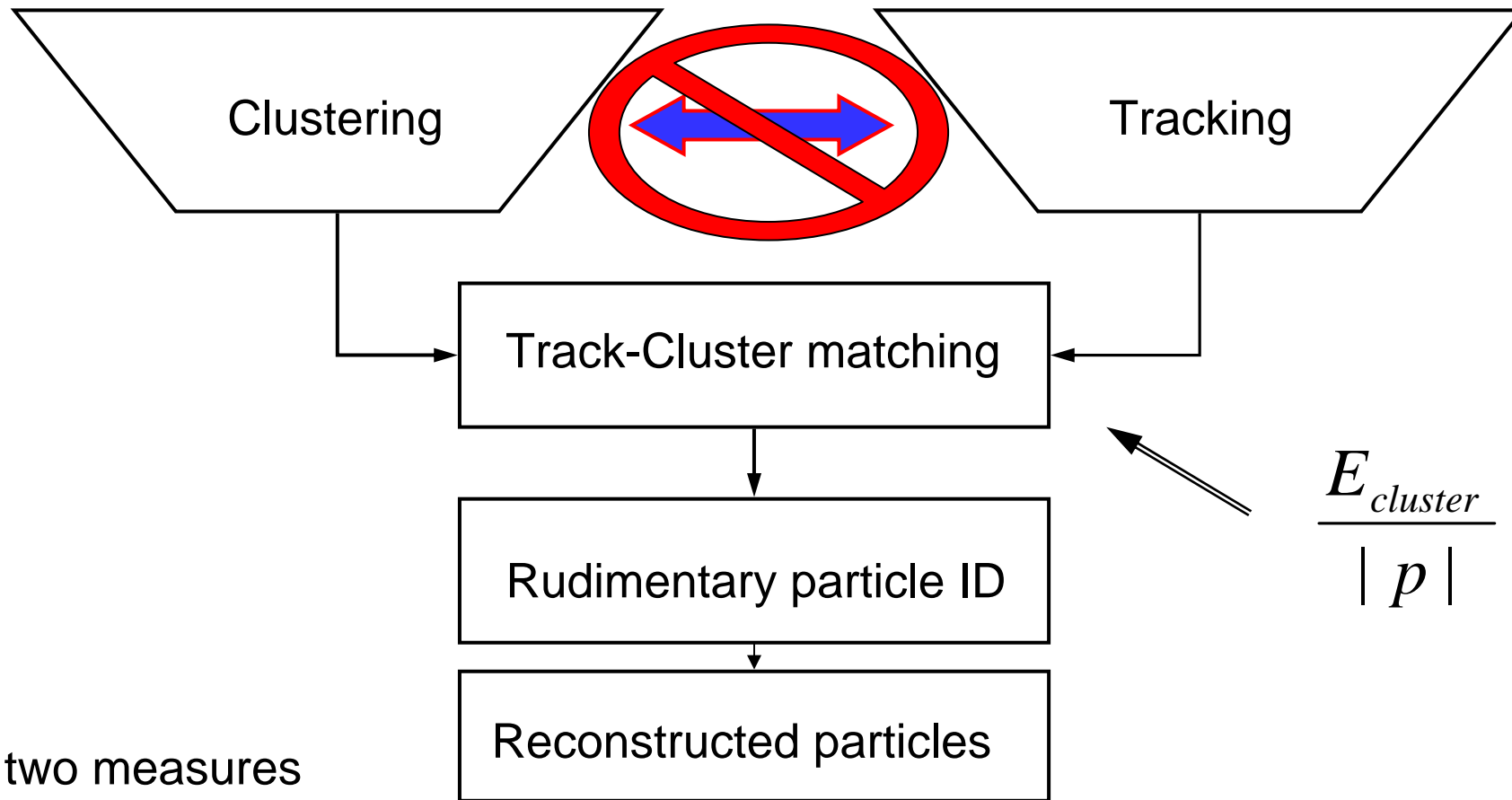


True particle flow and performance of recent particle flow algorithms

- Recent attempts to use so far implemented reconstruction software for detector optimization have shown unacceptable performance at higher center of mass energies
- Some uninformed people have even tried to question concept of Particle Flow
- Through this talk I will try to show you that the resulting performance is result of approach and implementation imperfectness
- WW events @500GeV only fully lepton ones ! - small statistics (10% of the sample) but easy to find the flows
- Simplest possible case at higher energy

