A track finding algorithm for the Inner Tracking System of MPD/NICA

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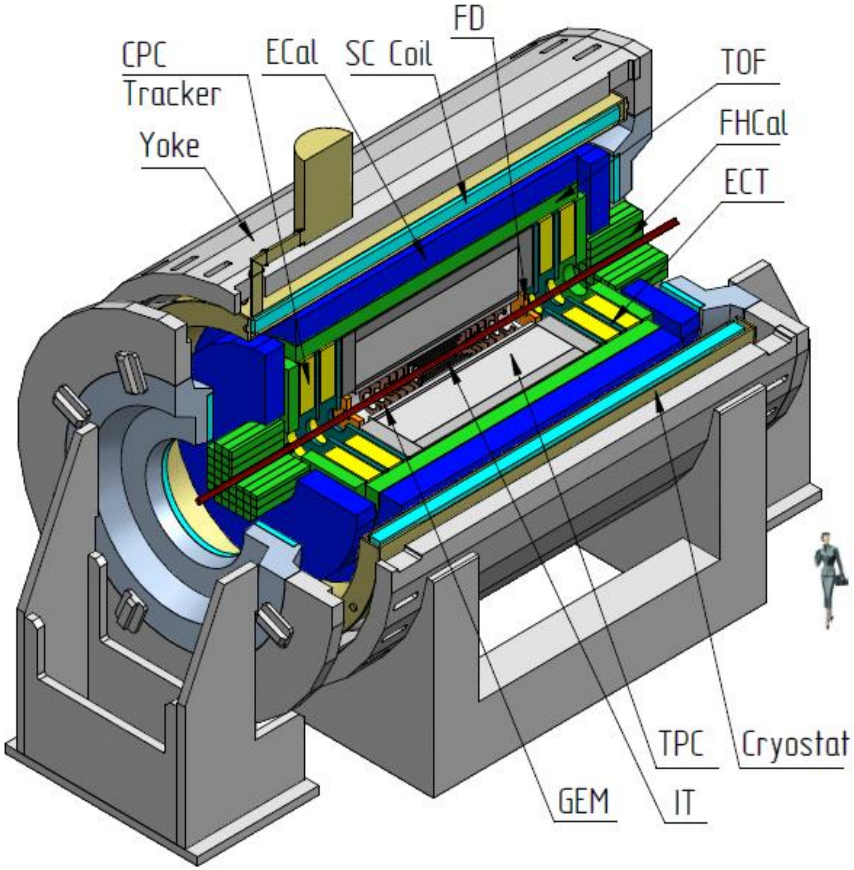
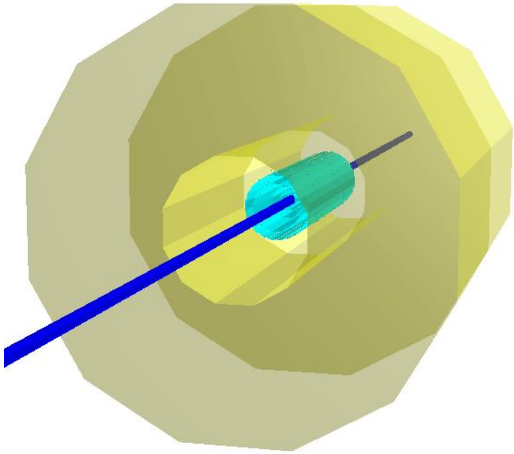
Outline

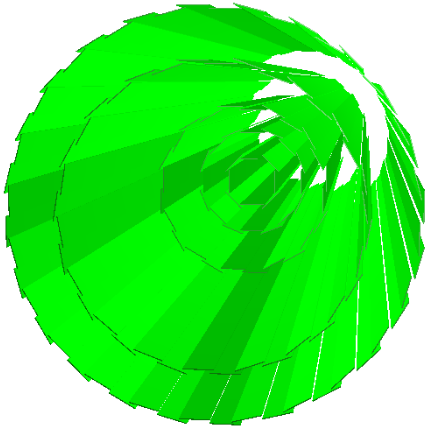
1. Detector geometry
2. Track finding approach
3. Some results
4. Summary and plans



