

*Track reconstruction in
VXD+Silicon Tracker*

Fedor Ignatov

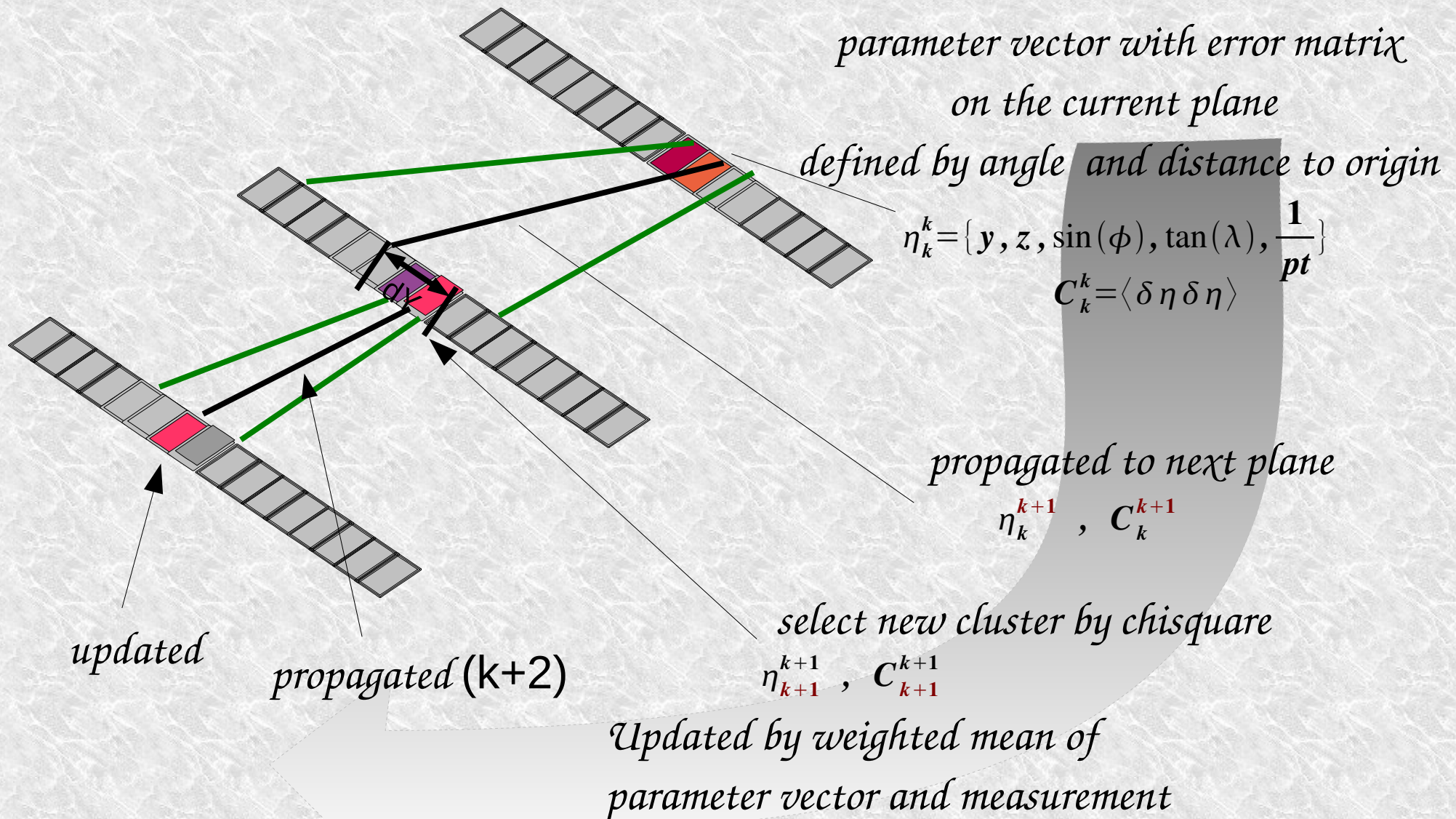
Tracking strategy

- ✗ *Seeding from inner layers to outside based on road approach:*
 - ✗ *From first RecPoints and vertex position
linear extrapolation to next layer*
 - ✗ *When 3 points are available => helix extrapolation to next
layer (parameters taken from 3 last points)*
 - ✗ *At each layer up to 4 closest points are taken inside road*
- ✗ *Refit by Kalman Filter all combinations:
trying to add new RecPoint and filtering bad RecPoints*
- ✗ *Select best combination by χ^2 and number of points*
- ✗ *Repeat seeding few times with wider road at each iteration*

Basic Principle of Kalman Filter

× Recursive least-squares estimation

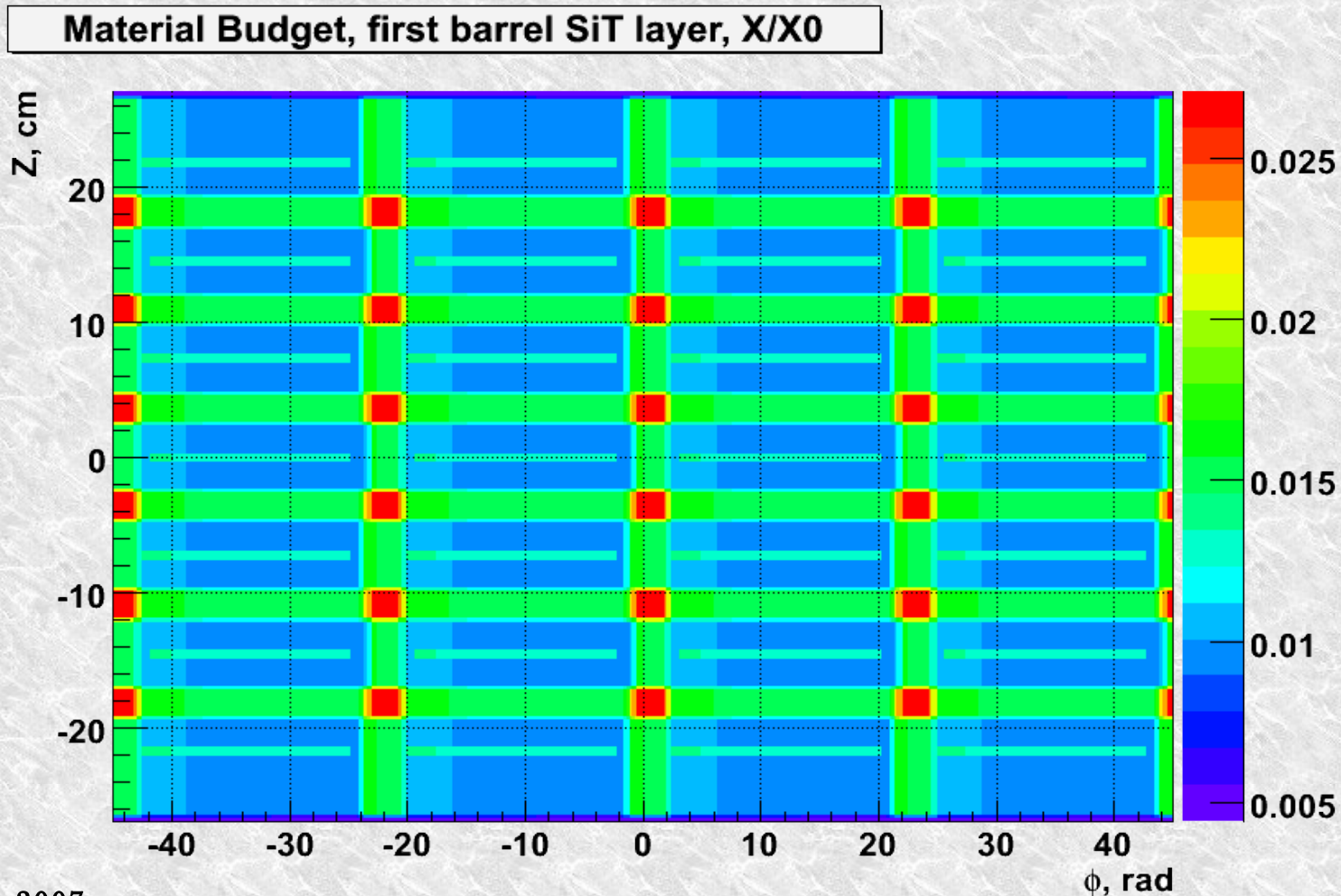
× Suitable for combined track finding and fitting