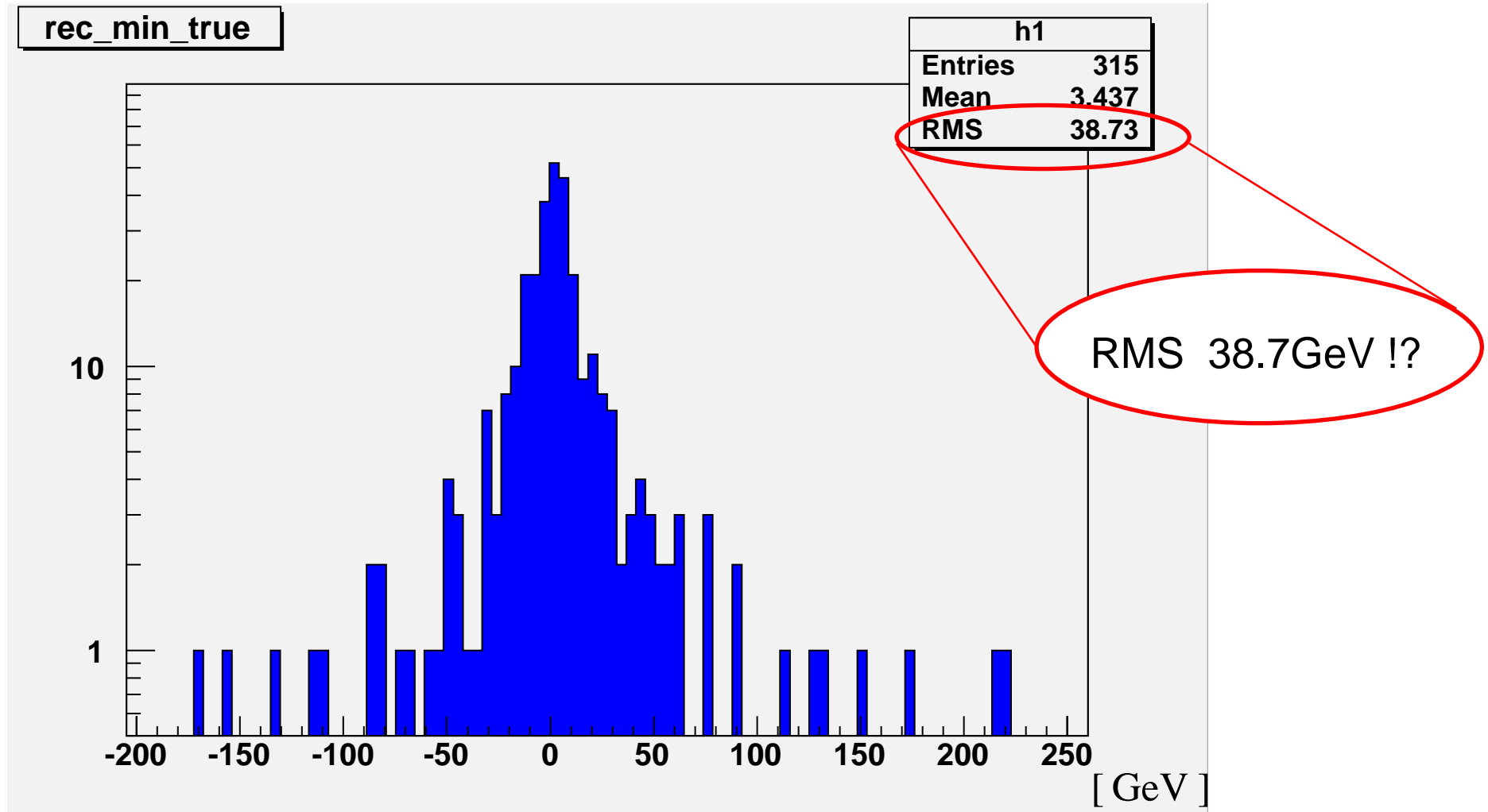
Algorithm at the moment



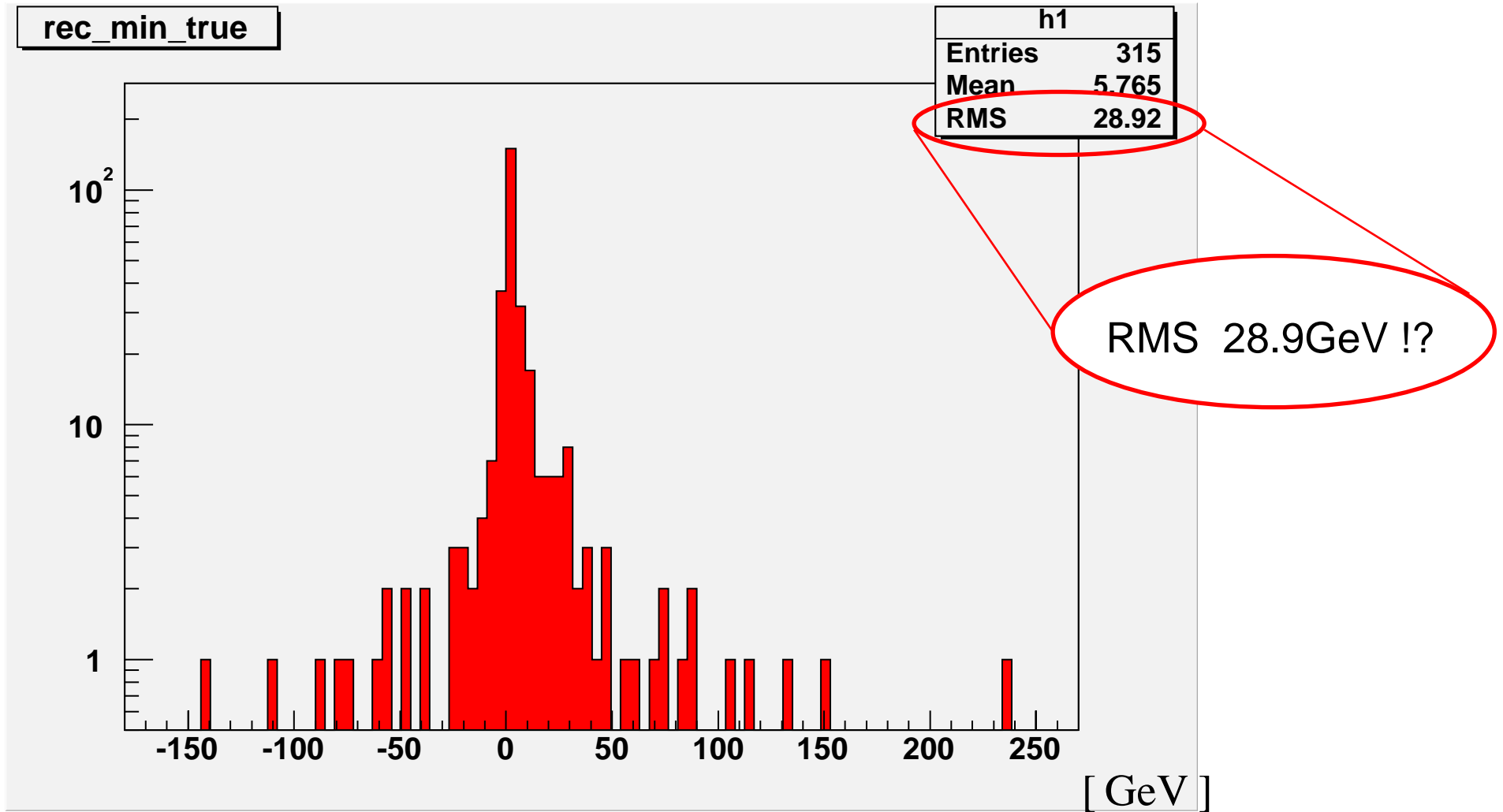
- two measures that will be used

$$\uparrow \text{diff} = \sum_i E_i^{reco} - \sum_j E_j^{measurable}$$

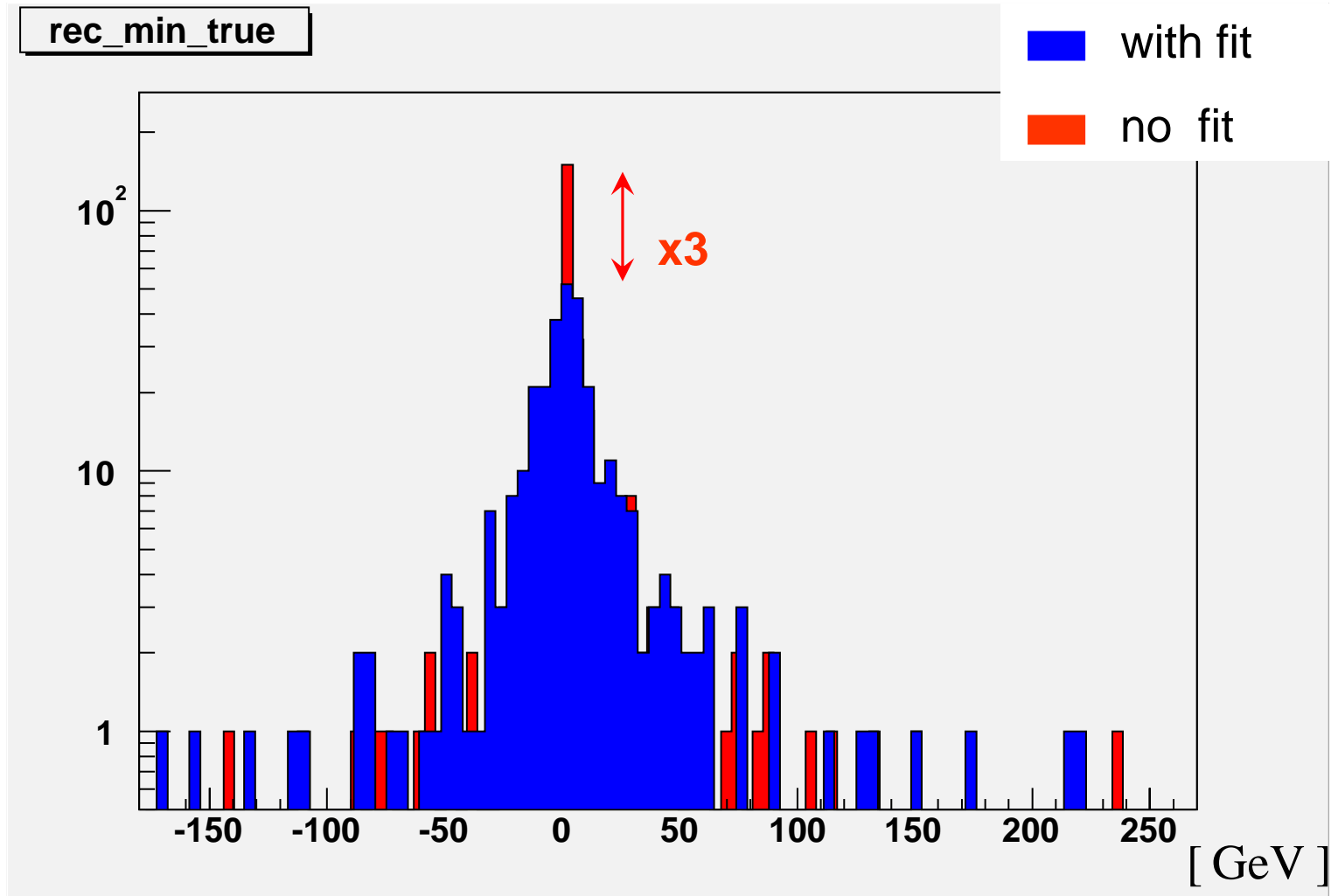
- track cheater (option FIT true tracks)
- Track wise Clustering
- Wolf



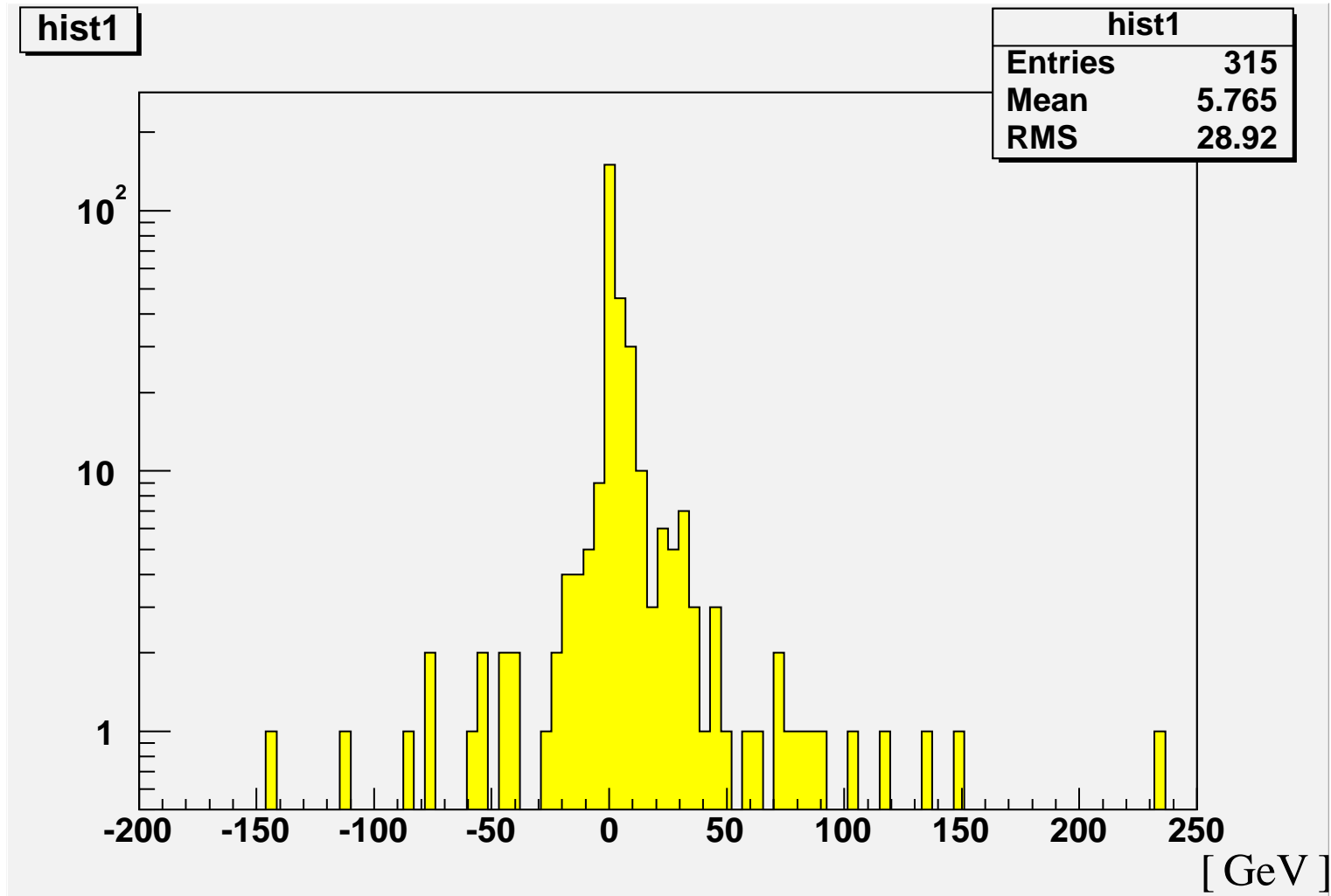
- track cheater (option NO FIT – MC momentum copied to track parameters)
- Track wise Clustering
- Wolf