MPD/NICA general design scheme

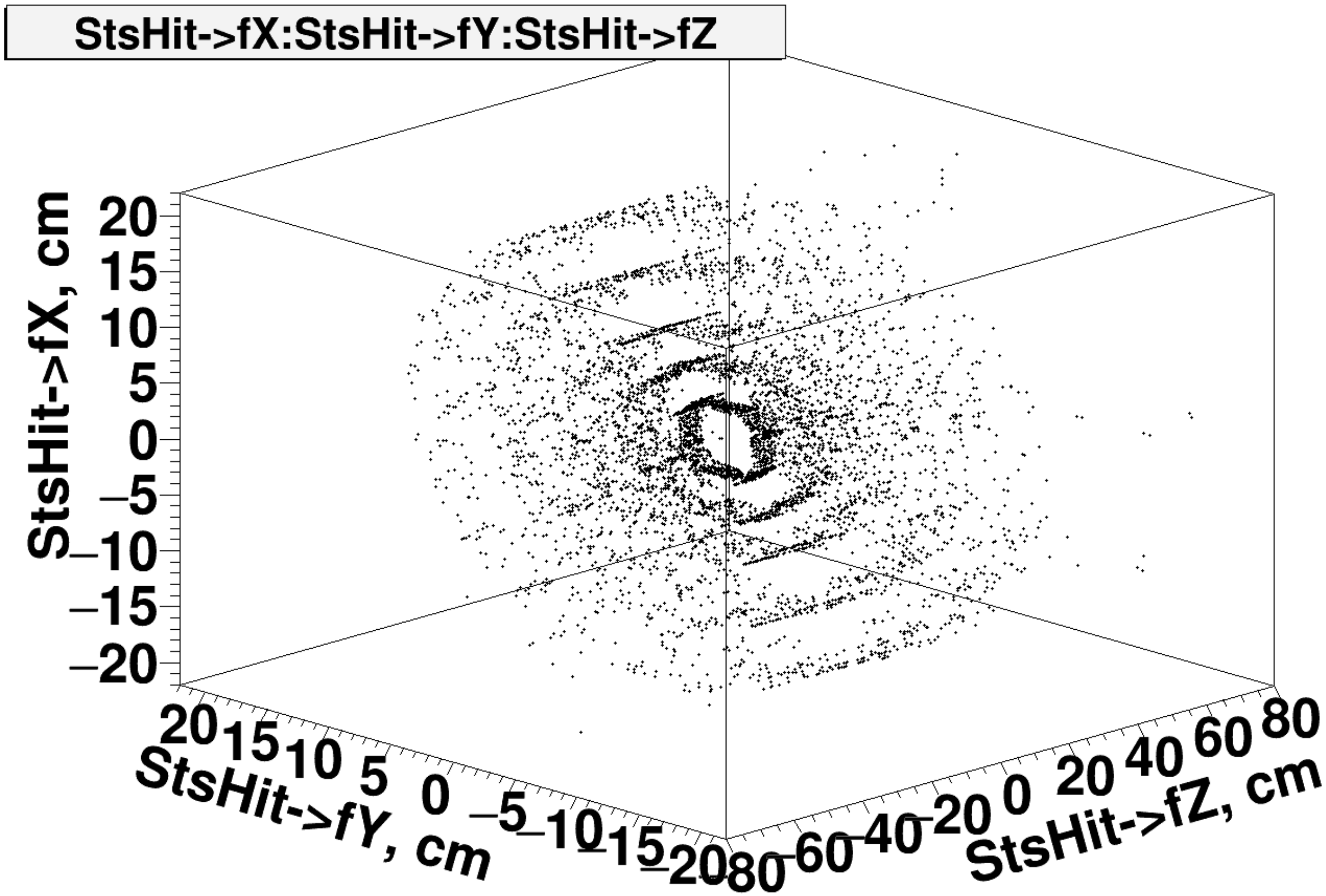


TPC and ITS geometry

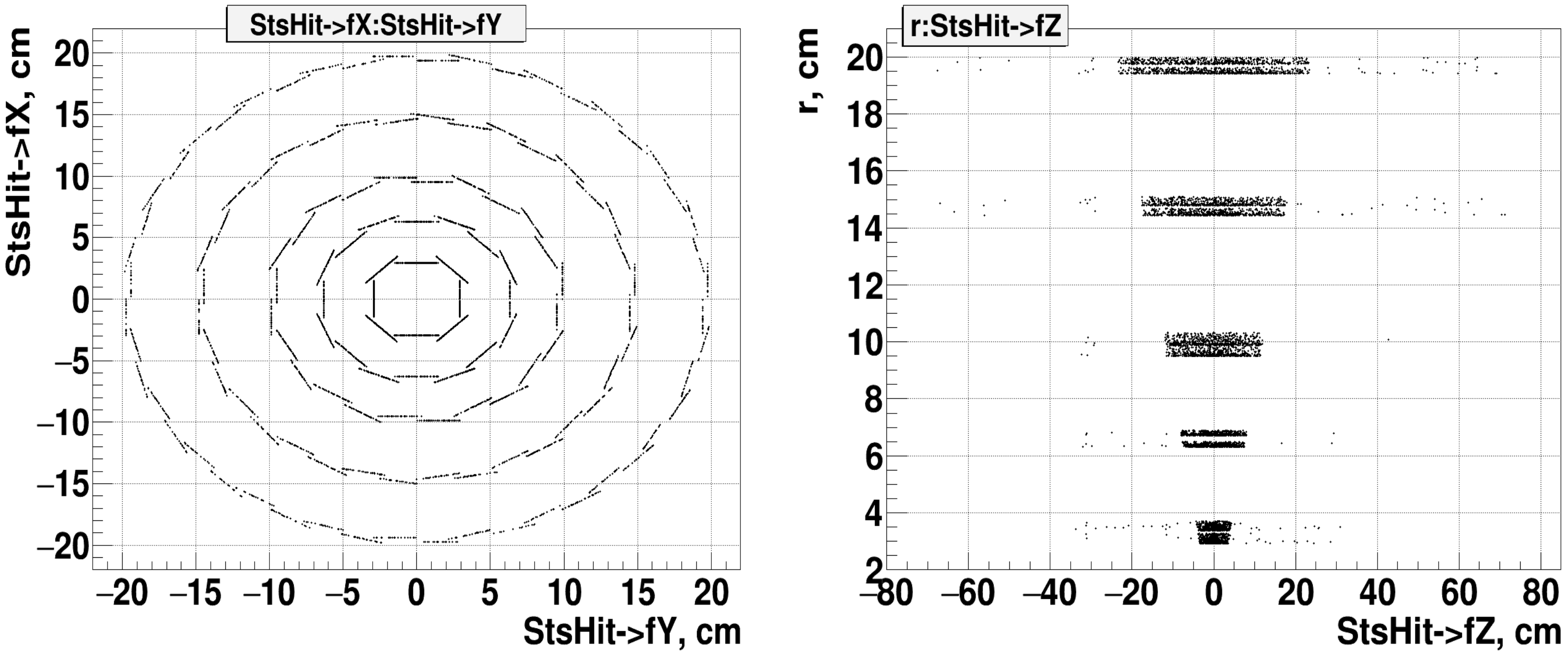


5-layer ITS geometry

ITS 3D hit picture