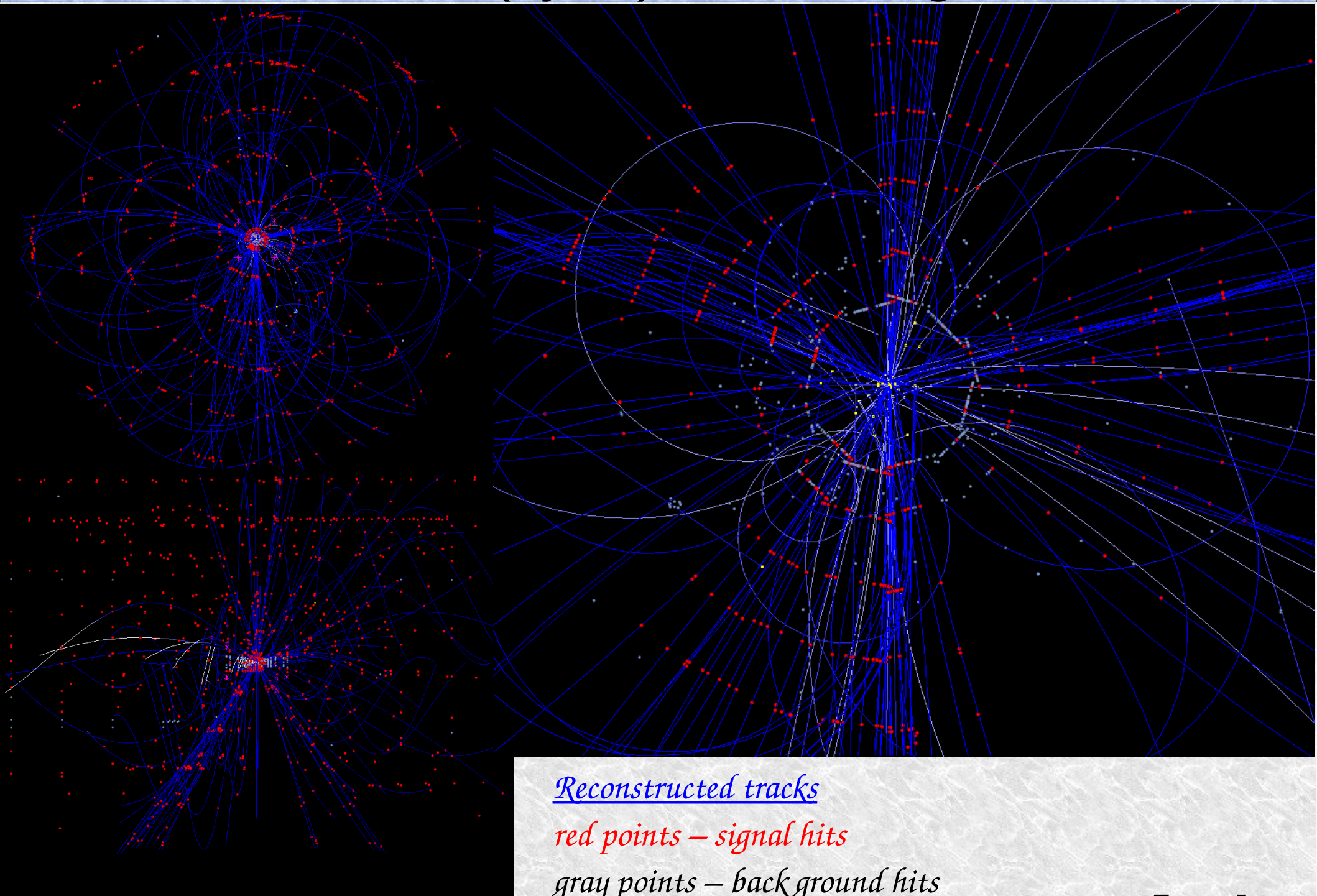
Material treatment

At each layer performed correction for energy loss and contribution from multiple scattering by using material from TGeoGeometry – material budget depend on position at layer (difference 1.0--2.7 % X/X_0)

It is also included virtual layers from support structures for track navigation between layers.



ttbar event(6jets) with background

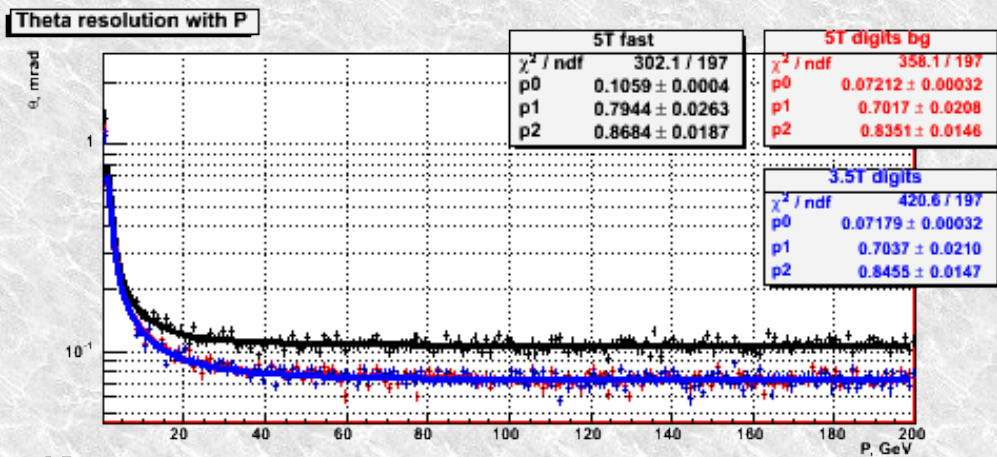
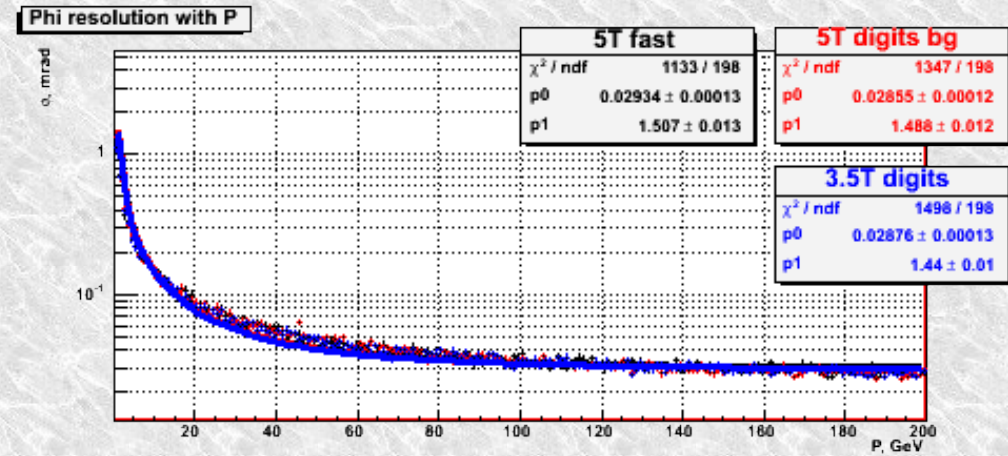
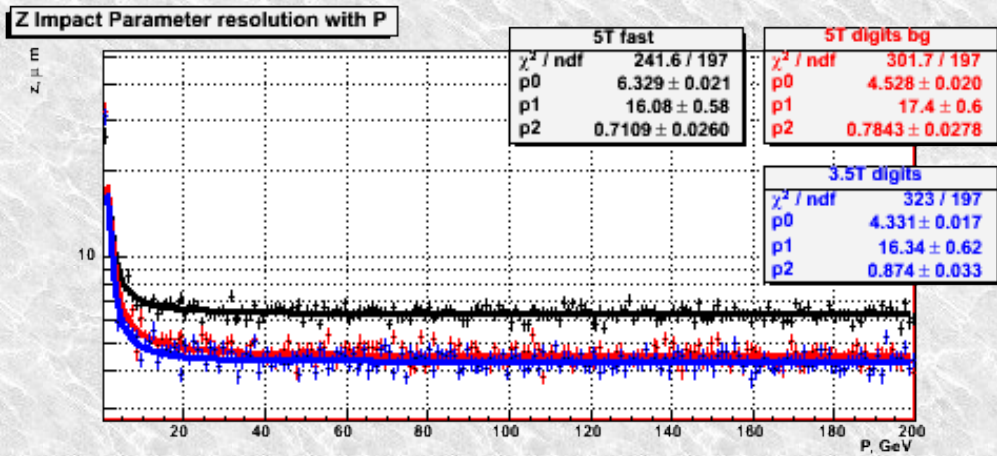
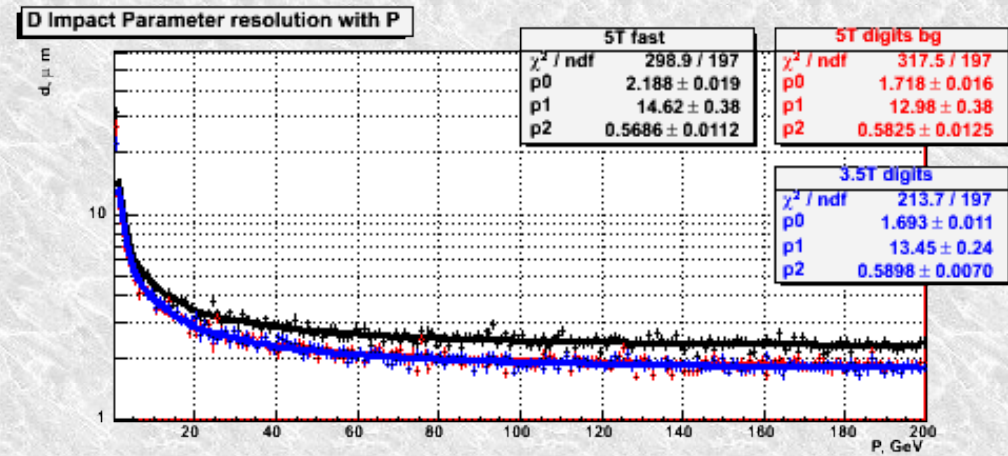
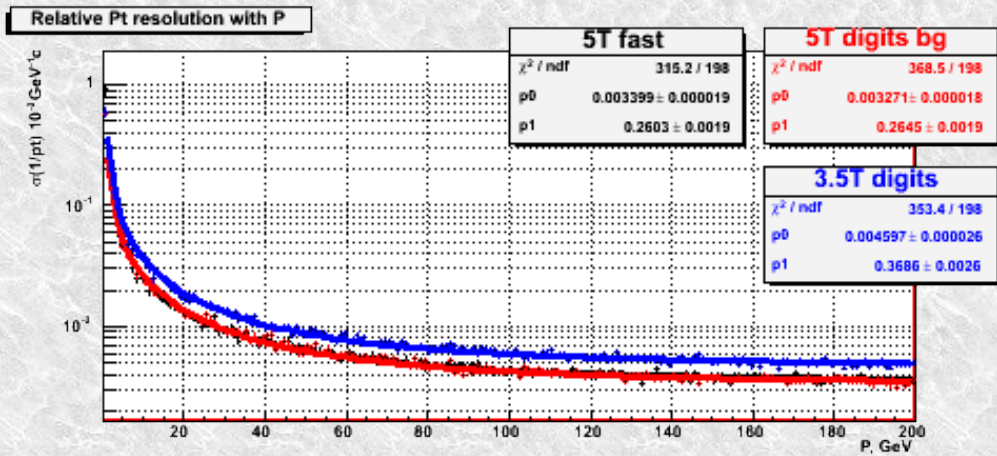


Reconstructed tracks

red points – signal hits

gray points – background hits

Resolution vs Momentum (10 muons)