- RMS 38.7GeV => 28.9GeV
- but the wings are still too large
something is still wrong !! => check the tracking



In further analysis I'll use the distribution with no fit – in yellow

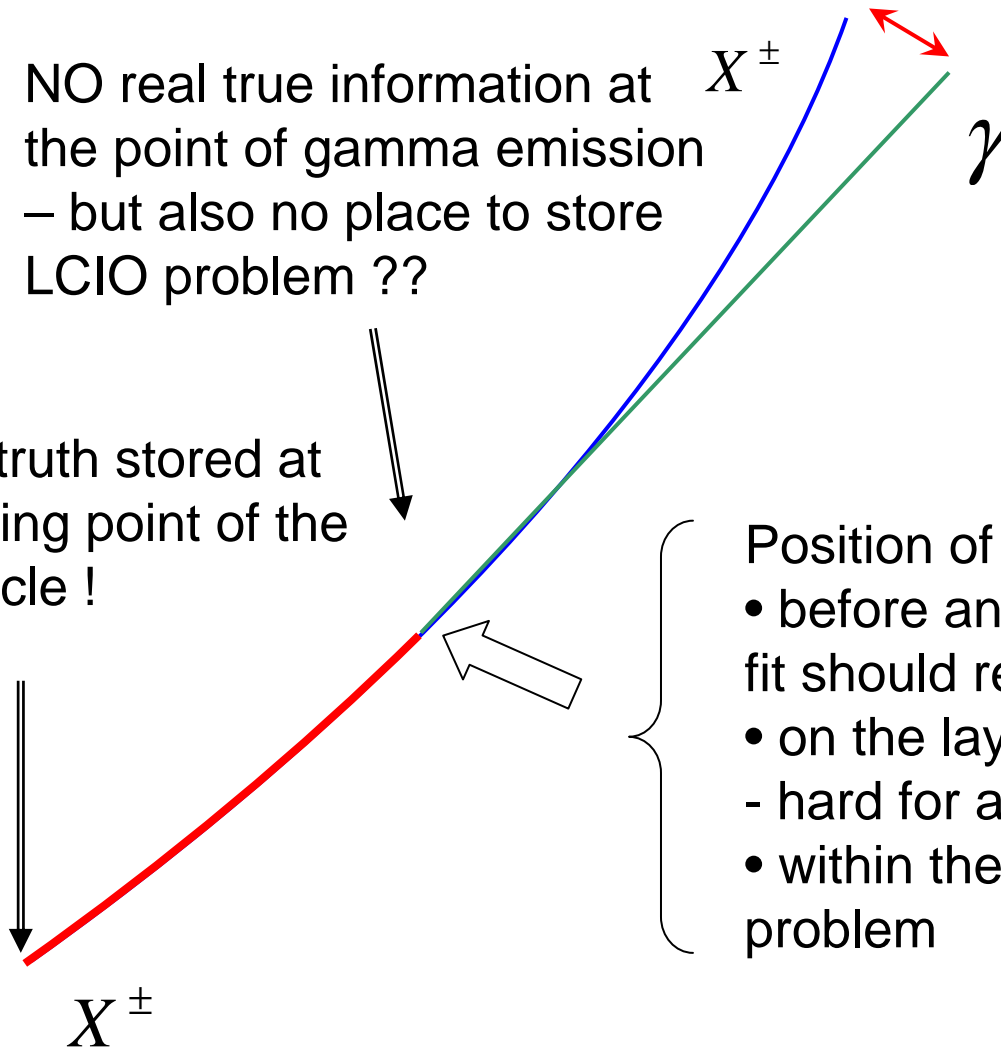


Kinks

Distance at the front face of calorimeter
- Usually very small for high energy tracks

NO real true information at
the point of gamma emission
- but also no place to store
LCIO problem ??

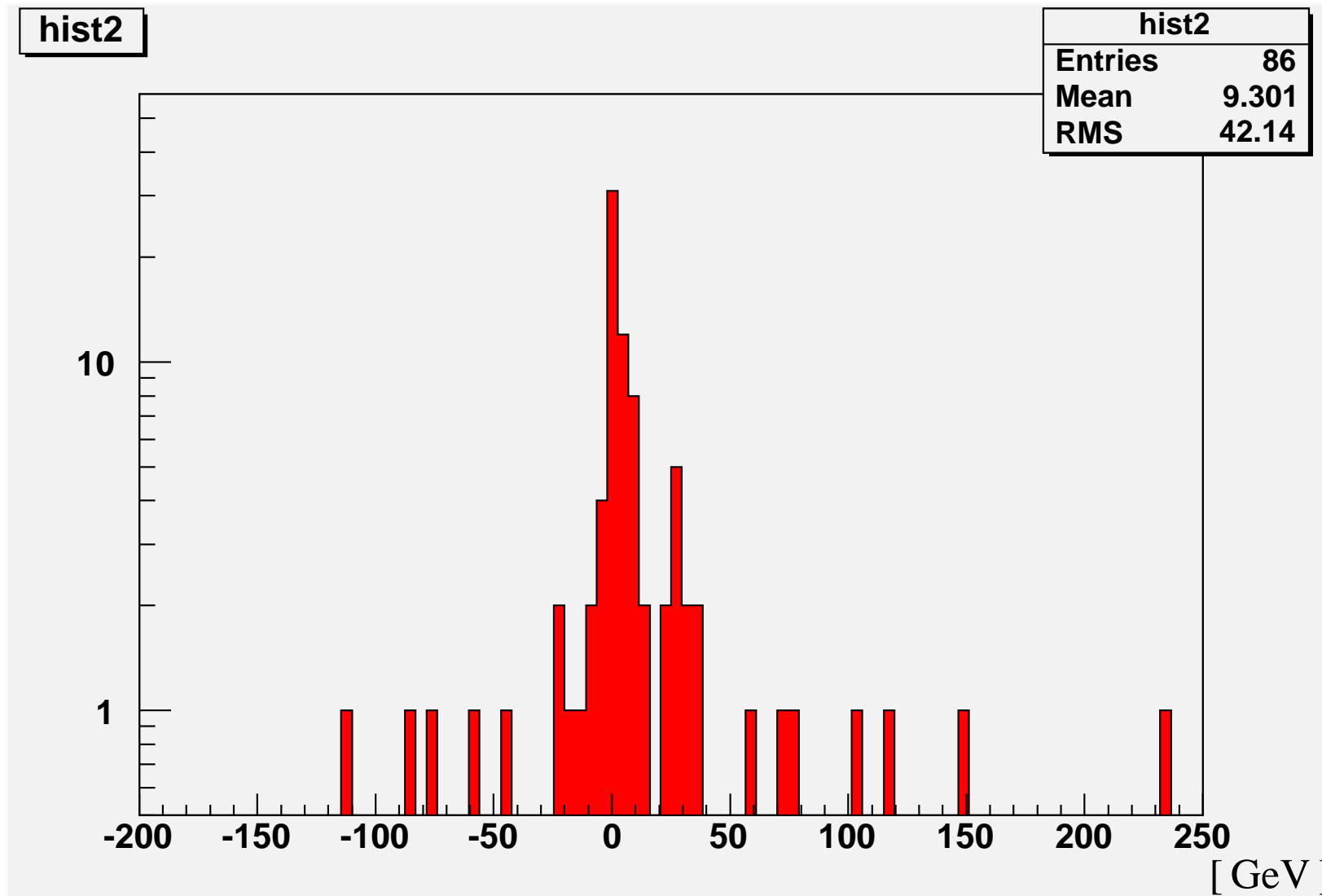
MC truth stored at
starting point of the
particle !