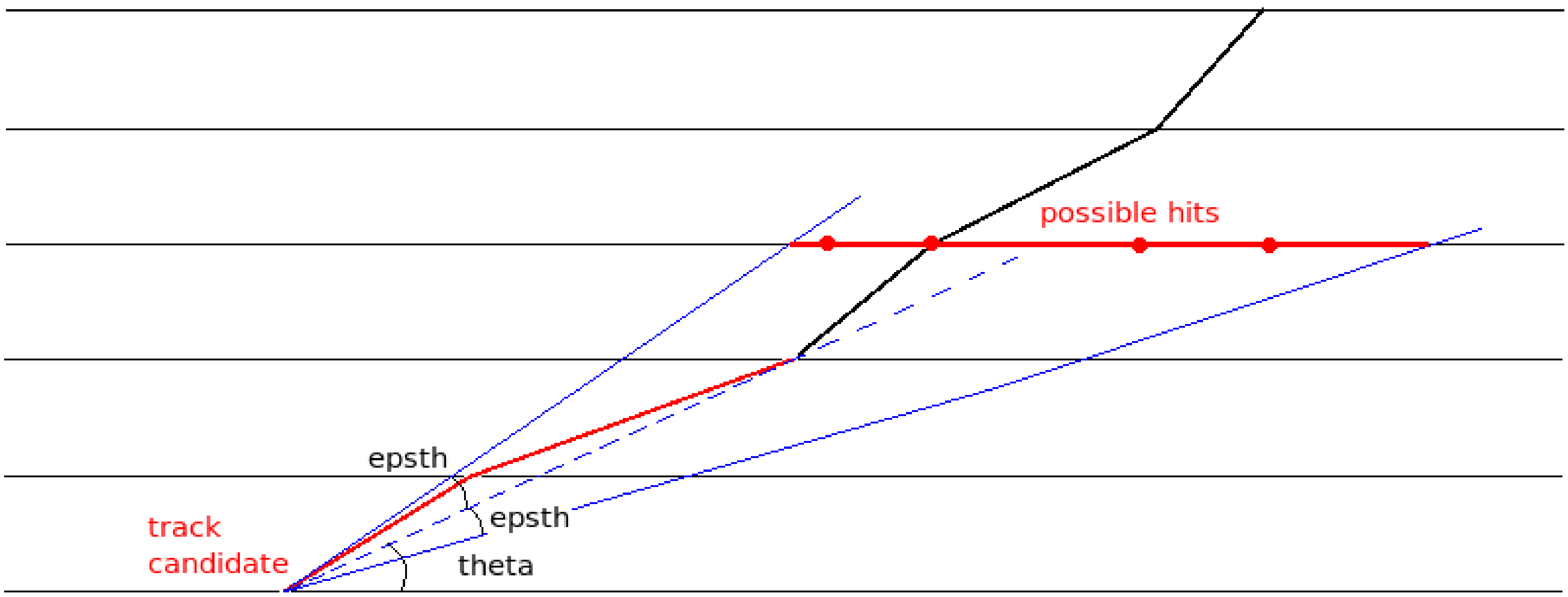


ITS hit projections



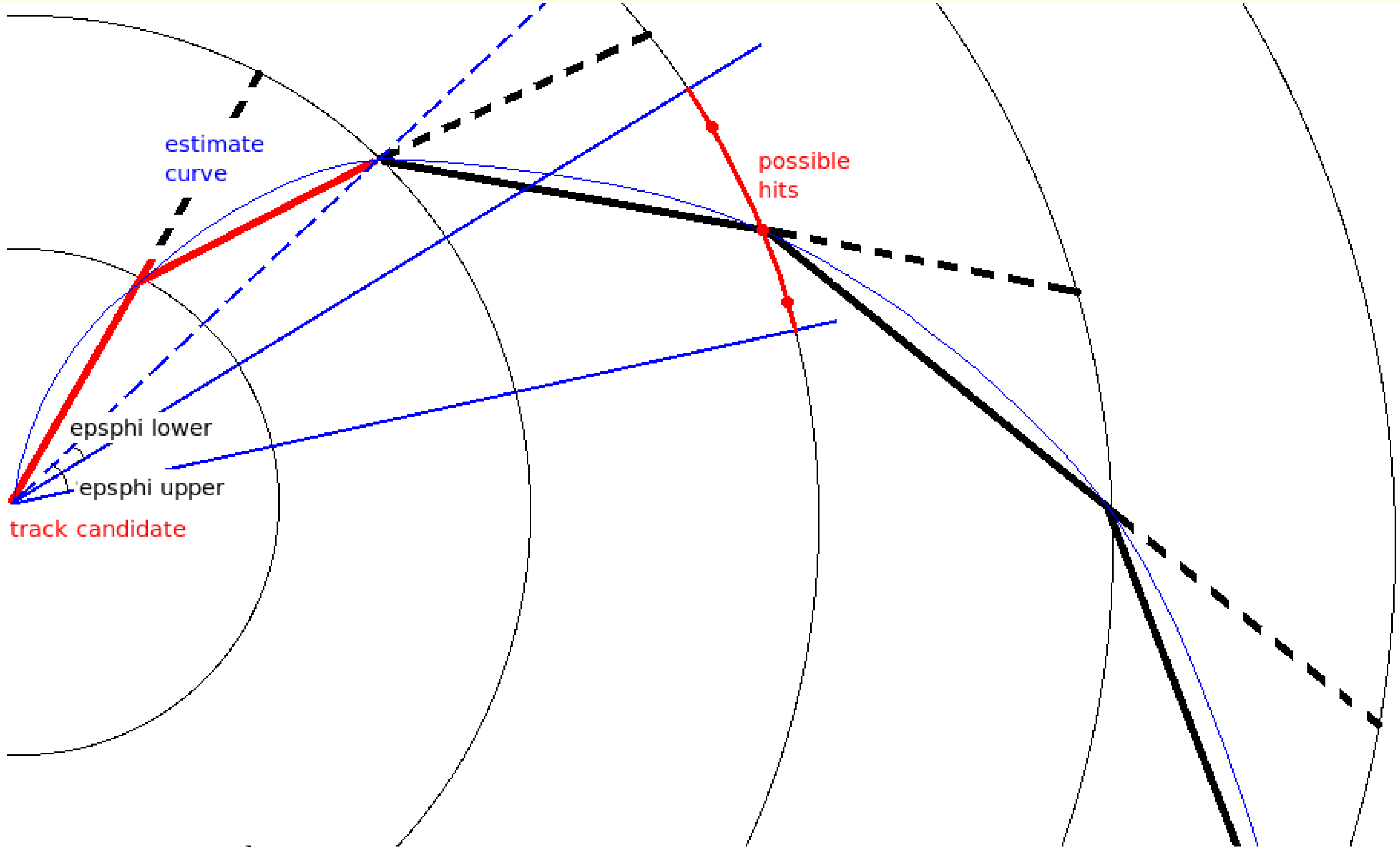
3D hit picture projections: transverse (left) and longitudinal (right)

Track scheme with angles (longitudinal)



Example: Adding 3[d] layer hit to current track candidate (red). Angle delta *epsth* is preset. Area where possible hits are searched for, is highlighted with red and bordered with blue lines.

