Embedding study

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RIKEN VTX meeting
Ryohji Akimoto

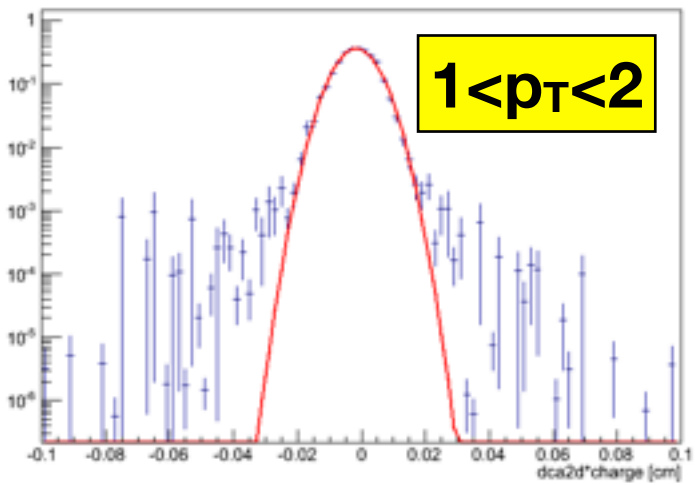
Embedding setup

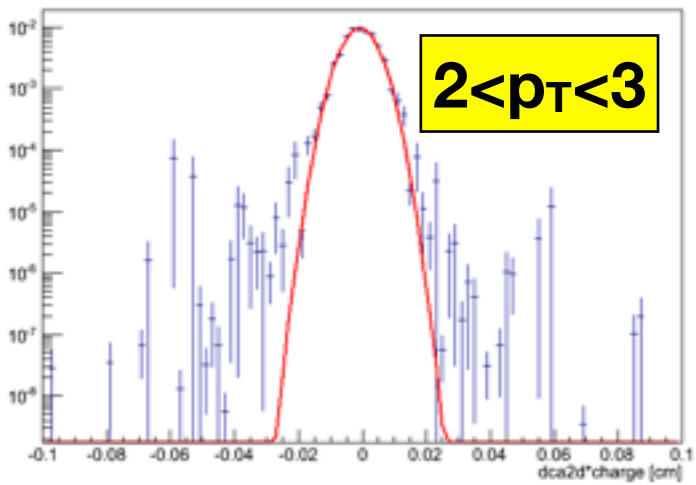
- Real data
  - run : 347128
  - hot dead map : get from database
  - z-vertex : |BBC-Z|<10cm
  - data sampling : MB
- Simulation
  - particle : $e^{\pm}$, $\pi^{\pm}$, $\pi^0 \rightarrow 2\gamma$, π^0 Dalitz, eta Dalitz, J/psi
  - pT : 0-10 GeV/c (flat distribution)
  - |eta| < 0.5
  - event vertex : (0.0515729, -0.0609596, 0.0) (fixed at beam center of run347128)
  - hot dead map : get from database