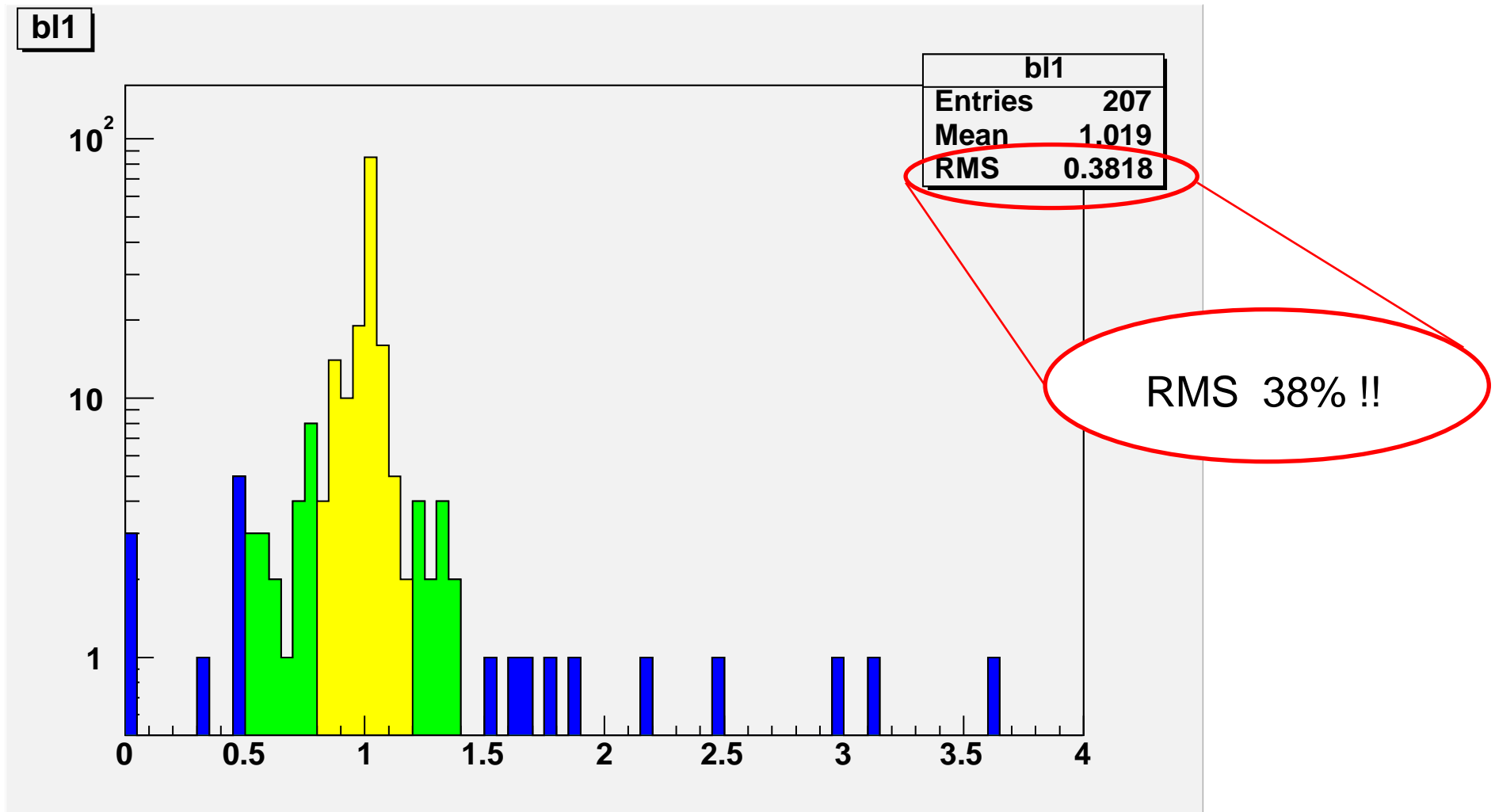
Position of the kink point -

- before any hit (on the beam tube) – fit should remedy this
- on the layers of silicon (VTX or SIT) - hard for a real tracking
- within the TPC - should be no problem

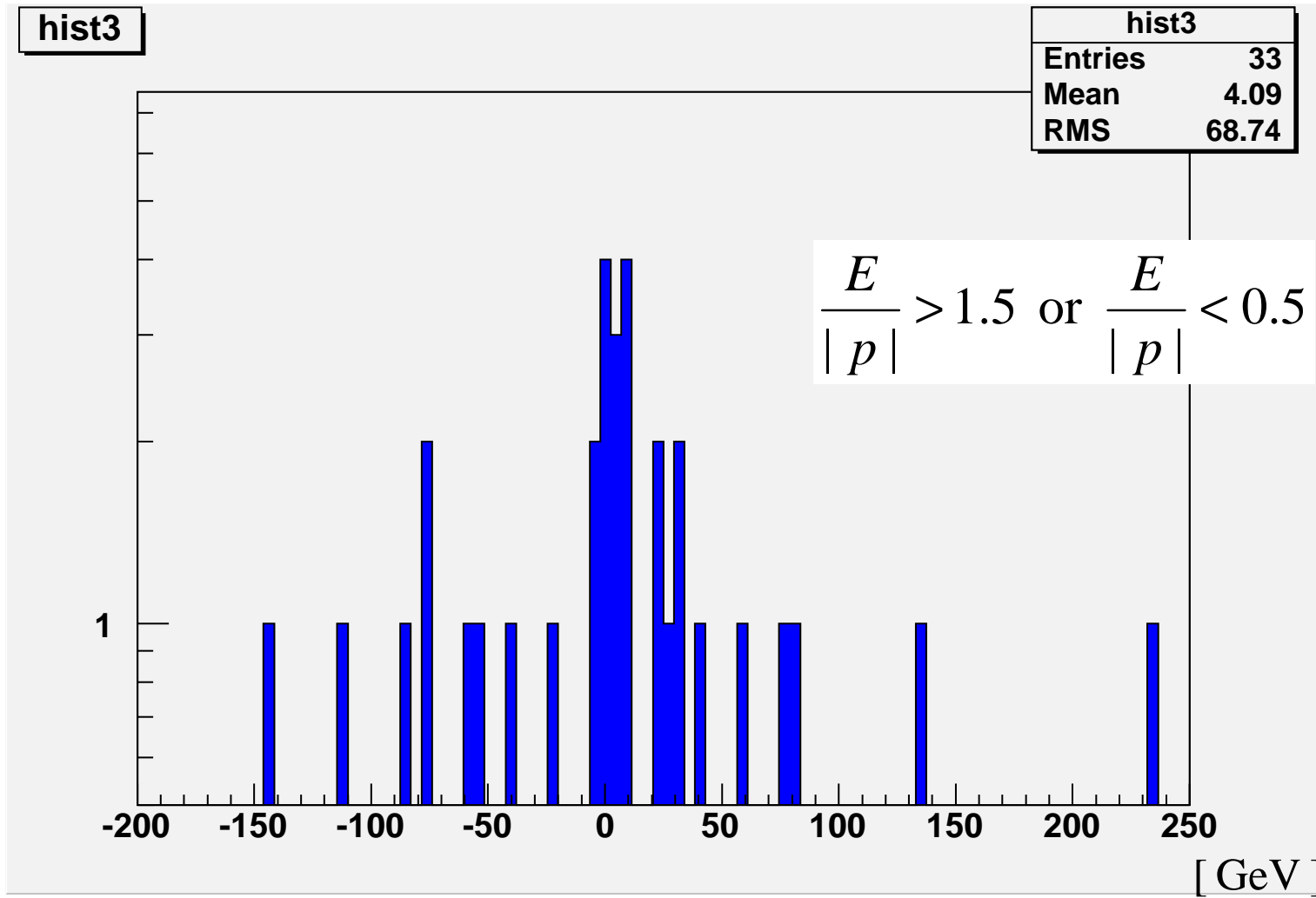
Kinks - from bremsstrahlung only ($E_\gamma > 1\text{GeV}$)
events in which this happen are in red



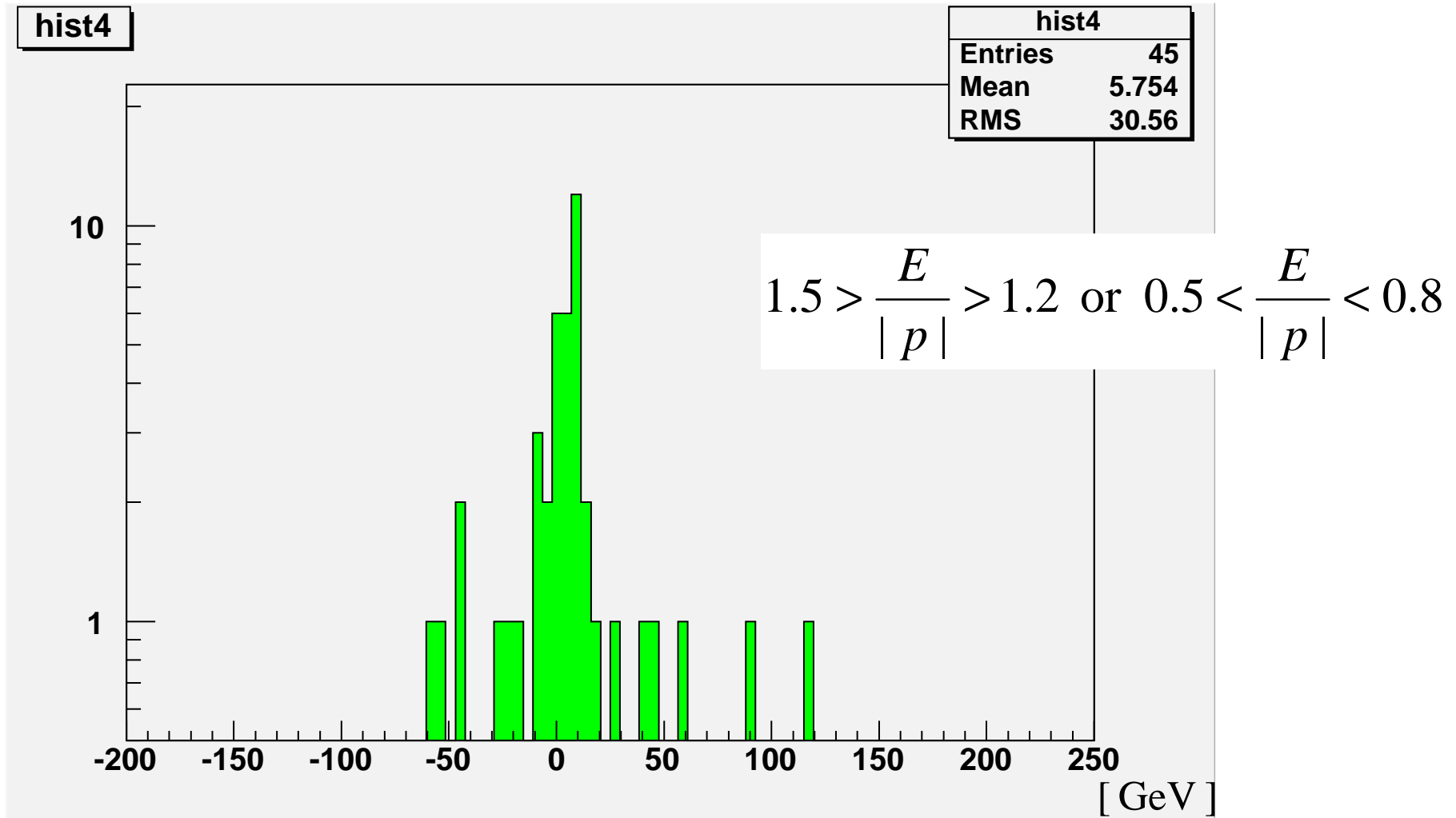
- Distribution of $\frac{E_{cluster}}{|p|}$ for the WW lepton events (muons excluded)



