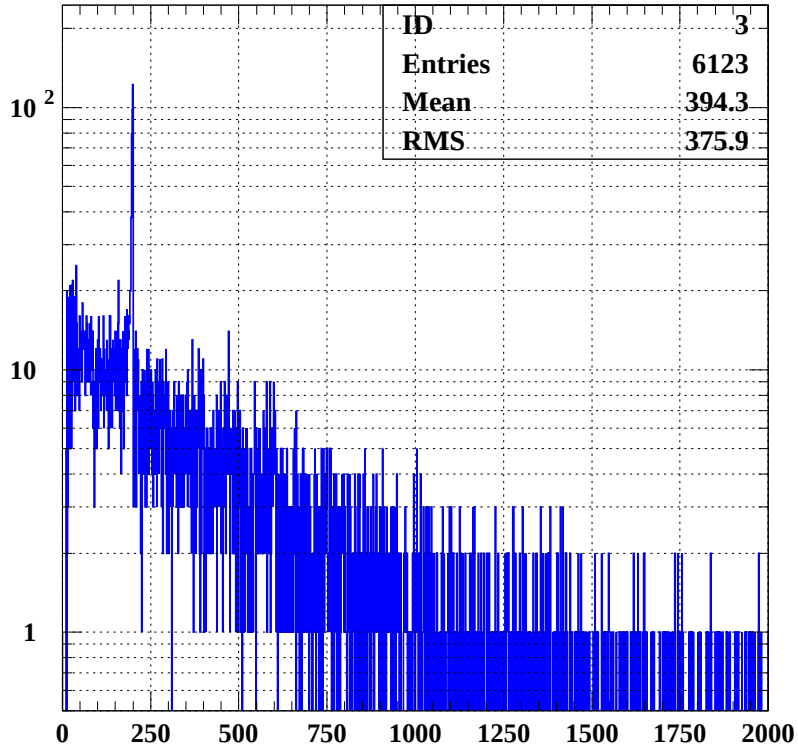
Momentum if track not found



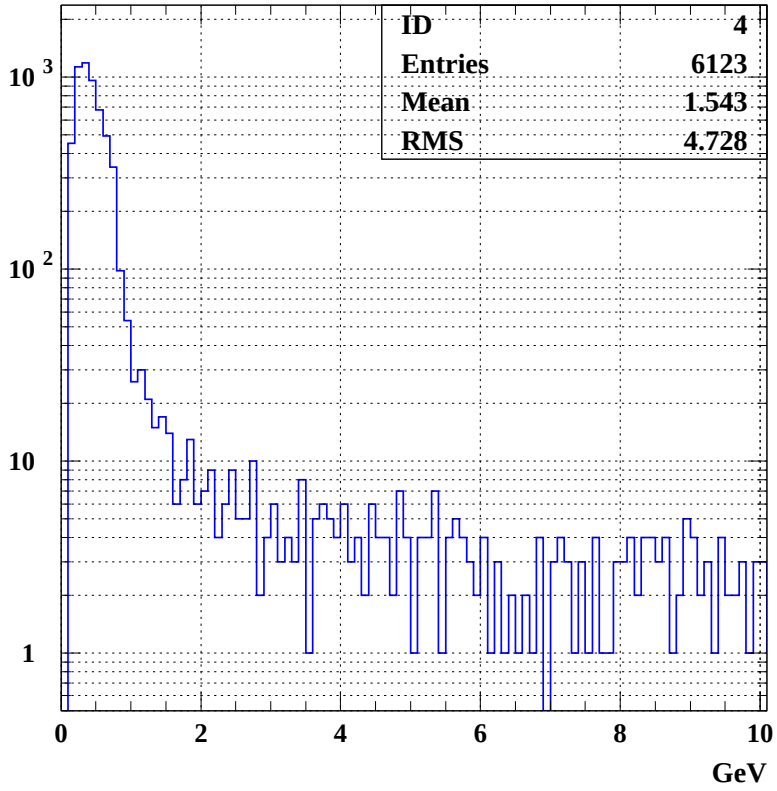
Overall efficiency = 98.0 % (on 37 221 True tracks)

t tbar 1000 GeV 3 Tesla

Number of points if many segments



Momentum if many segments



Conclusion

New track finding algorithm was developed.

It has an overall efficiency for the tracks from IP region better than 99 % ;

and efficiency for the tracks that far from IP region is about 96 % due to do not found curlings mainly.

The development of the found tracks fitting is under way.

It should give us the final result and it needs also for track segment merging as weel as for kink finding.