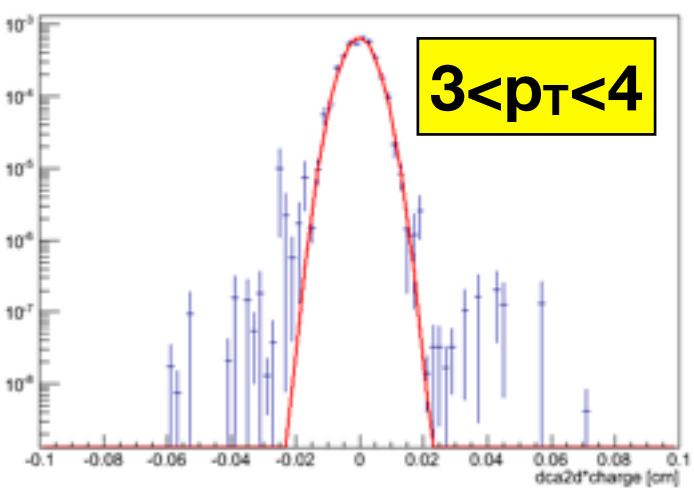
2D-DCA distribution : pi0 Dalitz decay

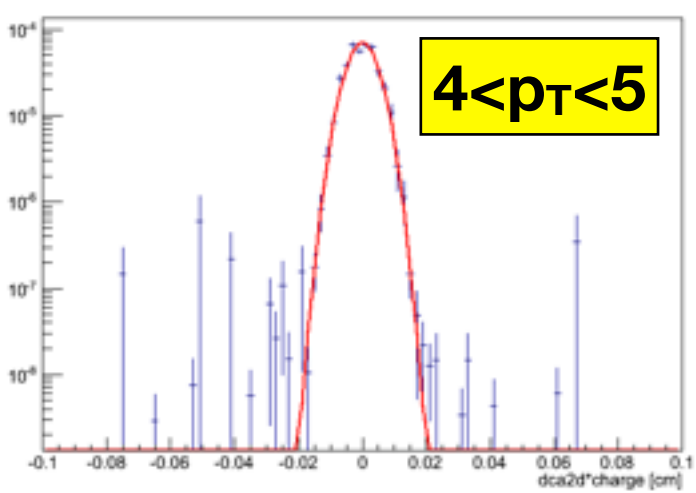
- requirement
  - (B0 & B1 hits) + (at least one hit at stripixel layers)
  - reconstructed p_T>0.75GeV/c
  - chi2/NDF < 6
  - |DCA-Z| < 0.075cm
  - p_T (MC) weight : p_T*pow(exp(-0.42172*p_T-0.21329*p_T*p_T)+p_T/0.70972,-8.34158)
  - apply isolation cut (=conversion veto cut)
  - eID cut : n0>2 && disp<5 && chi2/npe0<7 && dep>-2 && prob>0.01
  - EMC matching : |emcdphi|<0.03 && |emcdz|<10
  - quality==31 || quality==63
  - |zed| < 75

2D-DCA × charge : reconstructed p_T dependence







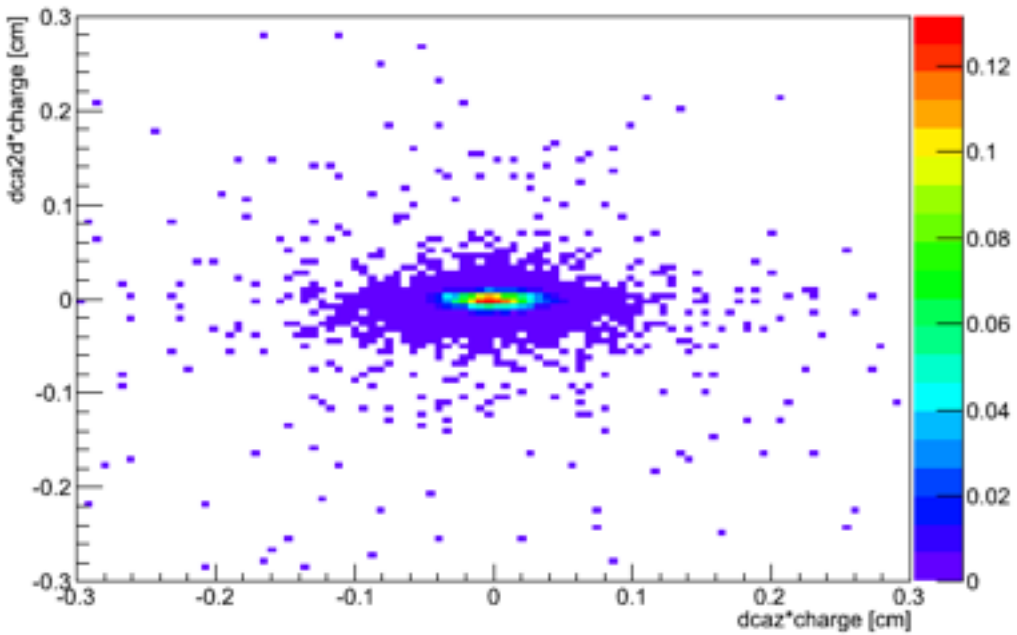


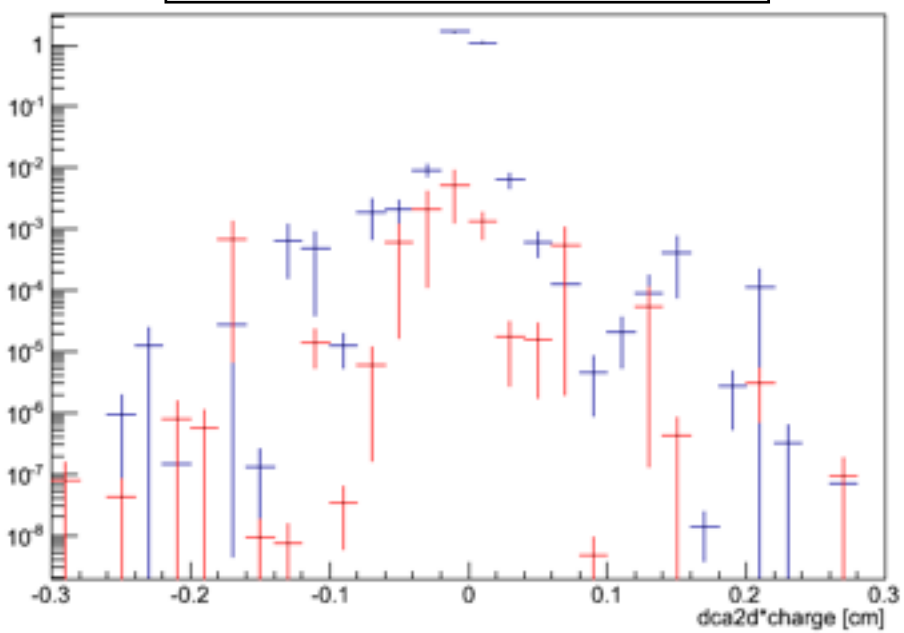
- DCA shapes are more symmetric than those of electron.
- Tail level decreases as pT increases.