Track scheme with angles (transverse)

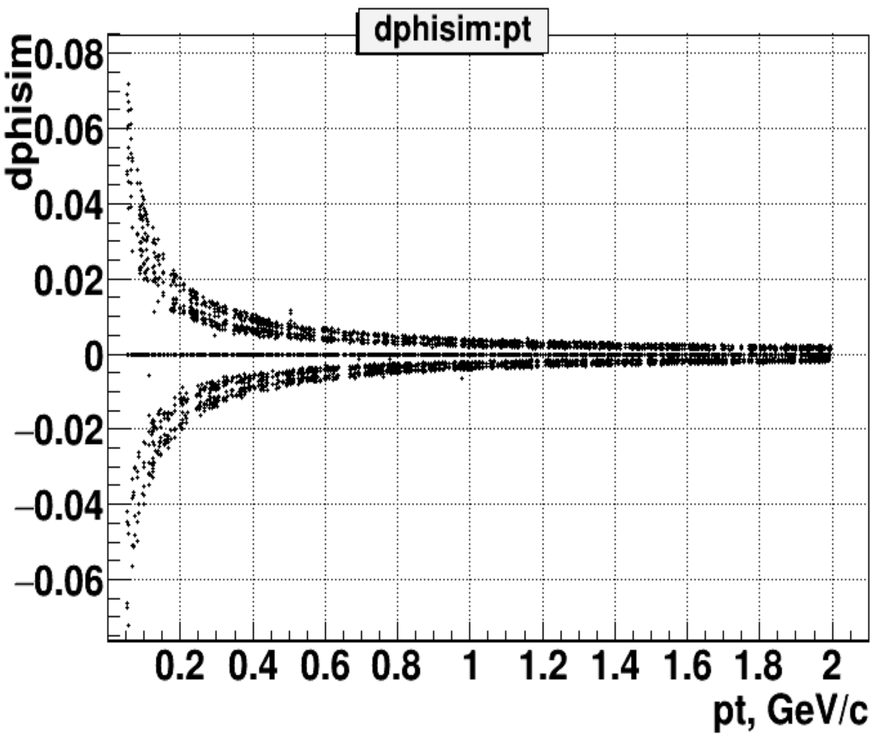


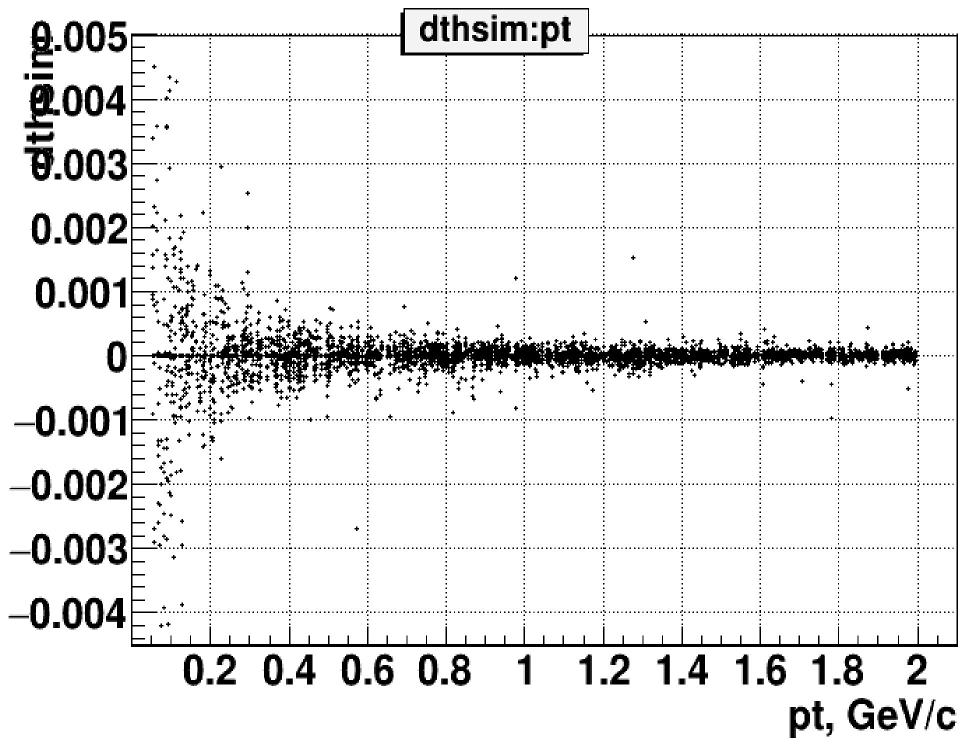
Example: Adding 3^{d} layer hit to current track candidate (red). Angles *epsphi*, lower and upper, depend on momentum, which is estimated based on track curvature for track candidate. Area where possible hits are searched for, is highlighted with red and bordered with blue lines.