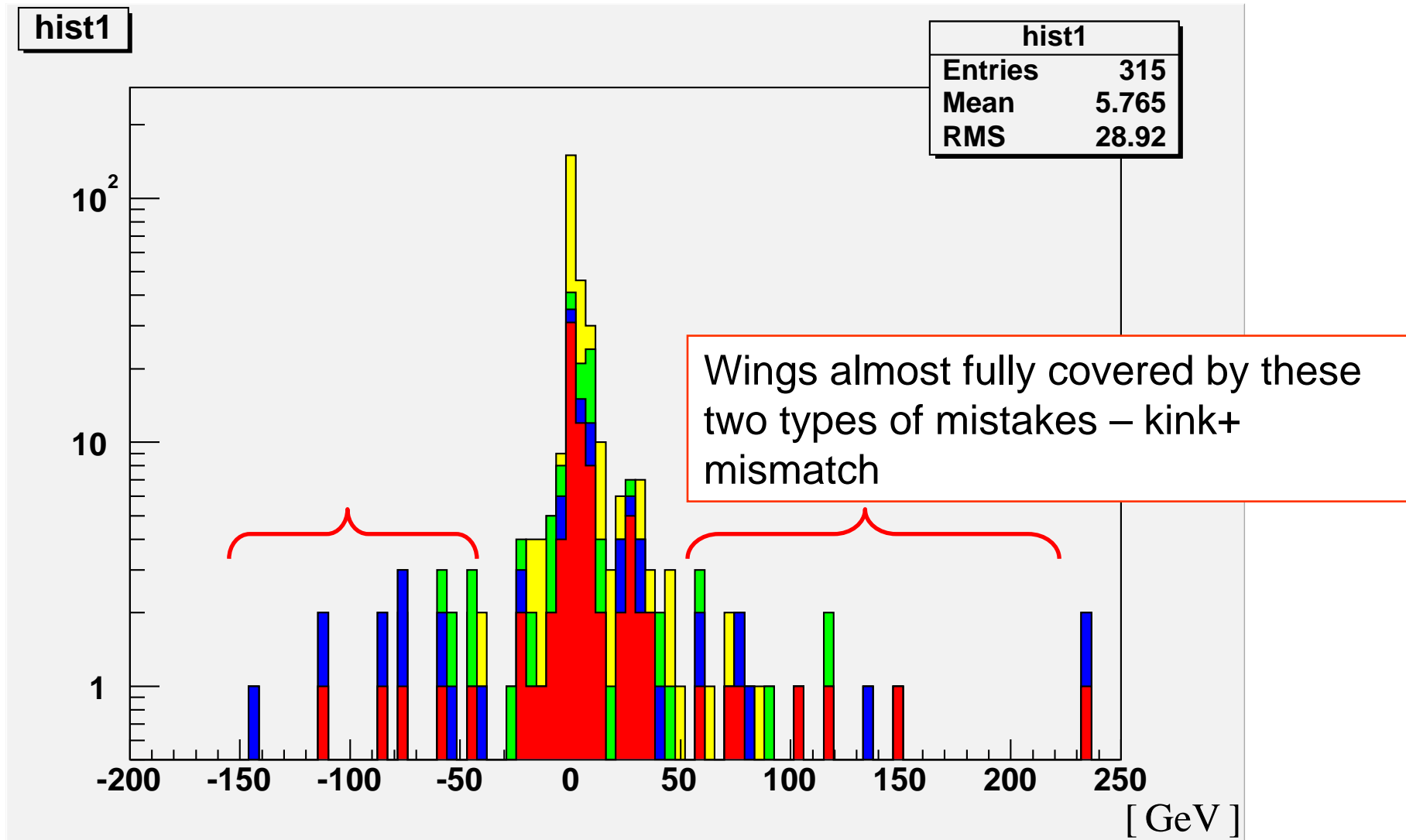
Mismatch of track momentum and energy in the cluster
(muon clusters excluded) events are in blue !



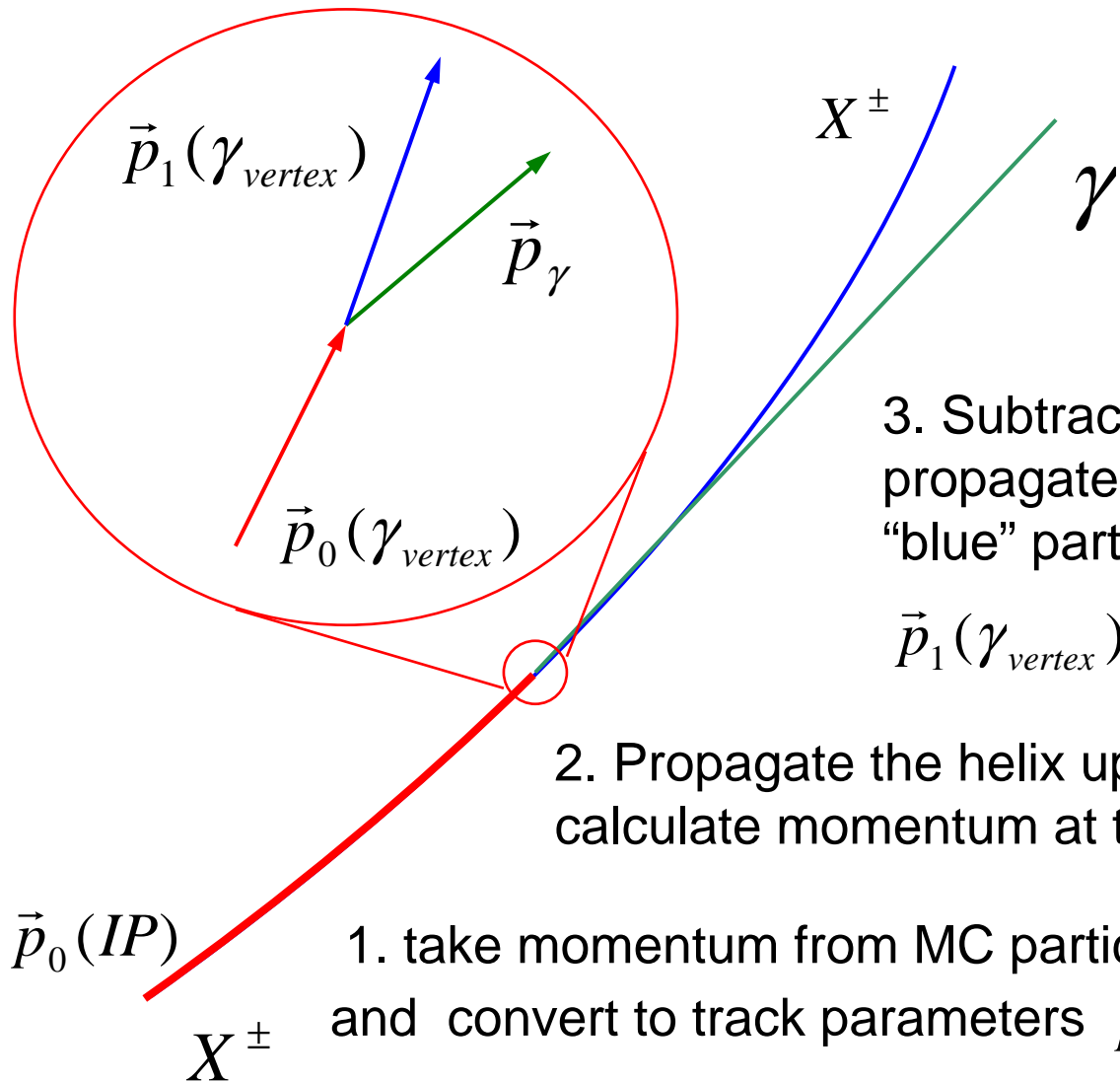
Mismatch of track momentum and energy in the cluster
(muon clusters excluded) events are in green !



All together



TMP solution for kinks



4. If there is another one loop through the steps again with $\vec{p}_0(IP) \rightarrow \vec{p}_i(\gamma_i^{vertex})$

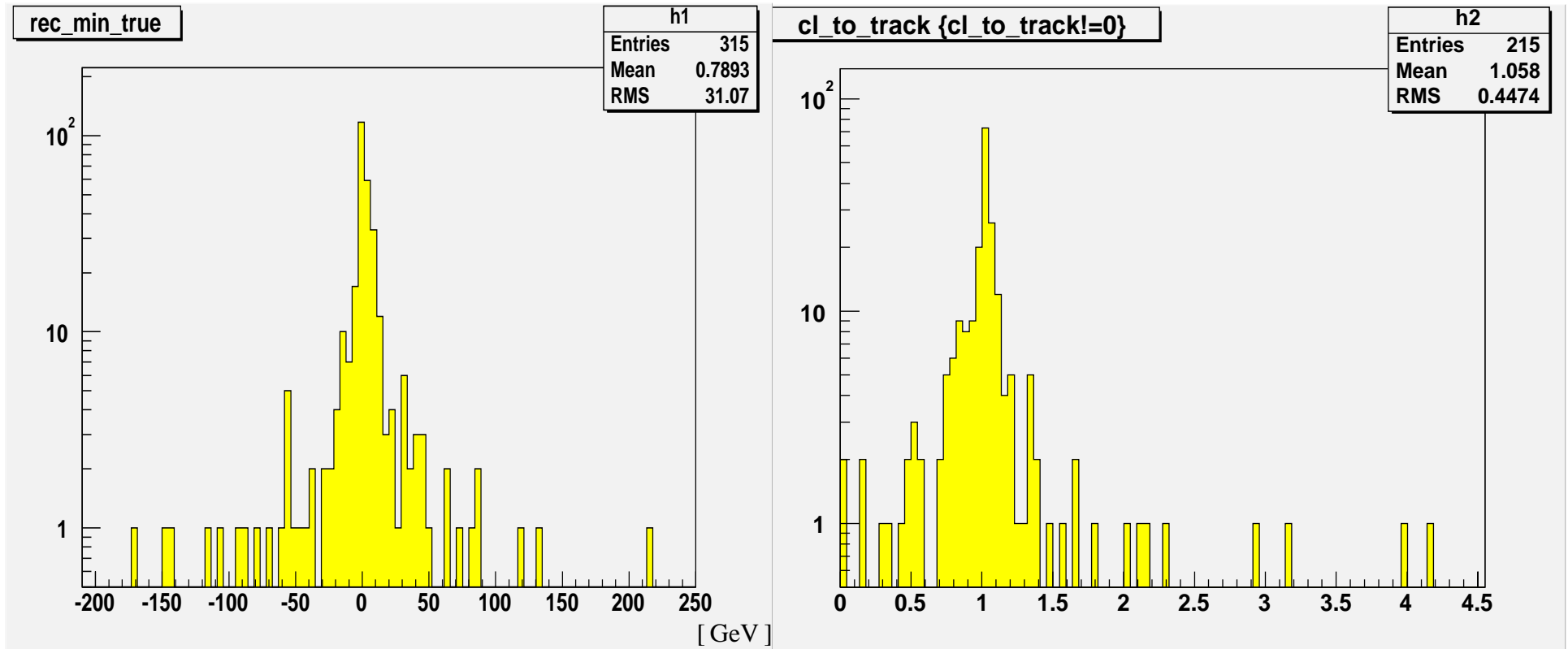
3. Subtract photon momentum from propagated one and assign to the "blue" part of track