2D-DCA × charge : Z-DCA cut dependence

2D(XY)-DCA v.s. Z-DCA

|Z-DCA|<0.075
|Z-DCA| : 0.1-0.15 x1.5

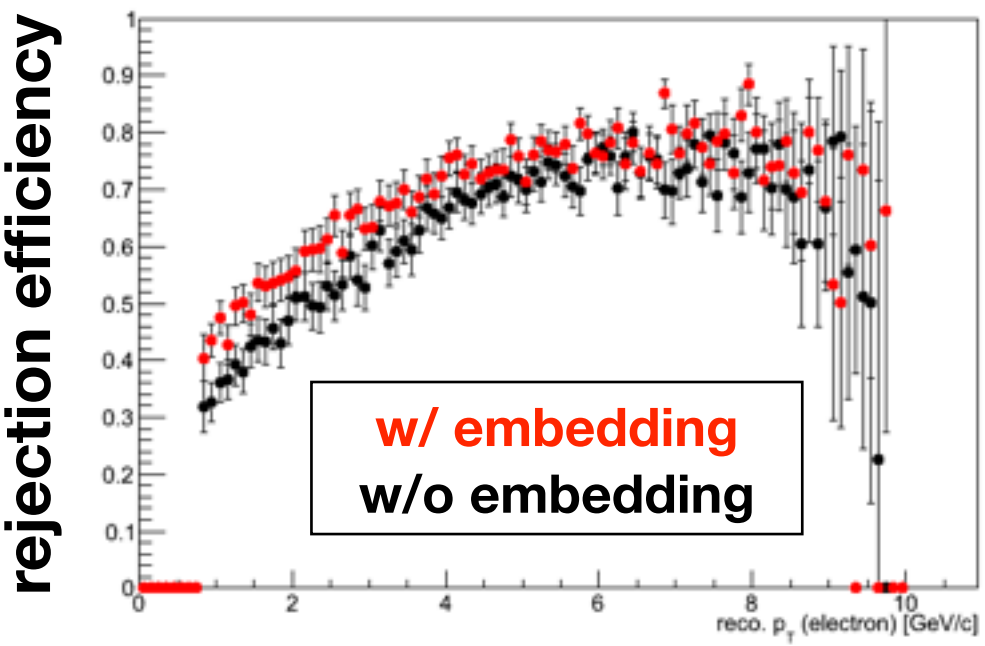




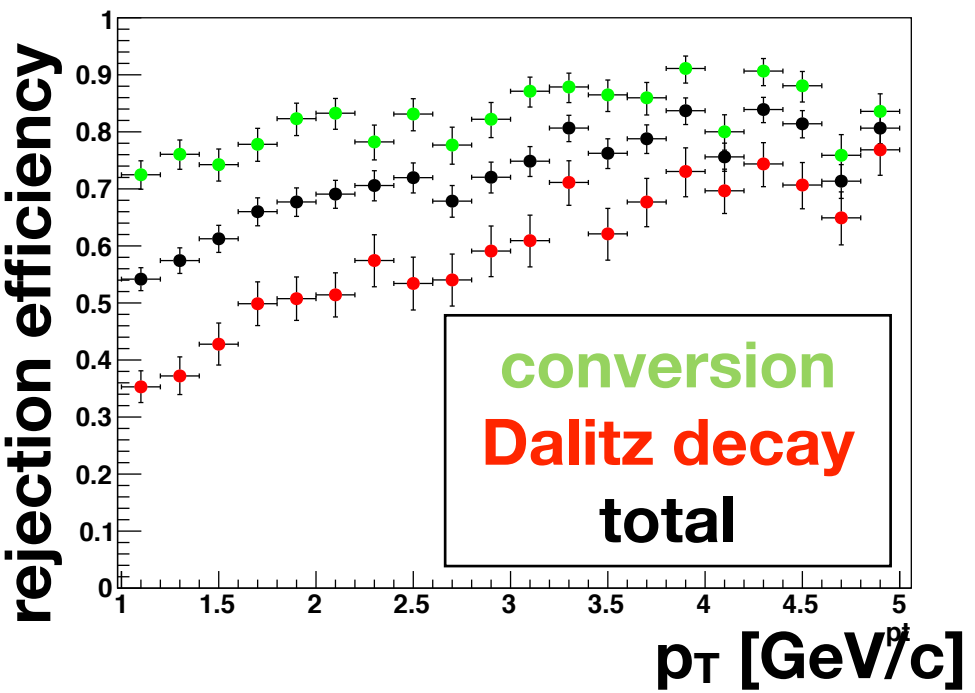
- Tail of 2D-DCA can not be reproduced by 2D-DCA shape of sideband region.