For muons with $P < 200 \text{ GeV}$

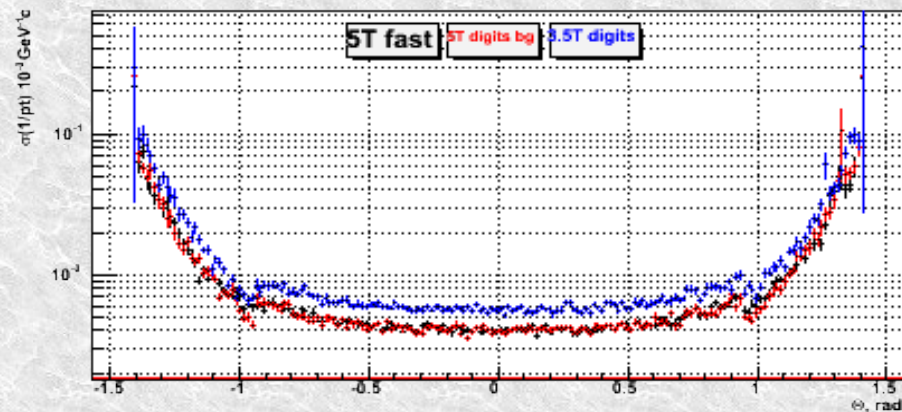
5 Tesla , digits , with background

3.5 Tesla, digits

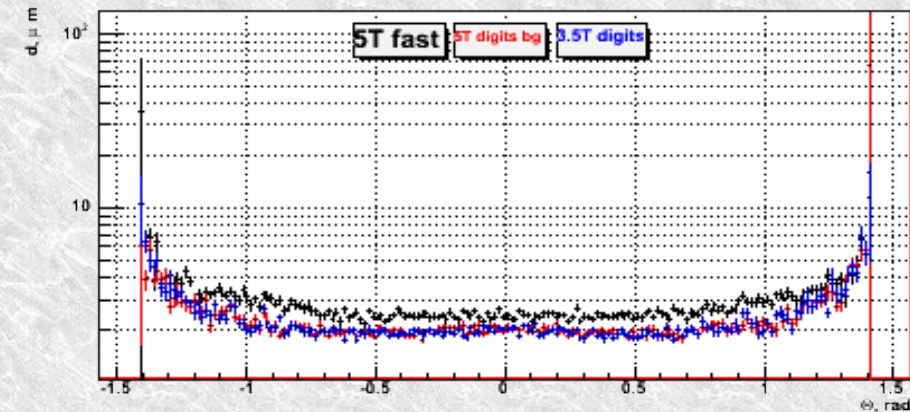
5Tesla , Fast RecPoints

Resolution vs Theta (10 muons)

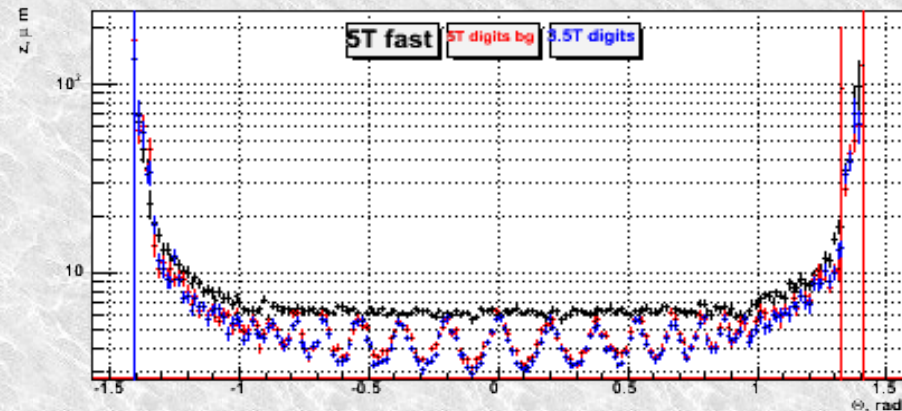
Relative Pt resolution with Theta



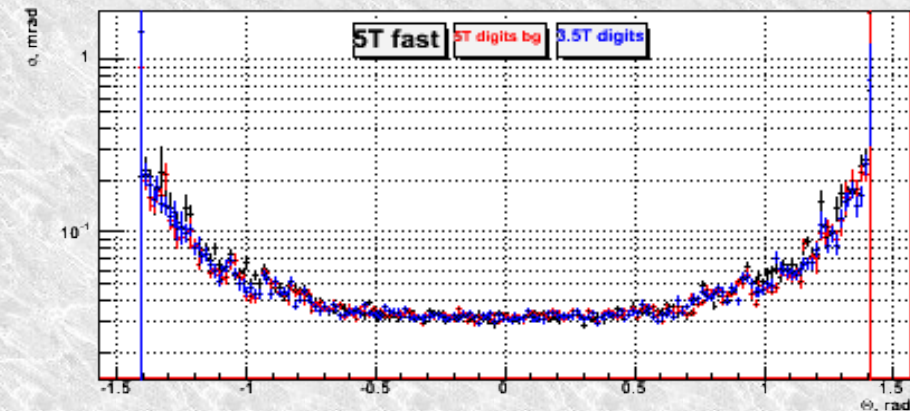
D Impact Parameter resolution with Theta



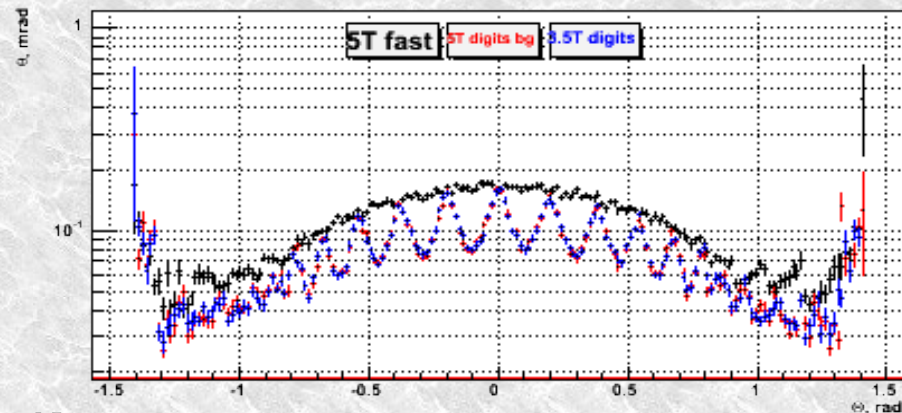
Z Impact Parameter resolution with Theta



Phi resolution with Theta



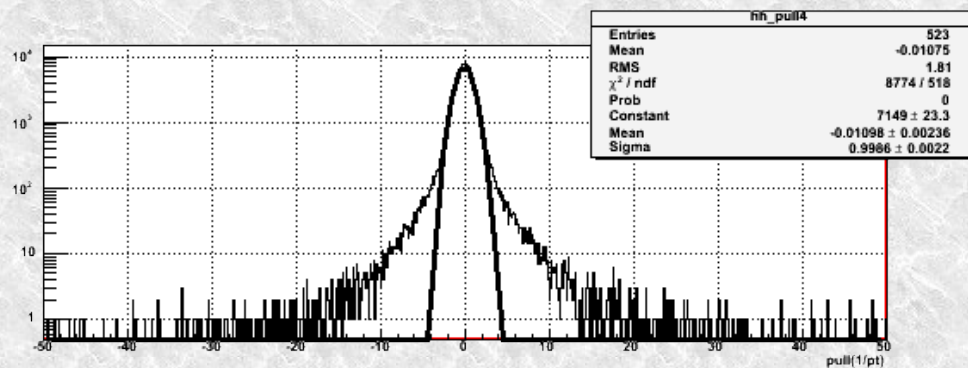
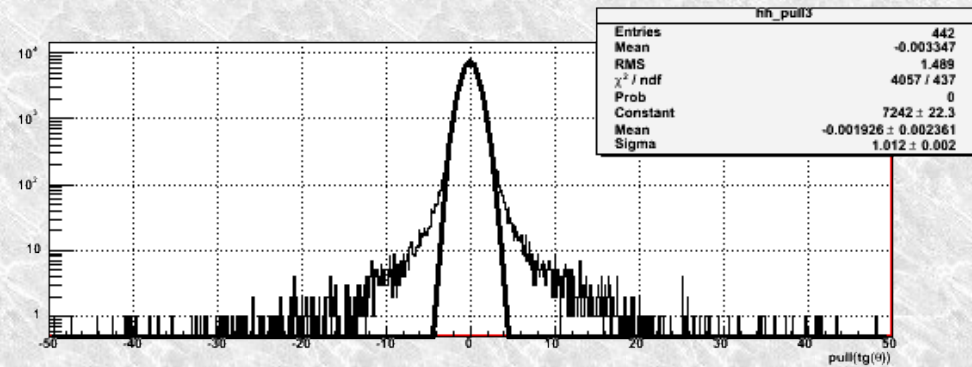
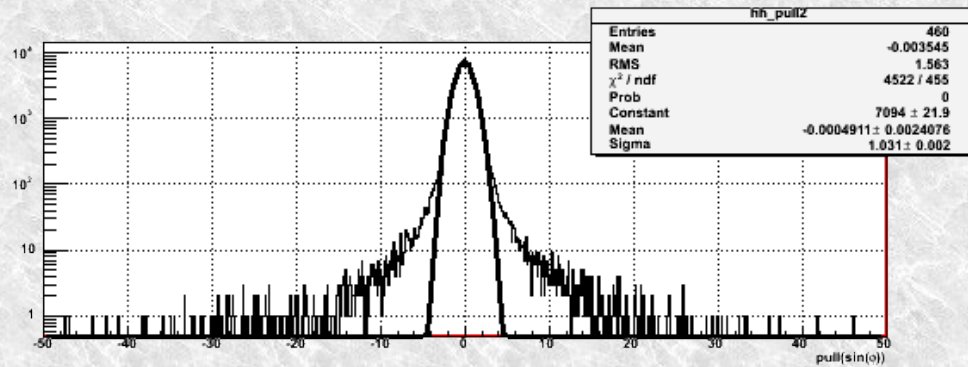
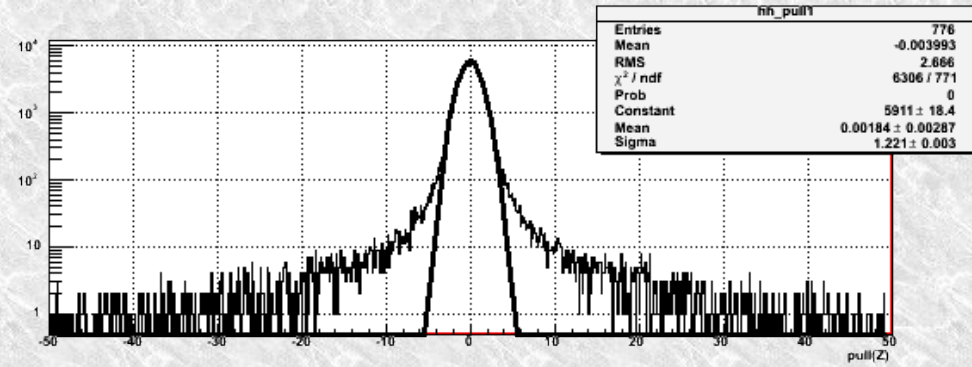
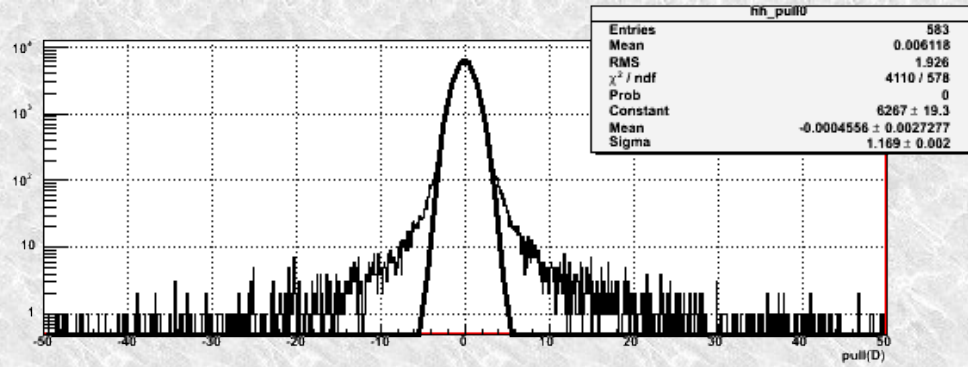
Theta resolution with Theta



for fast recpoint is used constant resolution defined by size of pixel $d/\sqrt{12}$