$$\vec{p}_1(\gamma_{vertex}) = \vec{p}_0(\gamma_{vertex}) - \vec{p}_\gamma$$

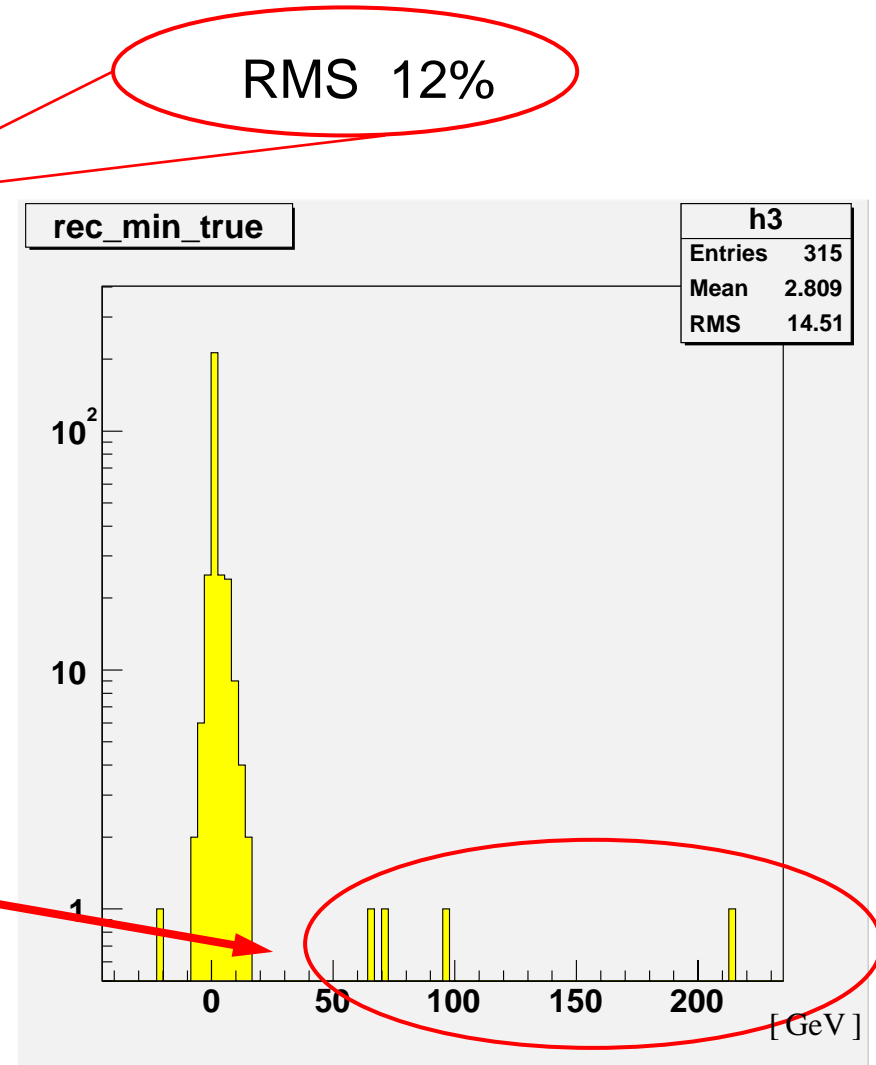
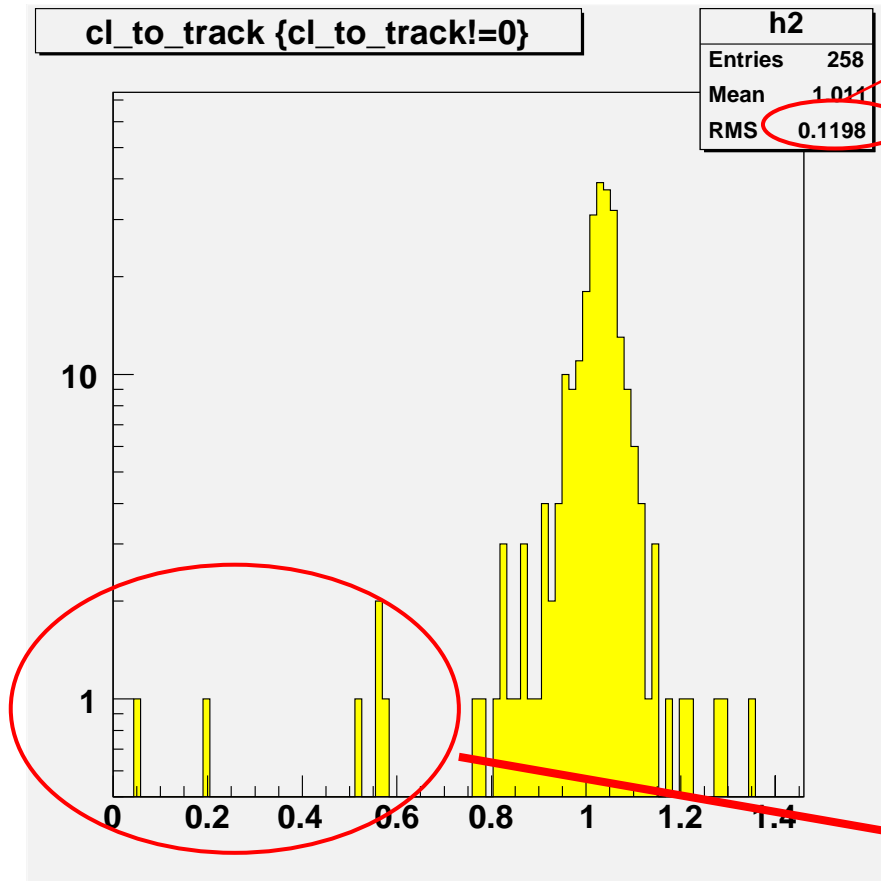
2. Propagate the helix up to the gamma vertex and calculate momentum at this point $track \rightarrow \vec{p}_0(\gamma_{vertex})$

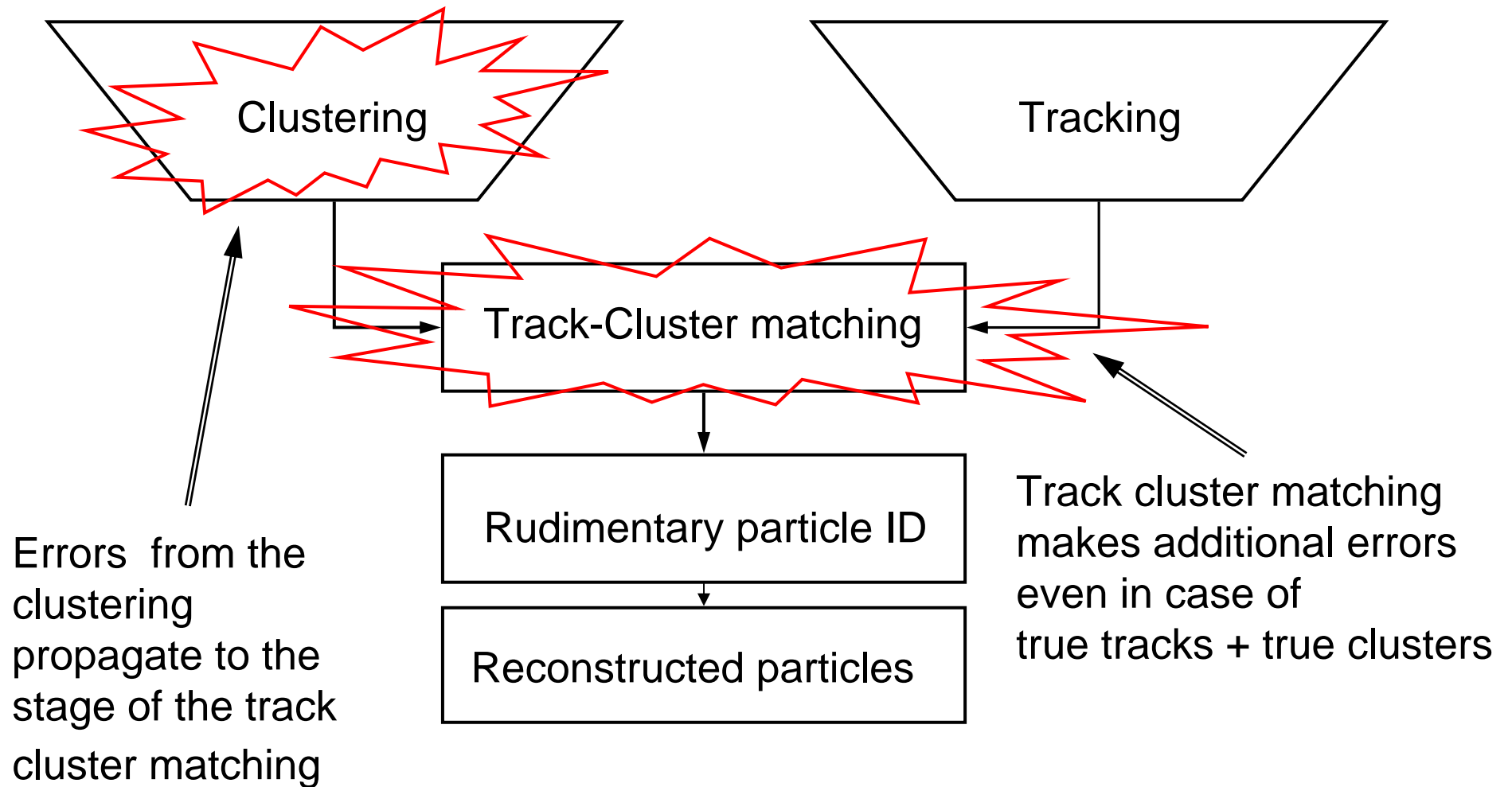
1. take momentum from MC particle at starting point and convert to track parameters $\vec{p}_0(IP) \rightarrow track$