Algorithm steps

- Initial track candidates are built from hits on the first layer of detector
- For detector layers 2 – 5:
  1) Build hit multimap for longitudinal and transverse angles
  2) For each track candidate:
     - If current layer number is 3-5, estimate particle momentum *pt*
     - Calculate longitudinal and transverse angle cuts and extract corresponding hits from multimaps
     - Find intersection of hit sets obtained after cuts
     - For each hit in the resulting hit set create track candidate for current detector layer

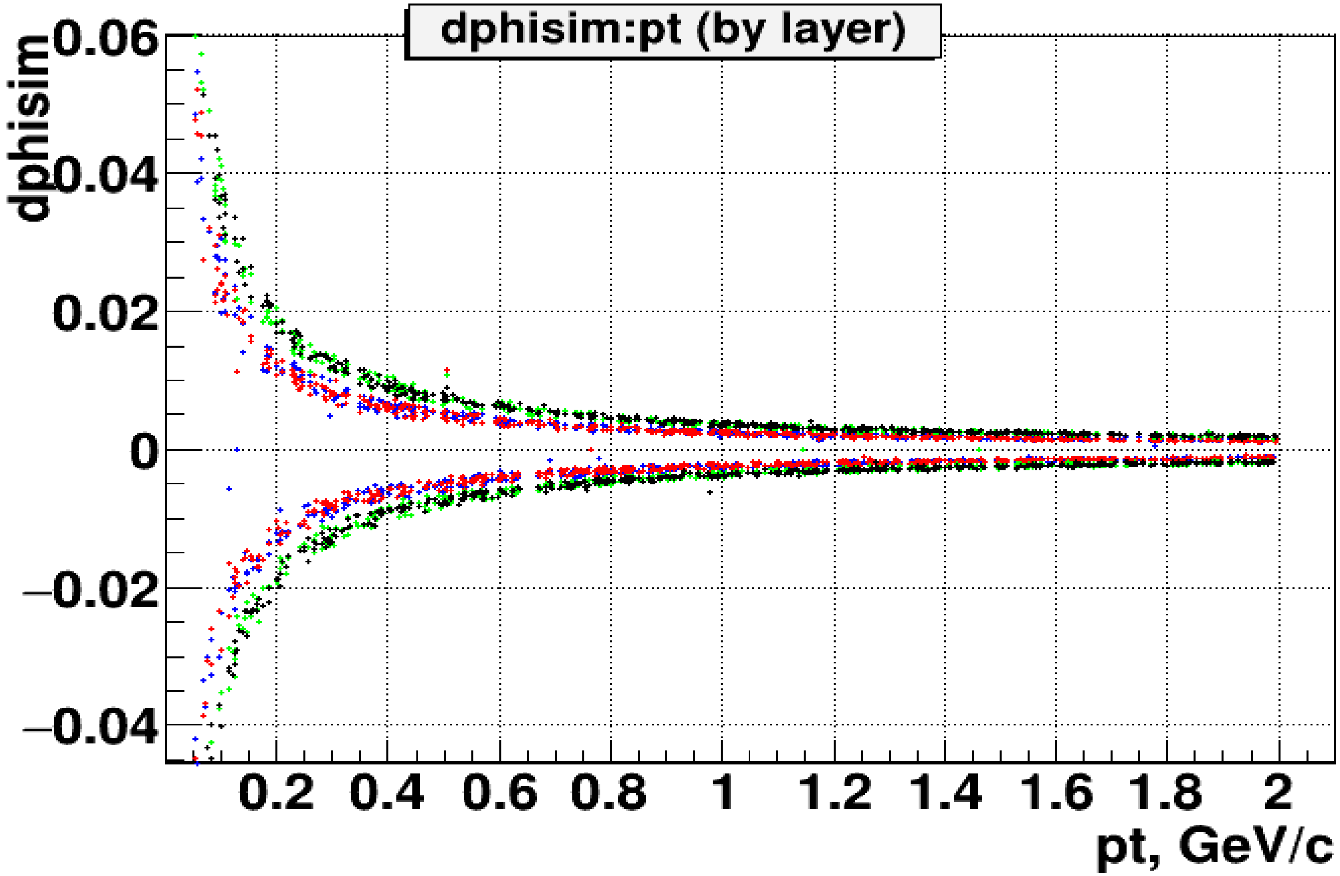
Angle delta dependencies on pt





- Left plot shows that delta between transverse angle on current layer and previous one is inversely proportional to particle transverse momentum, due to track curvature in the magnetic field
- Right plot shows that there is no such evident dependency for longitudinal angle delta, except some widening at low *pt* due to multiple scattering

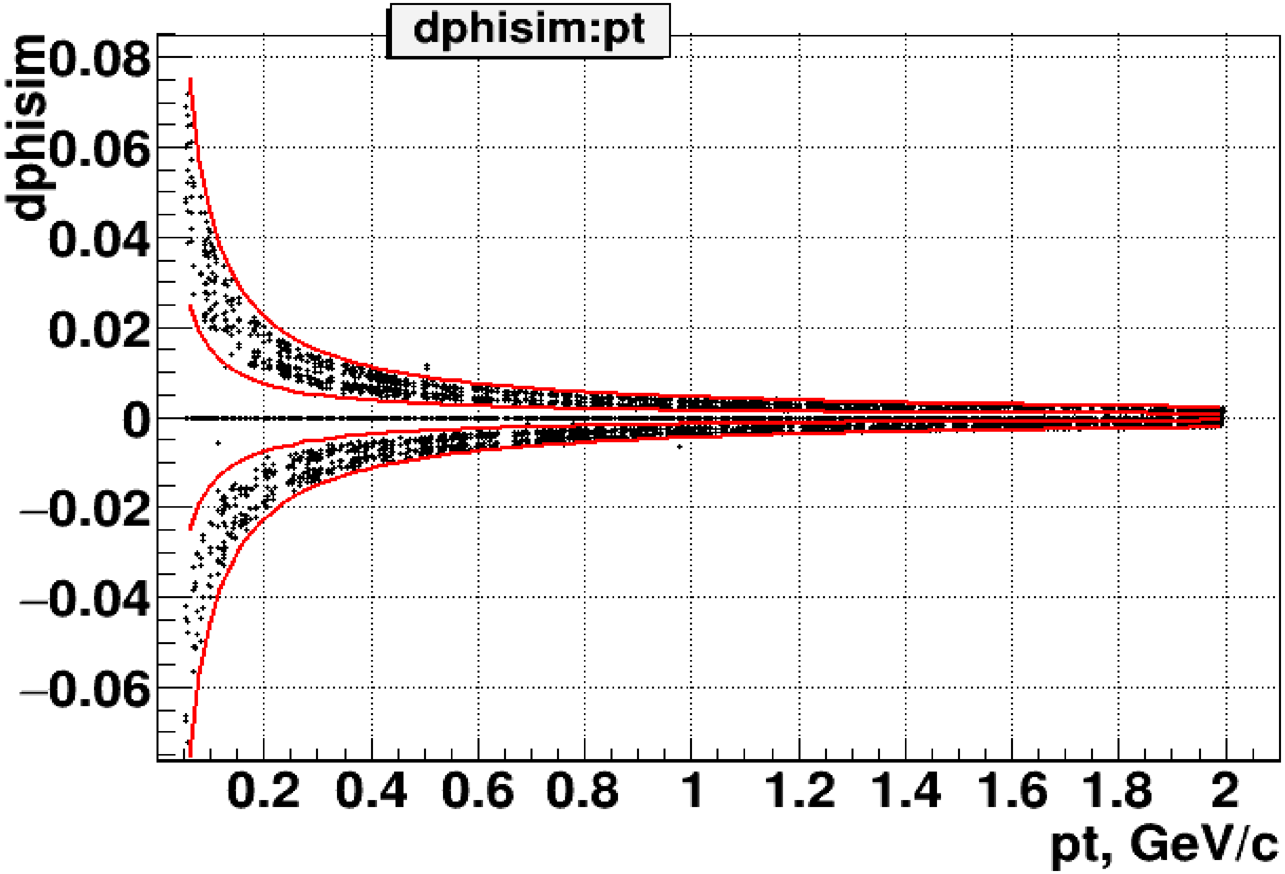
Transverse angle delta distribution by layer