Oscillation because of resolution in VXD are depend on angle of inclined track: odd or even number of pixel was crossed

Pull distribution for muons with $P < 1\text{GeV}$

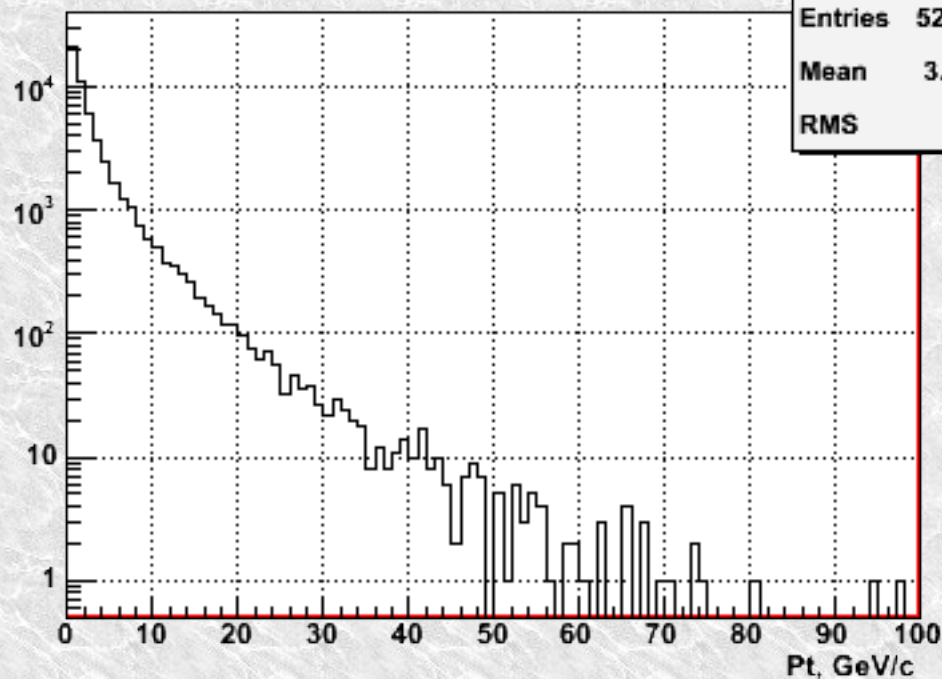


*Resolution defined
by Multiple Scattering
Sigma ~ 1.*

*In tails about 1% events –
mostly by not-Gaussian distribution
of MS and energy loss*

ttbar(6jets) events

Selected reconstructable tracks



*Spectrum of reconstructible tracks
from MC truth:*

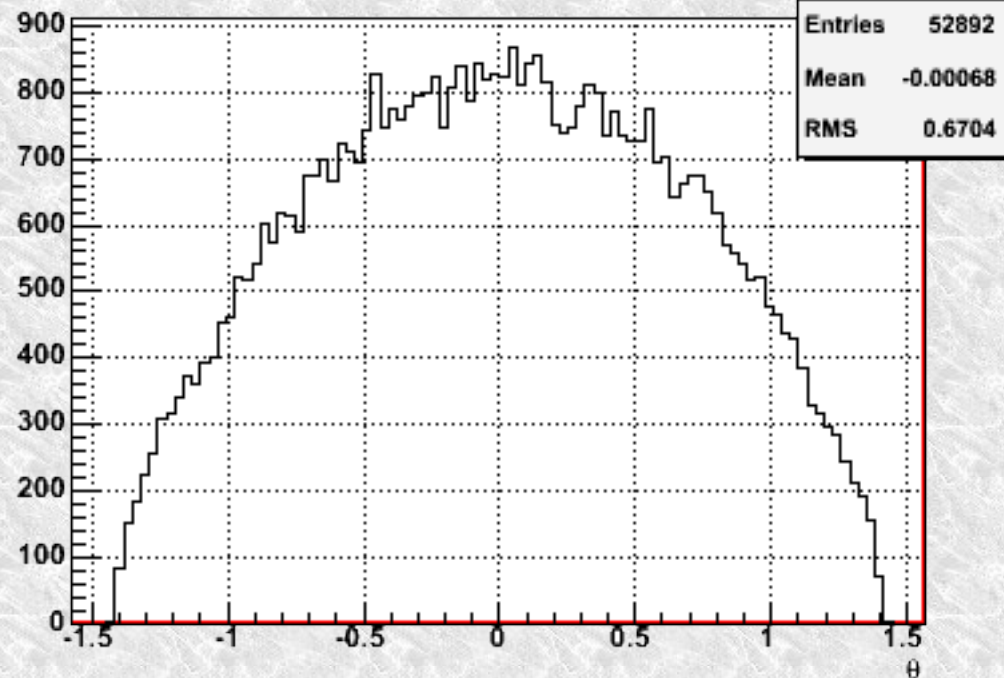
*distance to origin < 3.5 cm
at least 4 recpoints in different layers
and 3 in VXD*

In average 50 tracks per event

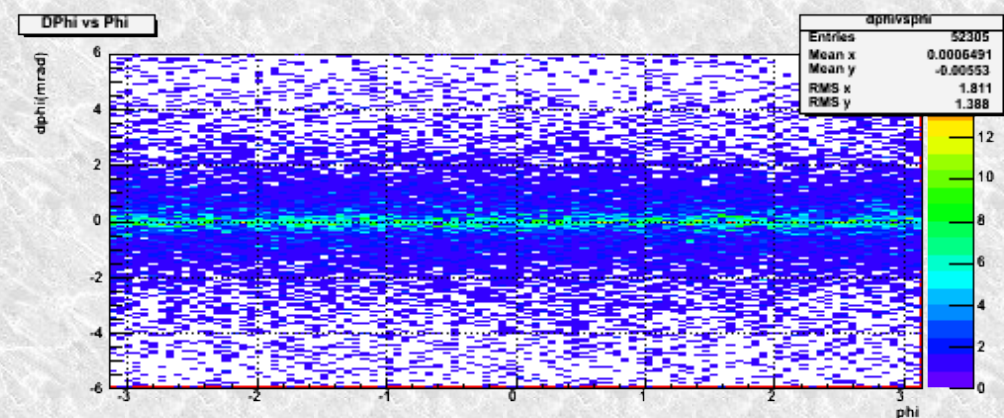
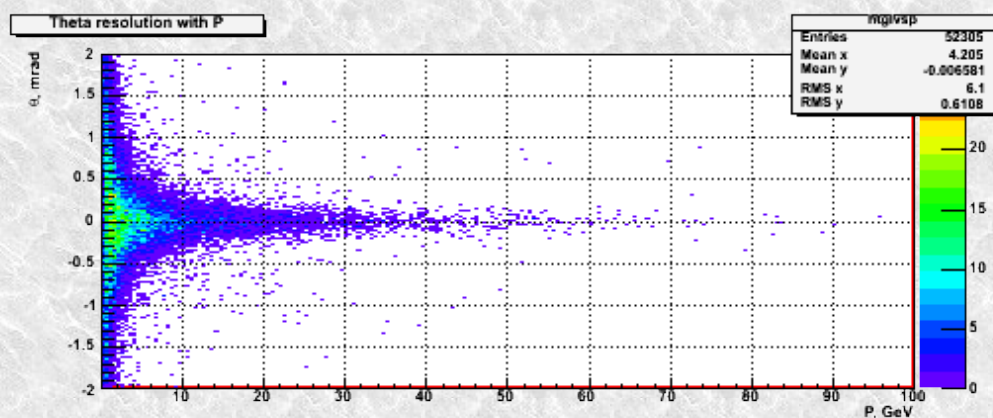
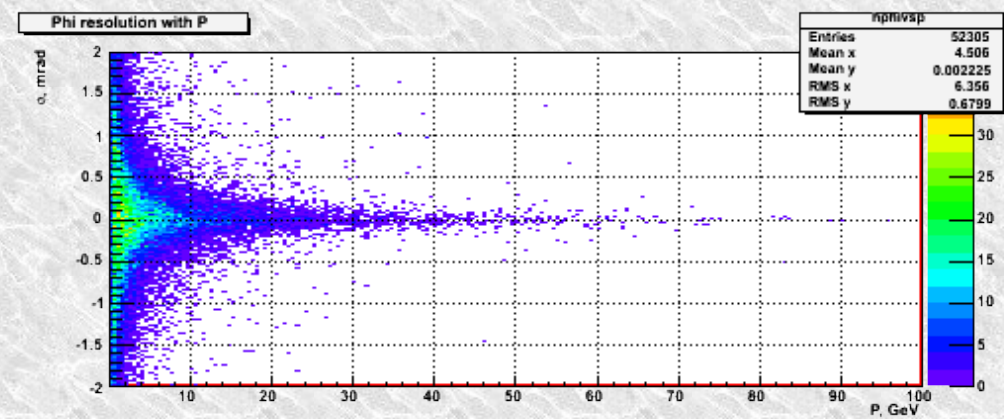
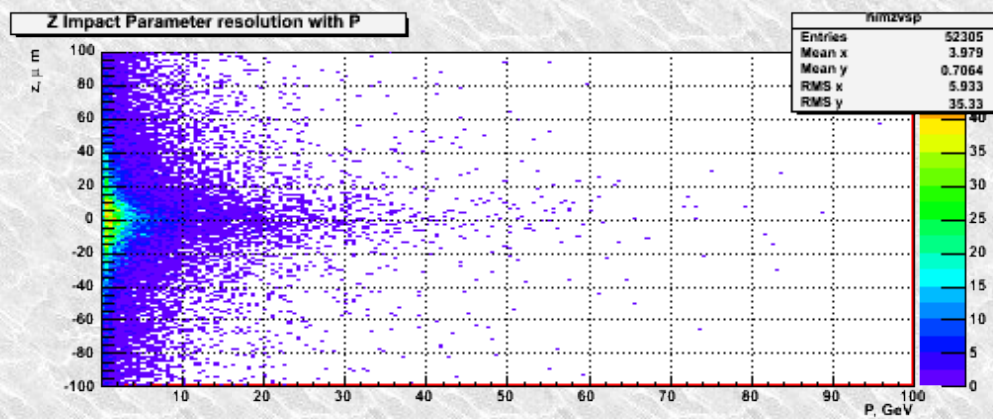
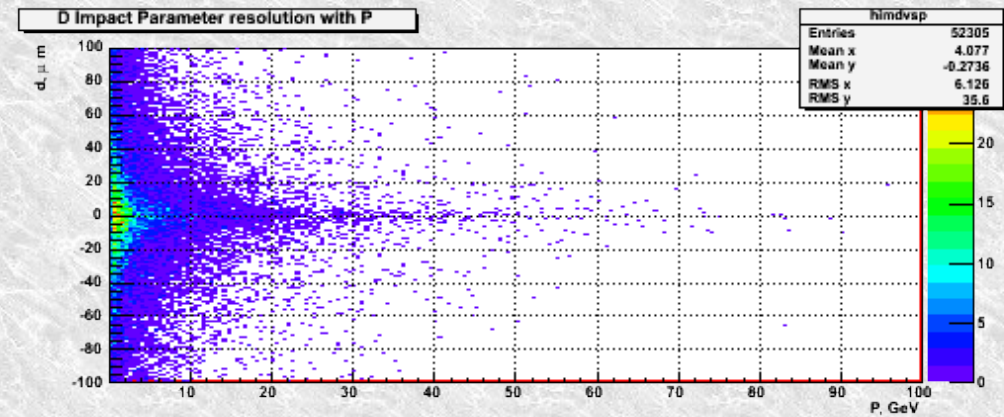
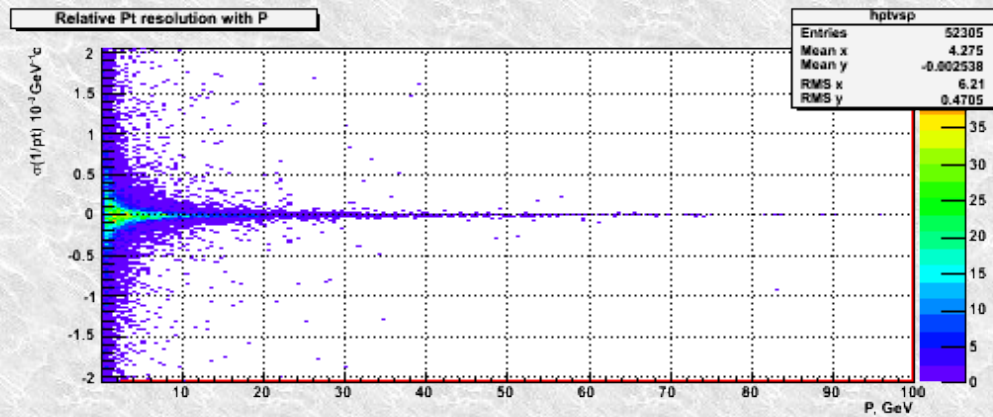
*Spectrum of particle dominated
by low momentum =>*