Now the tracking is fixed we can look again at distributions
It's not getting better !! so there is additional source of error
=> maybe clustering ?

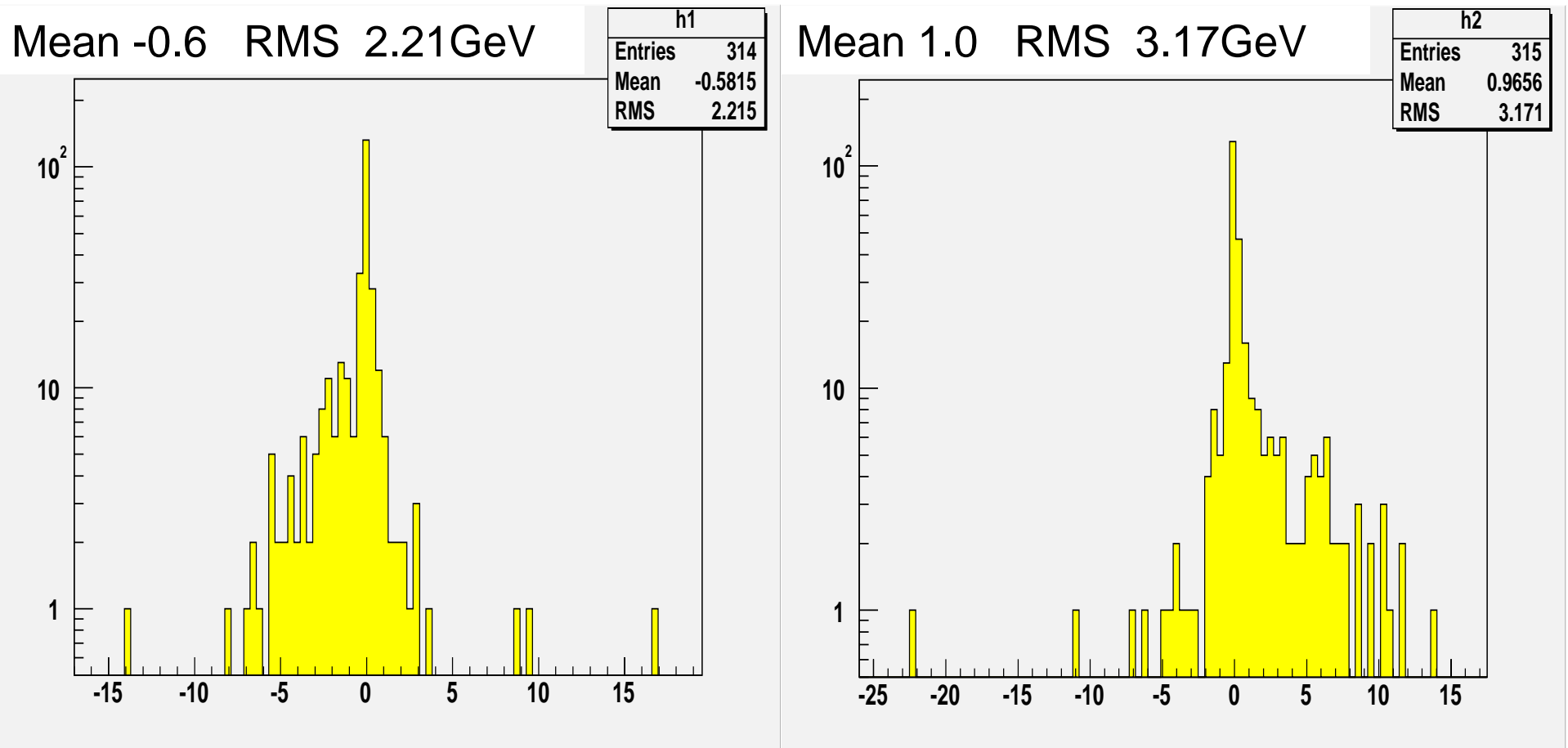


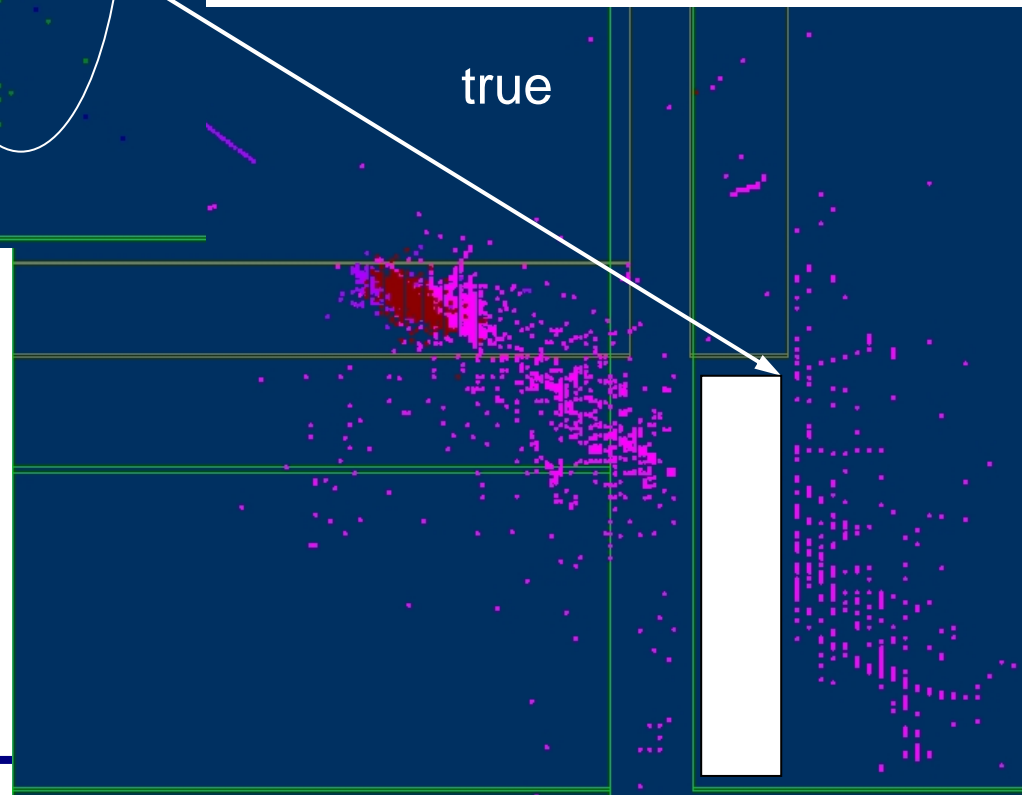
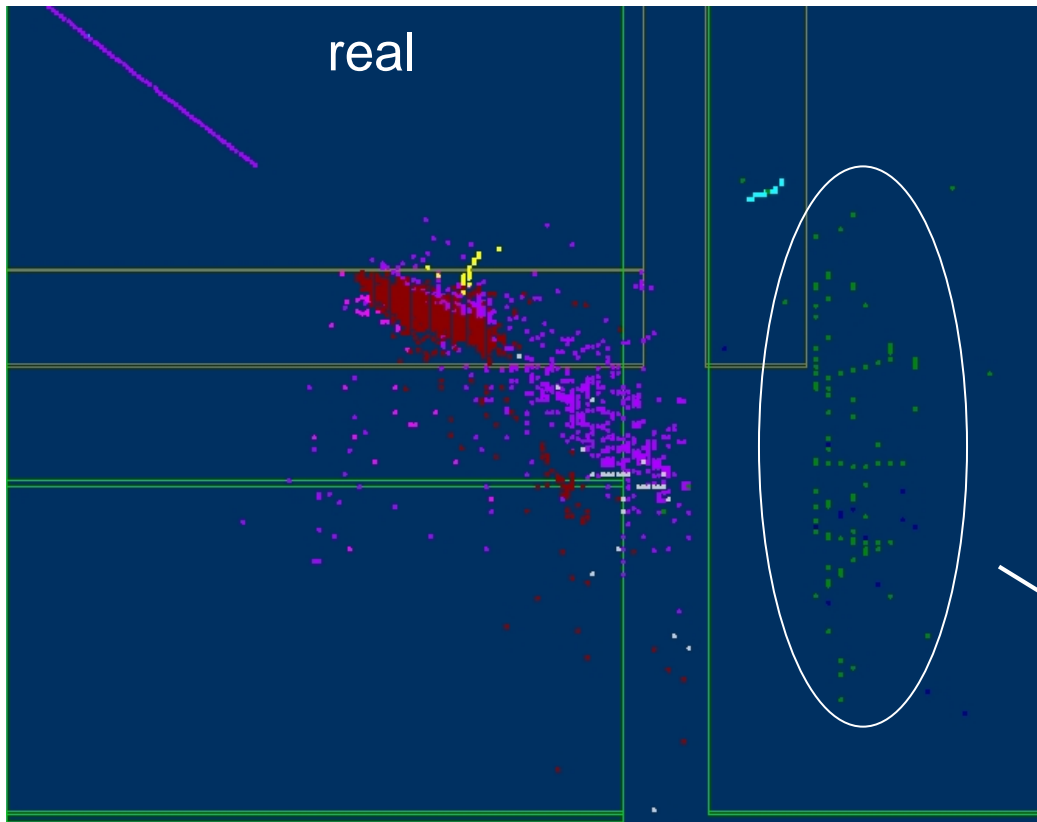
- kink corrected track cheater (option NO FIT for true tracks)
- true clusters
- Wolf