Layer 1 – blue, Layer 2 – red

Layer 3 – green, Layer 4 – black

Transverse angle cuts



- Upper cut: *eps* = *± 4.5e-3 / pt*
- Lower cut: *eps* = *± 1.5e-3 / pt*

Conclusions

- Transverse angle delta is inversely proportional to particle momentum, thus, cuts depending on momentum value can be applied
- For transverse angle delta lower and upper cuts can be applied
- For transverse angle it might be efficient to use different cuts depending on detector layer
- Longitudinal angle delta does not strongly depend on momentum and has smaller values, thus, a constant value cut is applicable

What was done

- Found parameters for transverse angle delta cuts, depending on momentum:

Upper cut: $eps = \pm 4.5e\text{-}3 / pt$

Lower cut: $eps = \pm 1.5e\text{-}3 / pt$

- Optimal constant value for longitudinal angle delta cut:

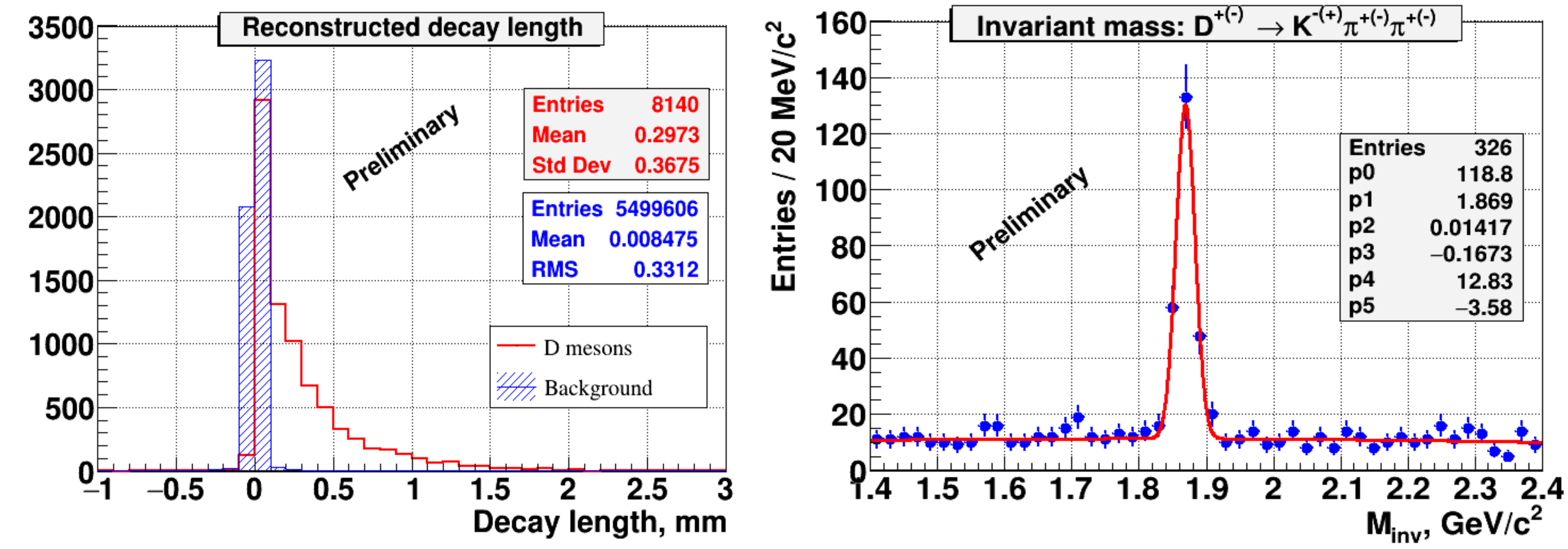
$eps = 5e\text{-}3$

- Hit arrangement in multimaps, cut application and track candidate composition implemented
- For an event with 1000 tracks with momentum range 0.05 – 2.0 GeV/c around 4% of track candidates found have hits from different MC tracks

Things to do

1) Track fitting in ITS and merging with TPC tracks
2) More complex cut can be implemented for longitudinal angles *dth*
3) Different cuts depending on layer can be implemented for transverse angles *dphi*

D-meson reconstruction with ITS



These results have been obtained using the existing TPC-based track reconstruction method in pp collisions at $\sqrt{s} = 25\ GeV$. The proposed algorithm is expected to improve the reconstruction results due to, for instance, better performance for low-pt tracks.

Acknowledgements

We would like to thank Yu.Murin (VBLHEP JINR) and V.Kondratiev (SPbU) for providing us with the information about one of the possible ITS configurations.