*Resolution dominated by
material budget in detector*

Selected good tracks

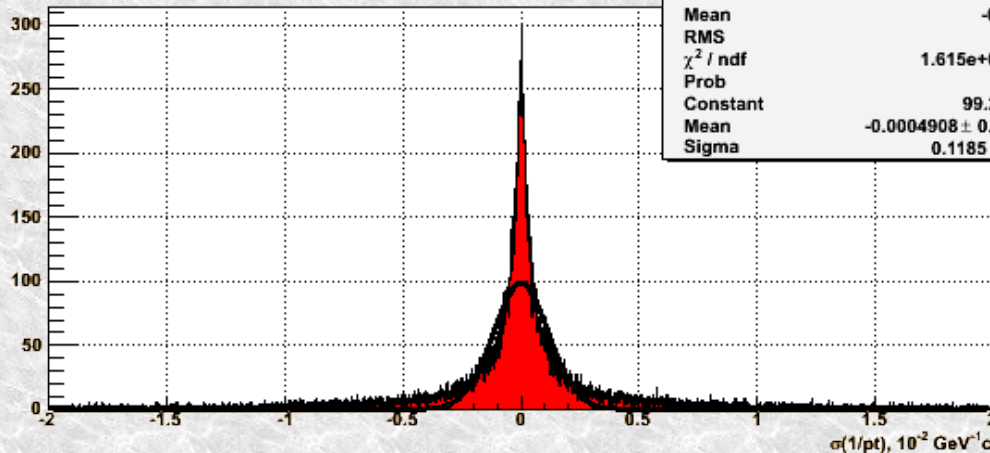


Tracks resolution in ttbar events

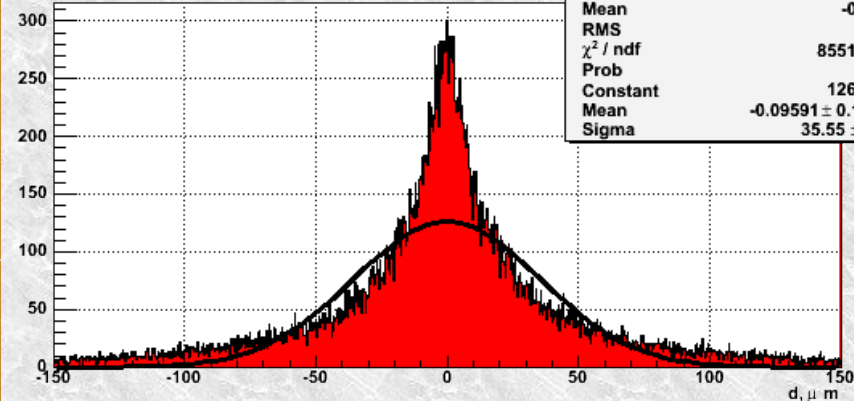


Tracks resolution in ttbar events

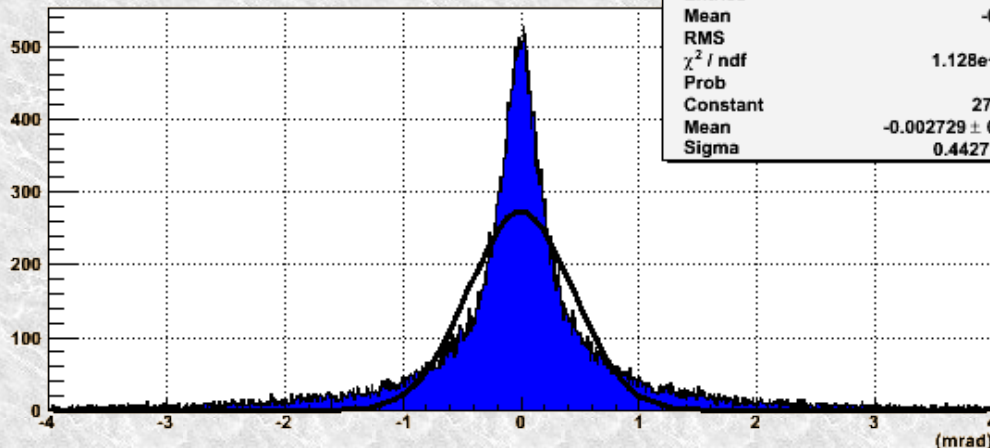
Relative Pt resolution



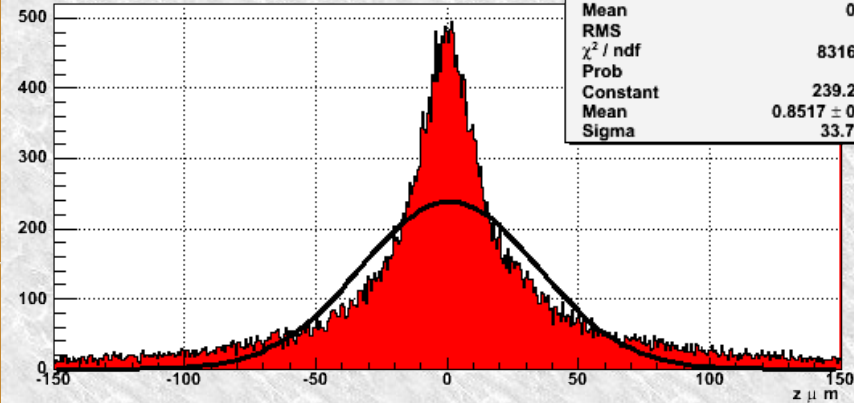
D Impact Parameter Resolution



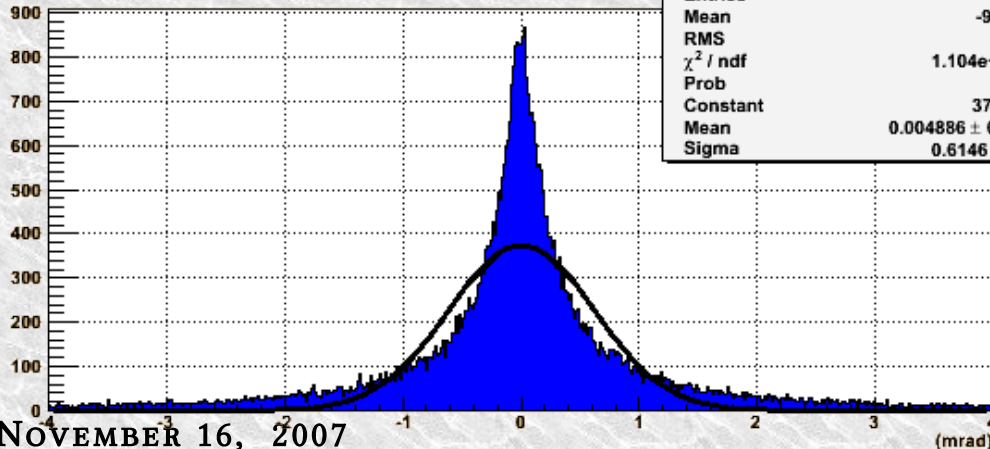
THETA resolution