- kink corrected track cheater (option NO FIT for true tracks)
- true clusters
- true matching
- **different calibration !!**
- think before you put `If(A<B)` in your code

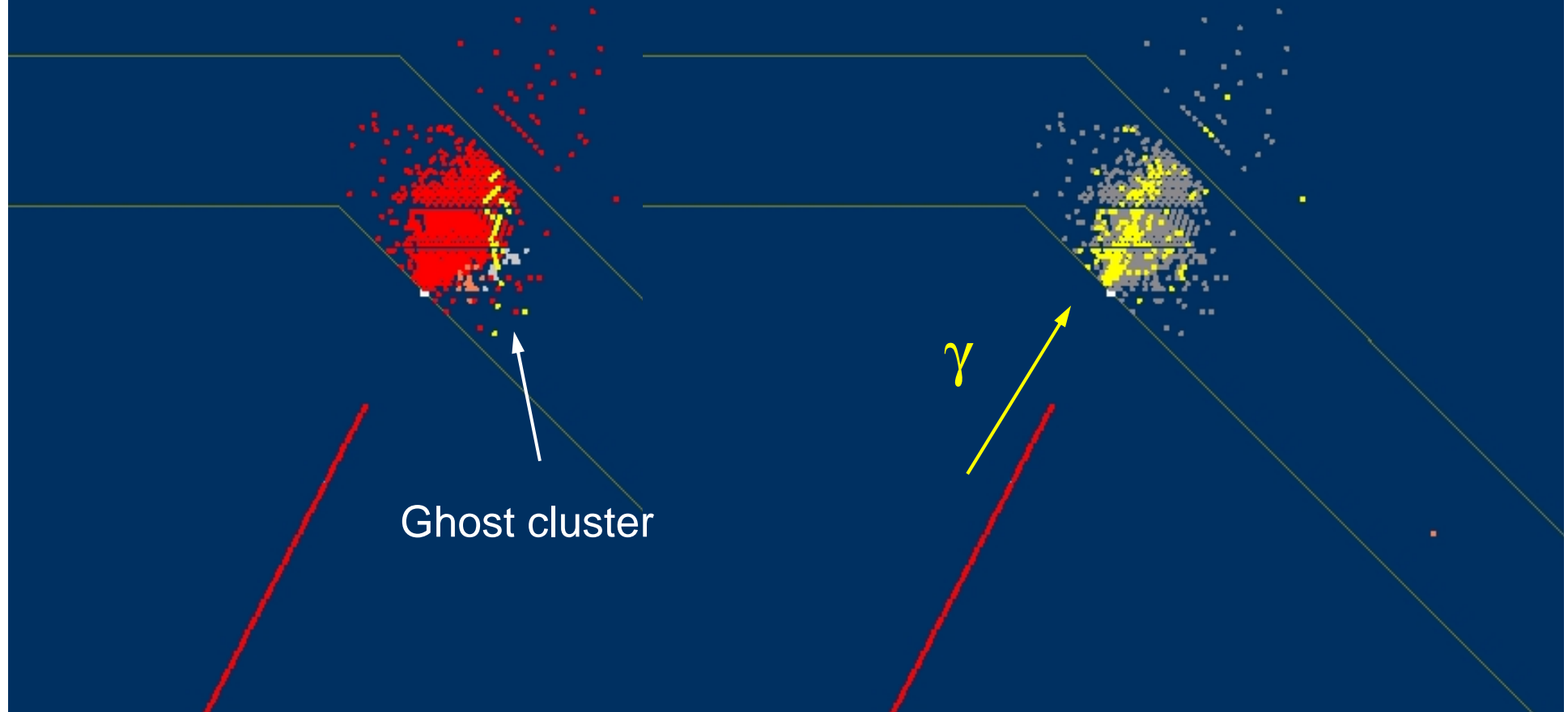


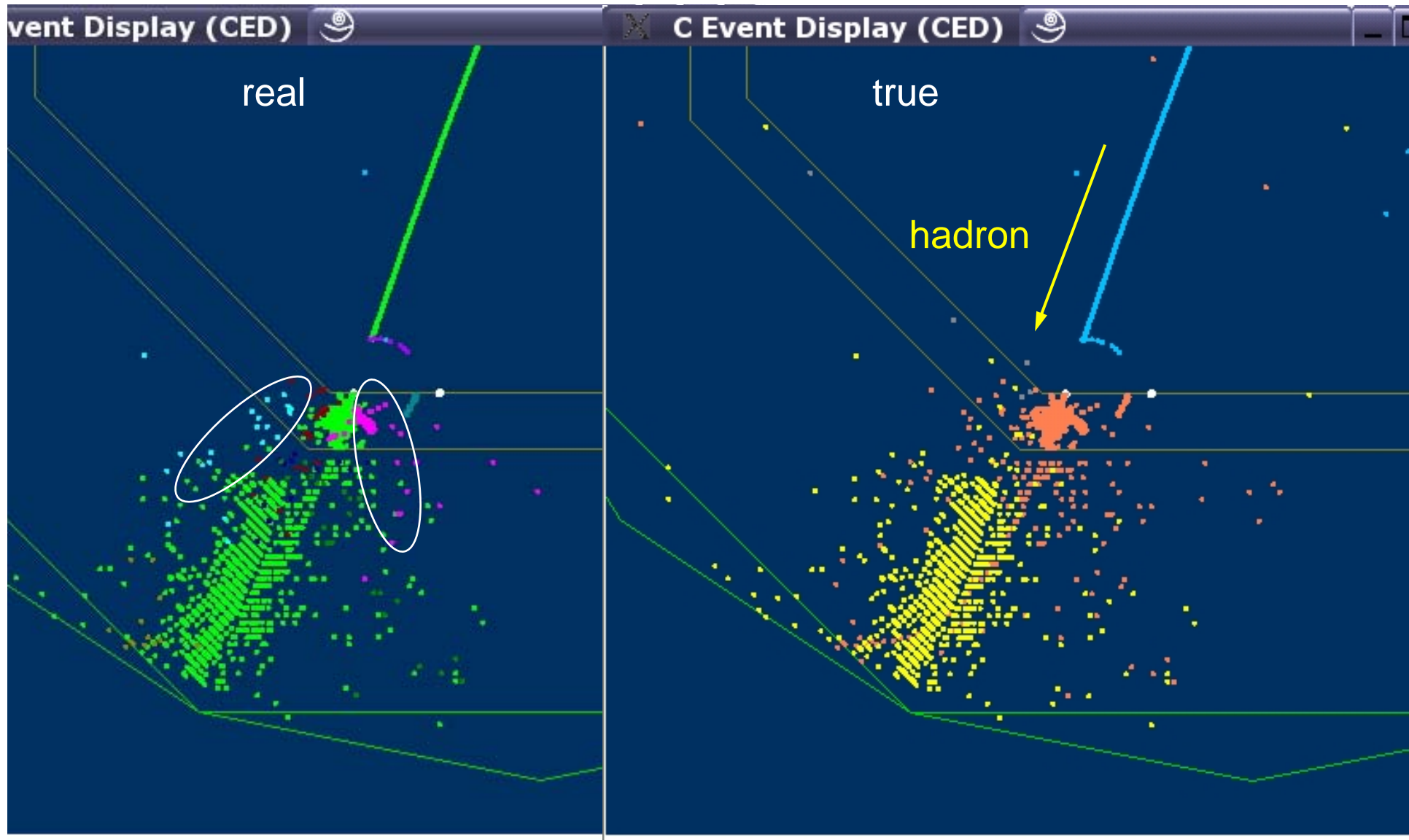


- need for more detail geometry description

real

true





Whole event resolution – fully hadronic events

Effect	Z_{pole}	500 GeV		
		Z	W^+W^-	$t\bar{t}$
σ_{NOT_PPF} [GeV]	1.76	2.76	3.13	3.01
σ_{PPF} [GeV]	1.63	3.94	4.79	4.38
σ_{total} [GeV]	2.40	4.81	5.72	5.31
σ_{total} %/ \sqrt{E}	25.1%	21.5%	25.6%	23.7%

Partial relative resolutions in percents

% to total resolution	Z_{pole}	500 GeV		
		Z	W^+W^-	$t\bar{t}$
$\sigma_{neutrino}$	12.28	2.44	1.50	6.66
$\sigma_{around\ tube}$	41.48	30.66	28.43	25.41
sum	53.76	33.10	29.93	32.07
σ_{HCAL}	34.12	40.01	51.39	54.79
σ_{ECAL}	5.66	20.95	14.40	6.95
σ_{masses}	6.56	5.95	4.28	6.19
sum	46.34	66.91	70.07	67.03

Conclusions

- We are ready for GigaZ option ☺
- Clustering decoupled from tracking will not give the desired performance
- There is a need both to restructure the algorithm and to improve it in several parts
- There is urgent need to solve some “technical” questions –geometry, storage of full true information ...
- If the performance is not what you have hoped for it's not the concept - you have done something wrong