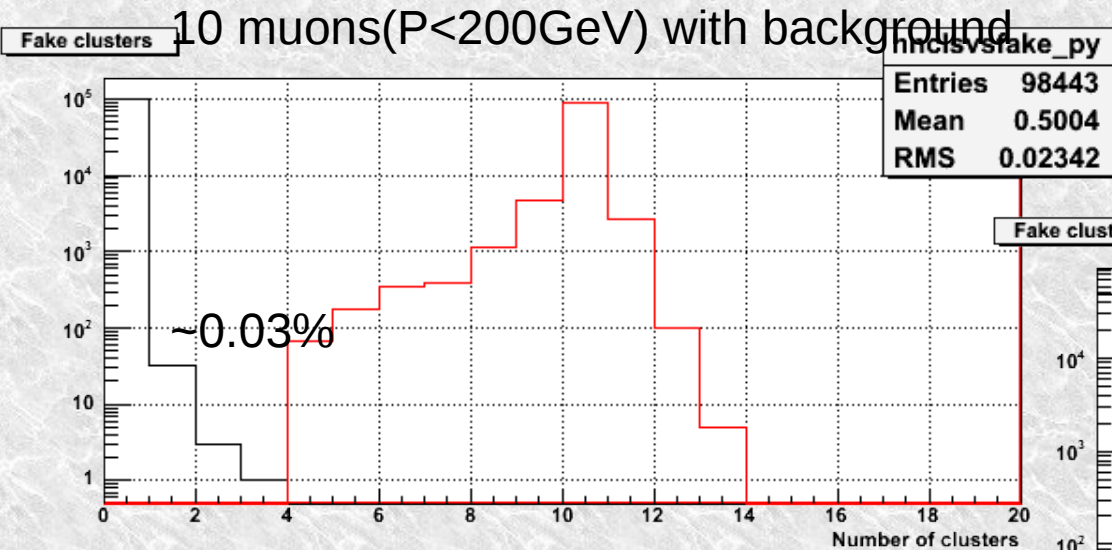
Z Impact Parameter Resolution



PHI resolution

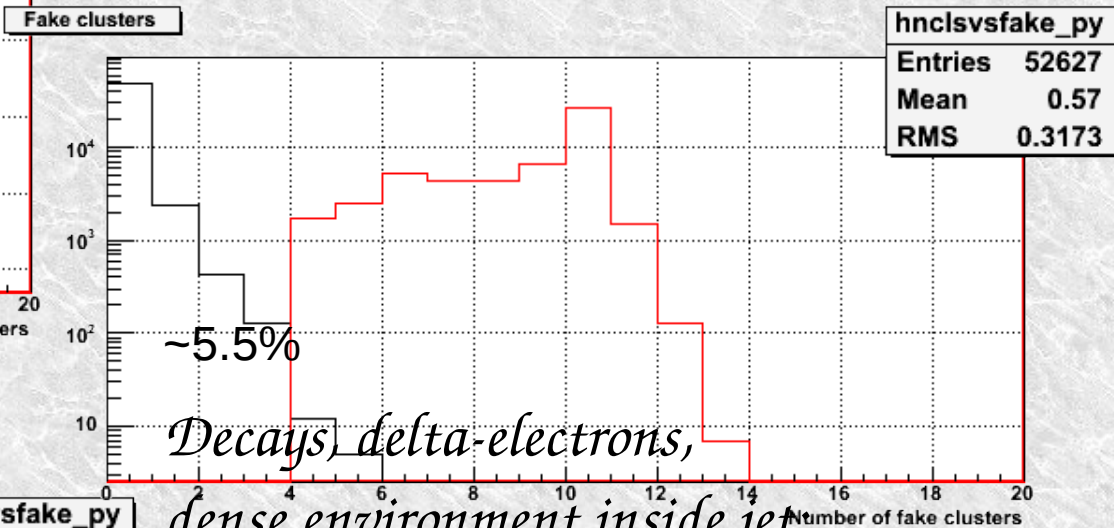


Number of Clusters in Reconstructed track

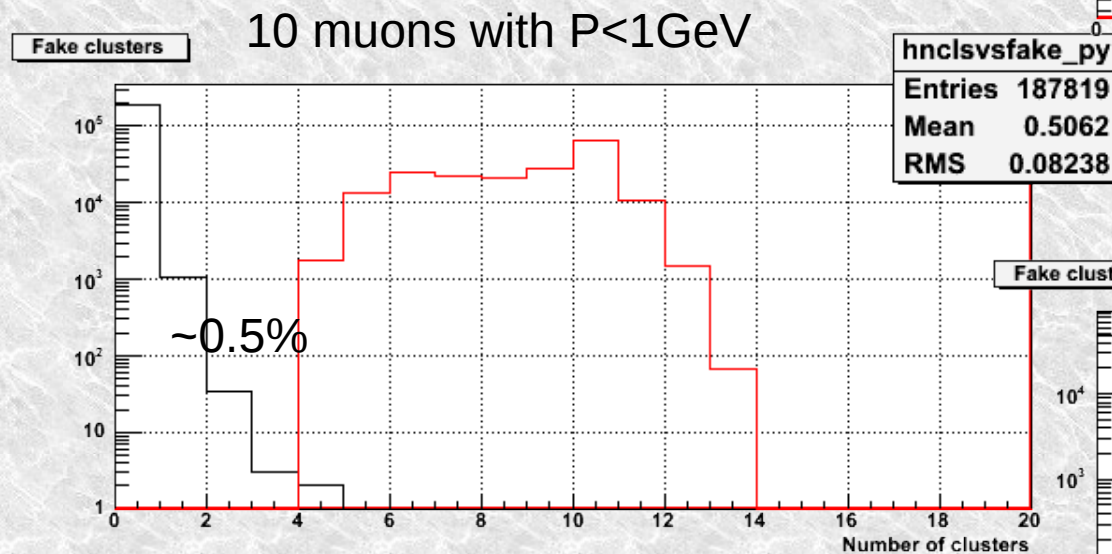


Black – number of wrong repoints in track
red – total number of repoints

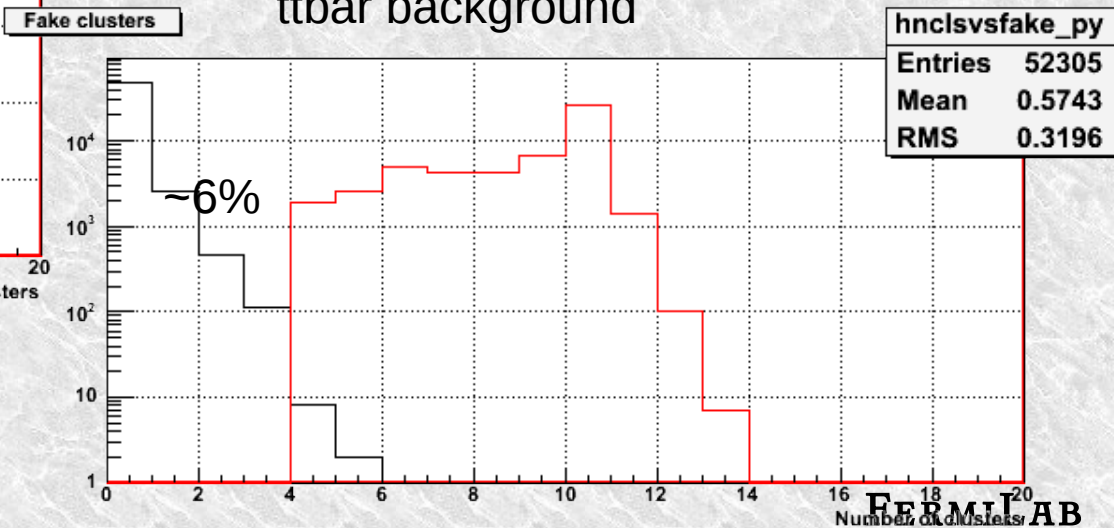
ttbar without background



*Decays, delta-electrons,
 dense environment inside jet:
 main contribution from barrel part of SiT*

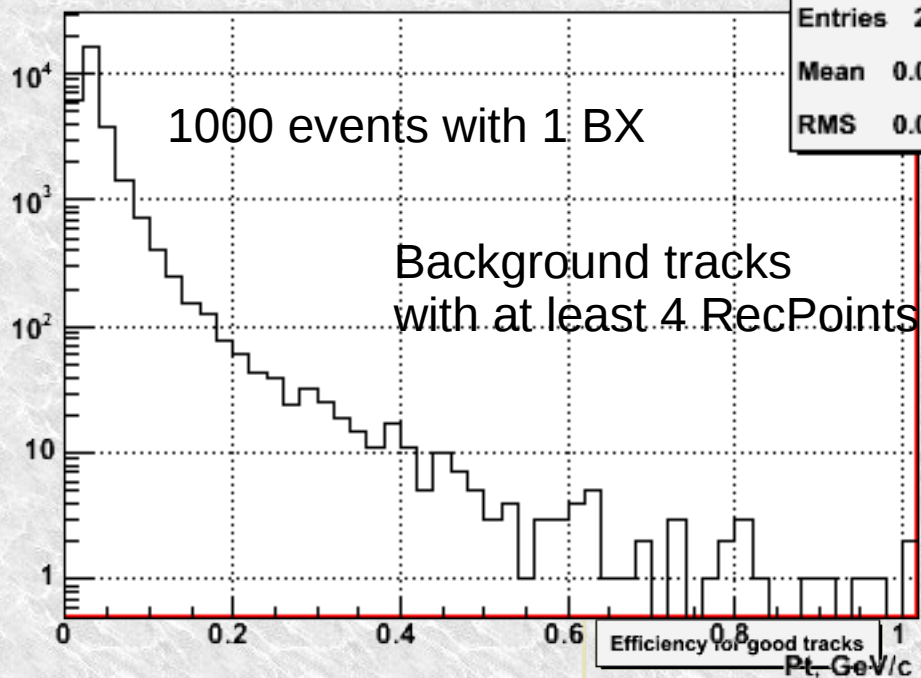


ttbar background



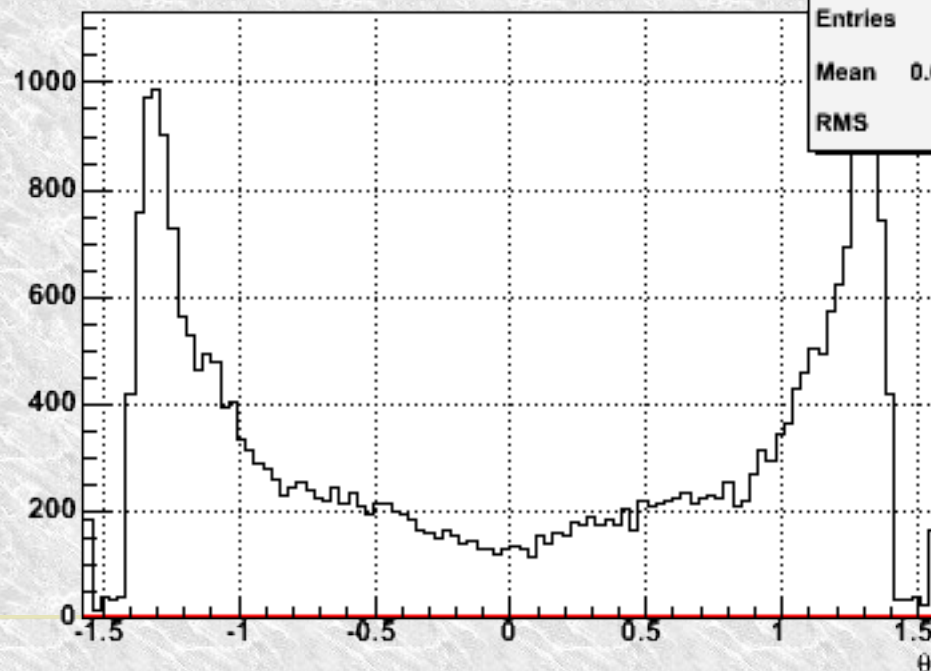
Background distribution

Selected good tracks



hselectfoundpt
Entries 29999
Mean 0.03905
RMS 0.04552

Selected good tracks

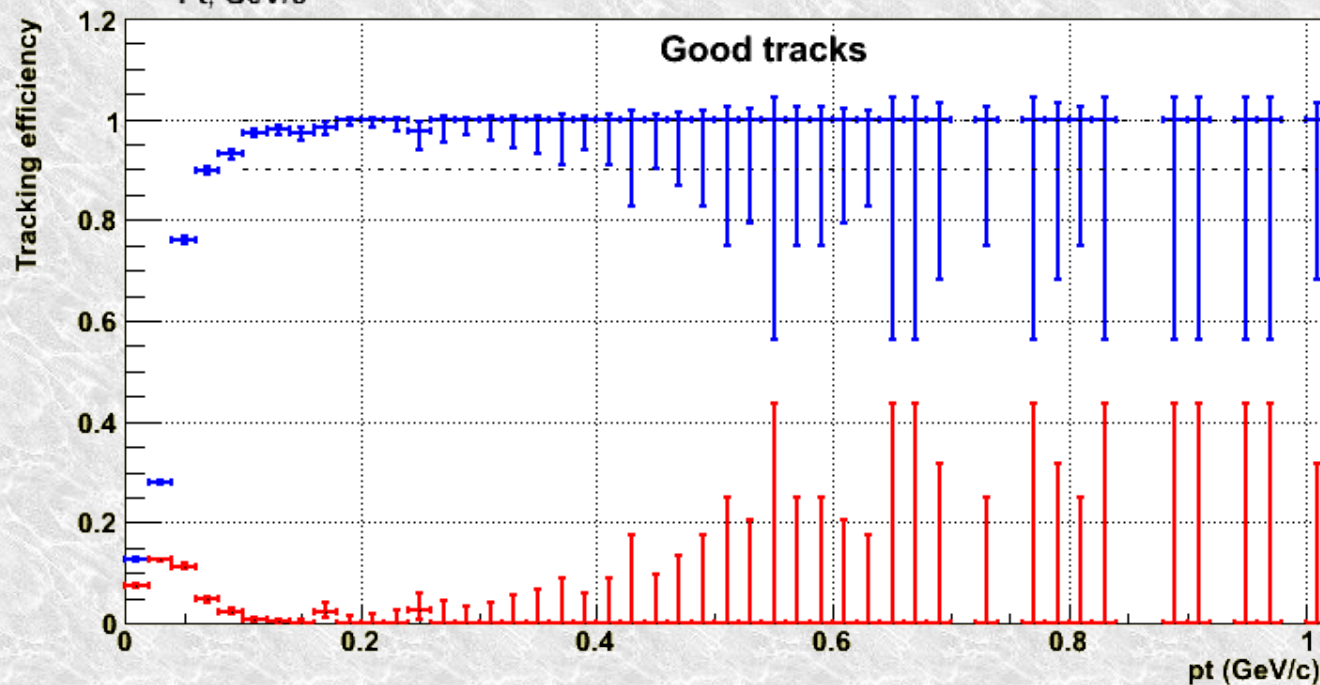


hselectfoundth
Entries 29999
Mean 0.004531
RMS 1.03

*Average number
of reconstructible tracks*

30 per event

Maybe no big sense
for trying to reconstruct
tracks for $Pt < 100\text{MeV}$



Conclusion

It always still room for improvement:

limitations to reconstruct nearest tracks?

Silicon Tracker reconstruction alone?

V0 finding

Question and suggestion?

Definition of tracking efficiency

Possible reconstructible tracks from simulation

from MC truth:

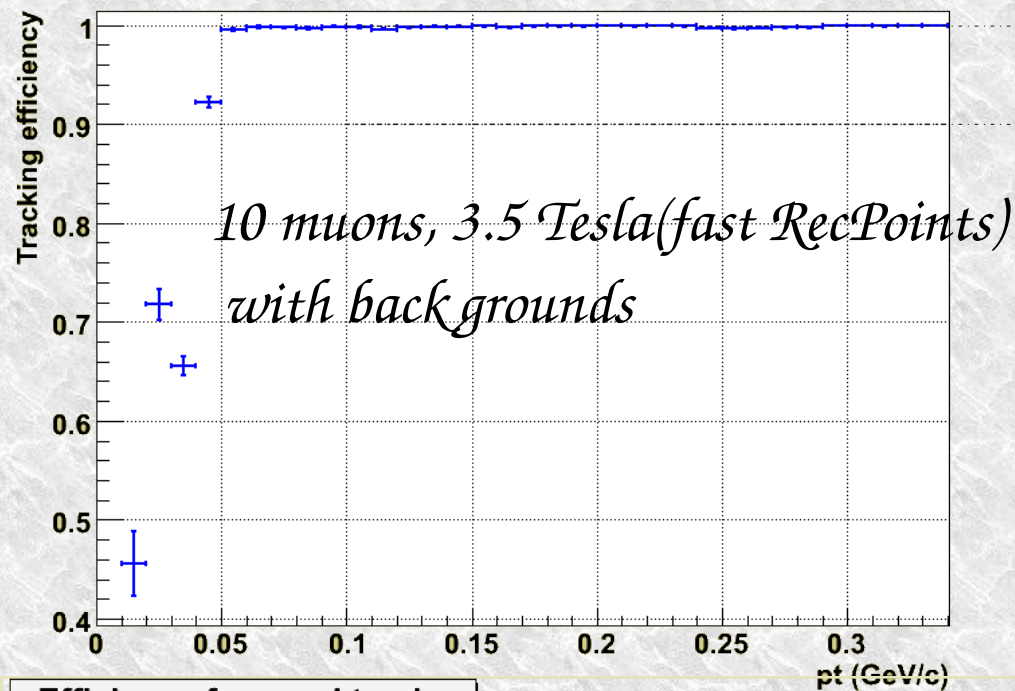
distance to origin < 3.5 cm

at least 4 recpoints in different layers and 3 in VXD

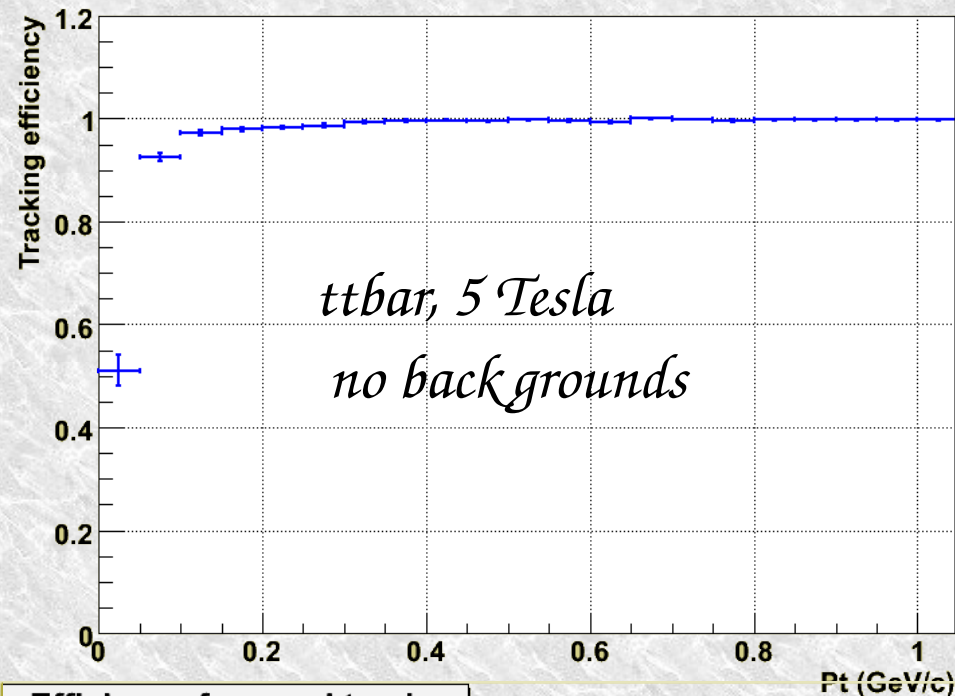
Efficiency plots related to
efficiency of reconstruction algorithm
on the set of reconstructible tracks

Efficiency

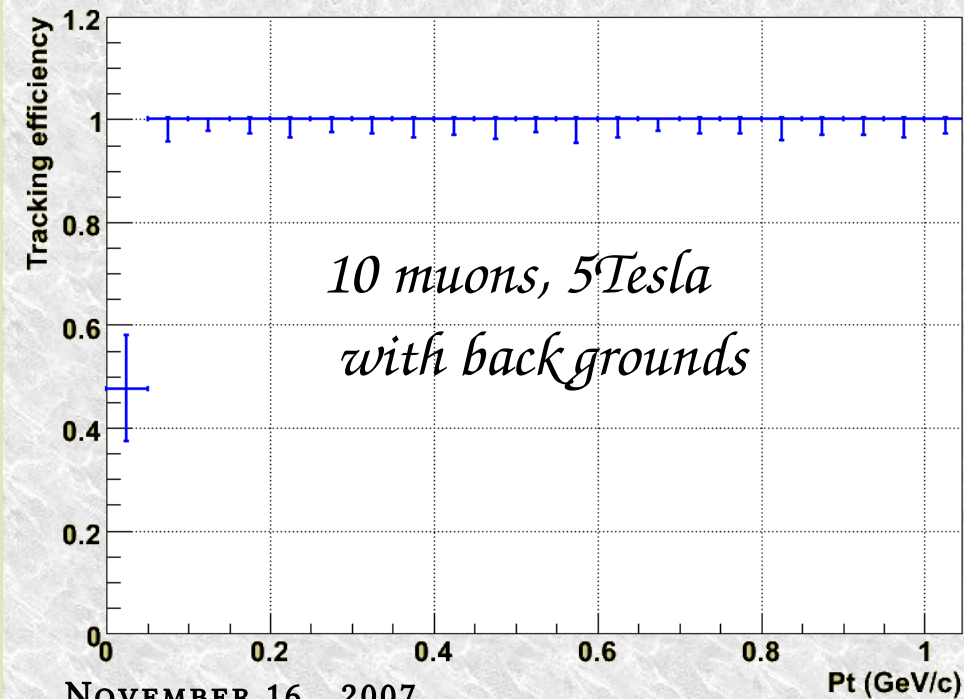
Efficiency for good tracks



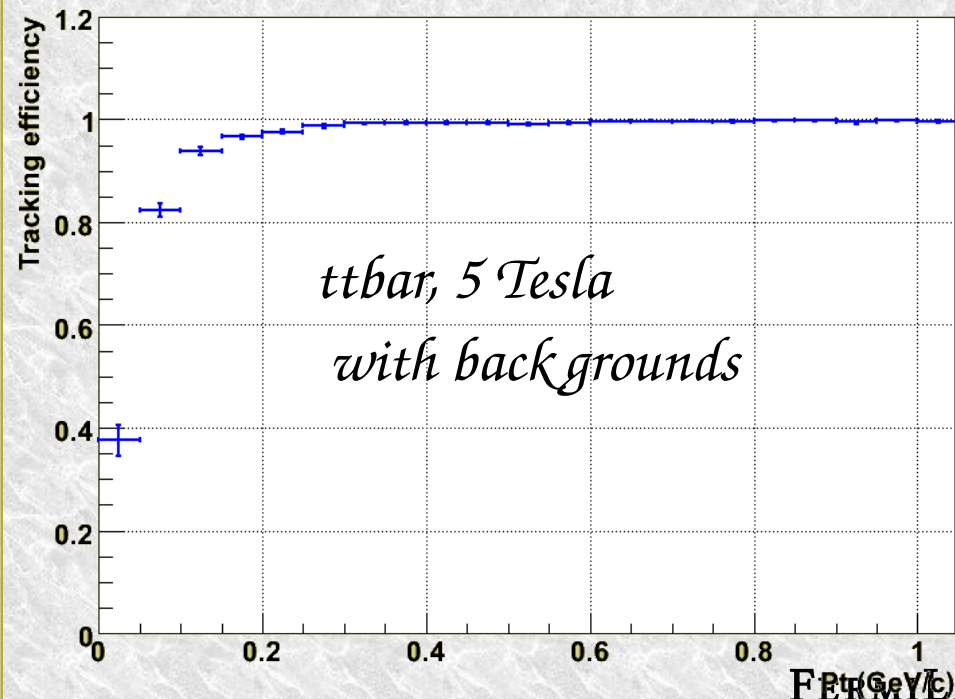
Efficiency for good tracks



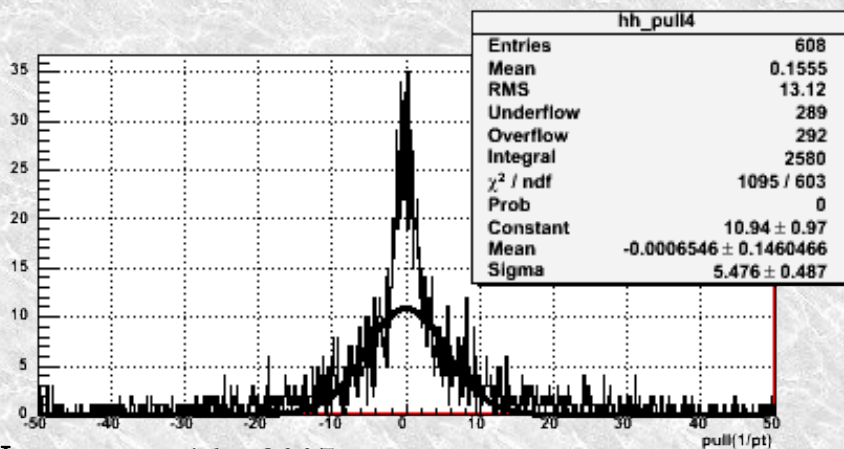
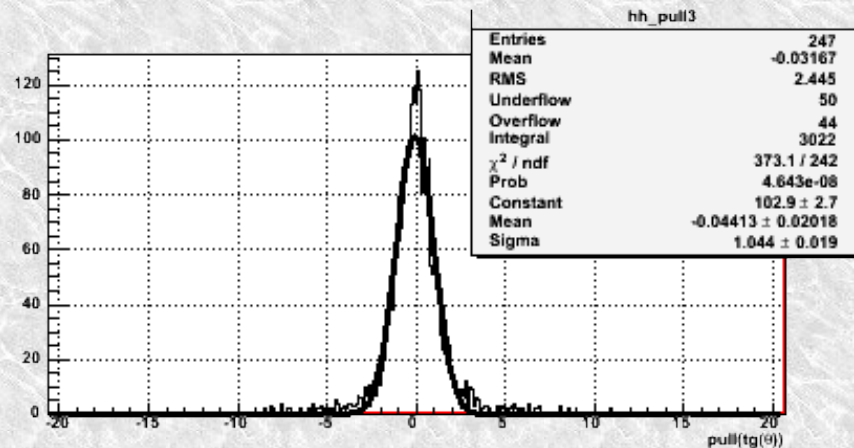
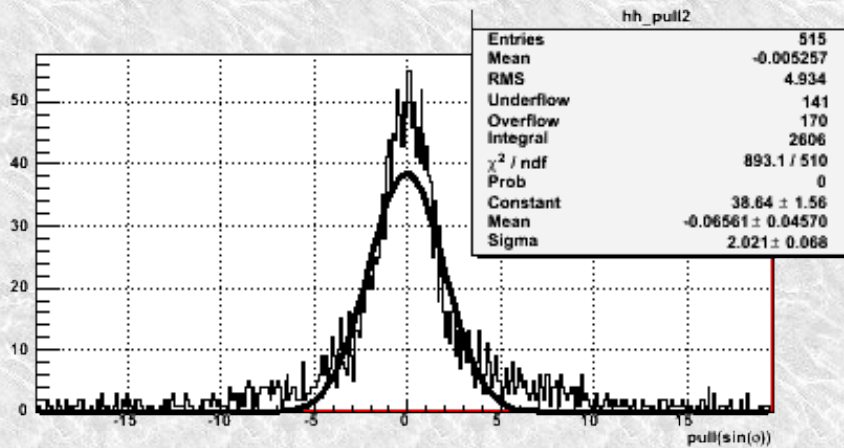
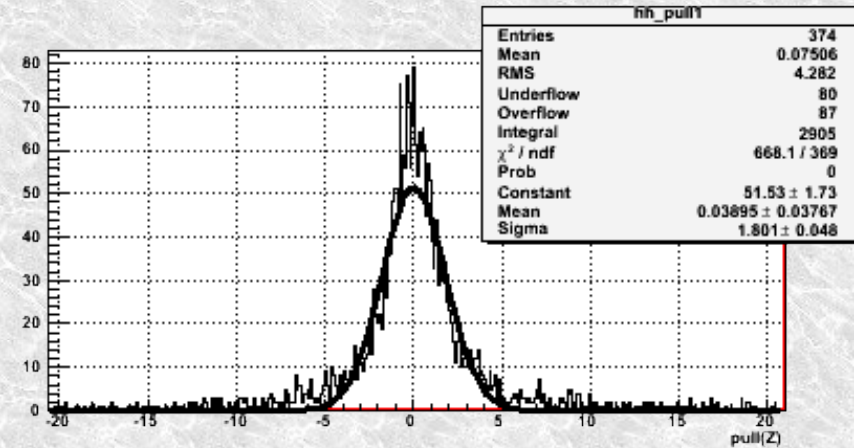
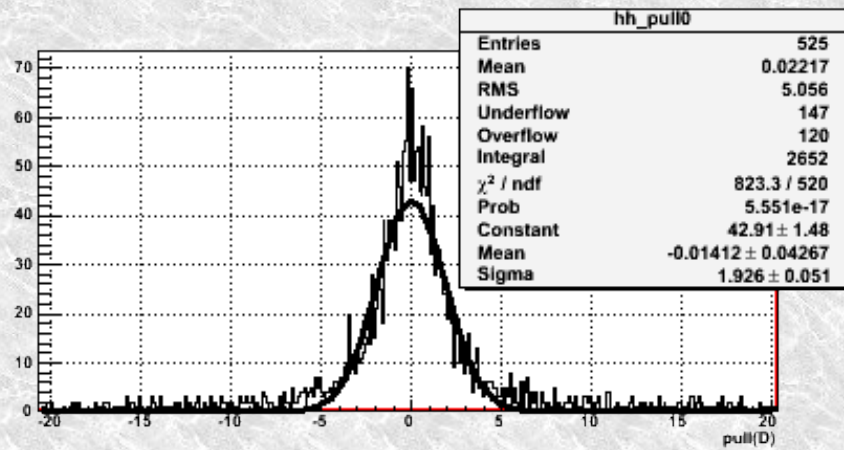
Efficiency for good tracks



Efficiency for good tracks



Pull distribution for track with fake clusters



*ttbar event with background
in tails about ~ 20% events*