Rejection fraction of isolation cut

Rejection fraction



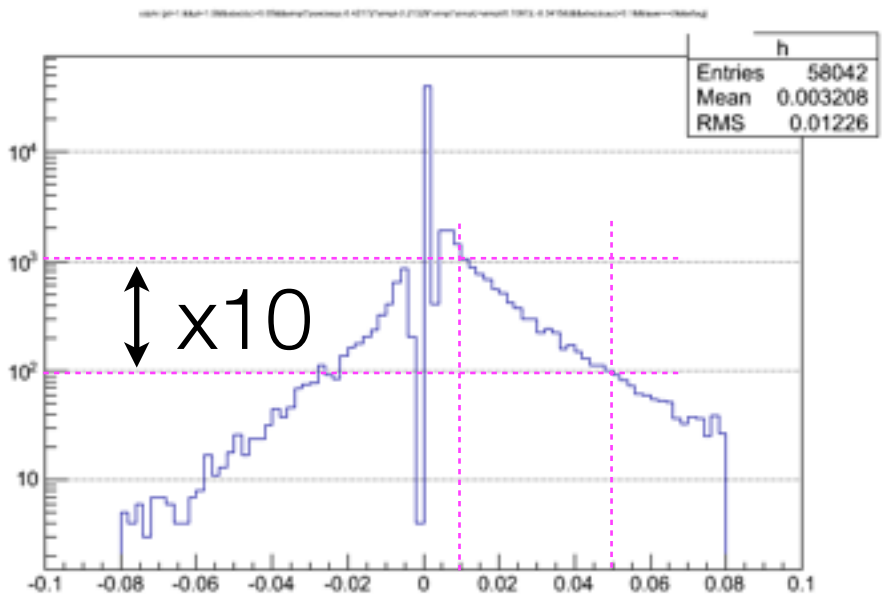
Rejection fraction (in A.N.)

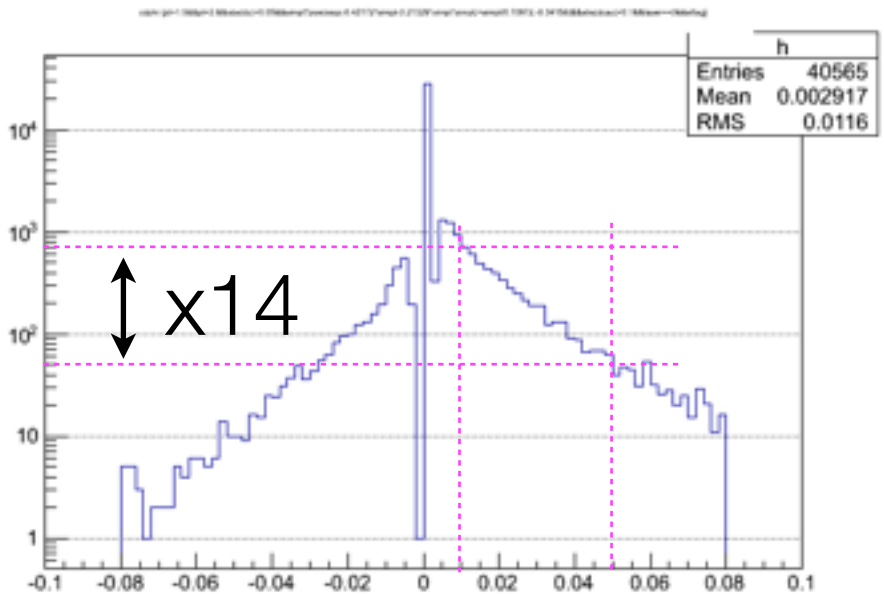


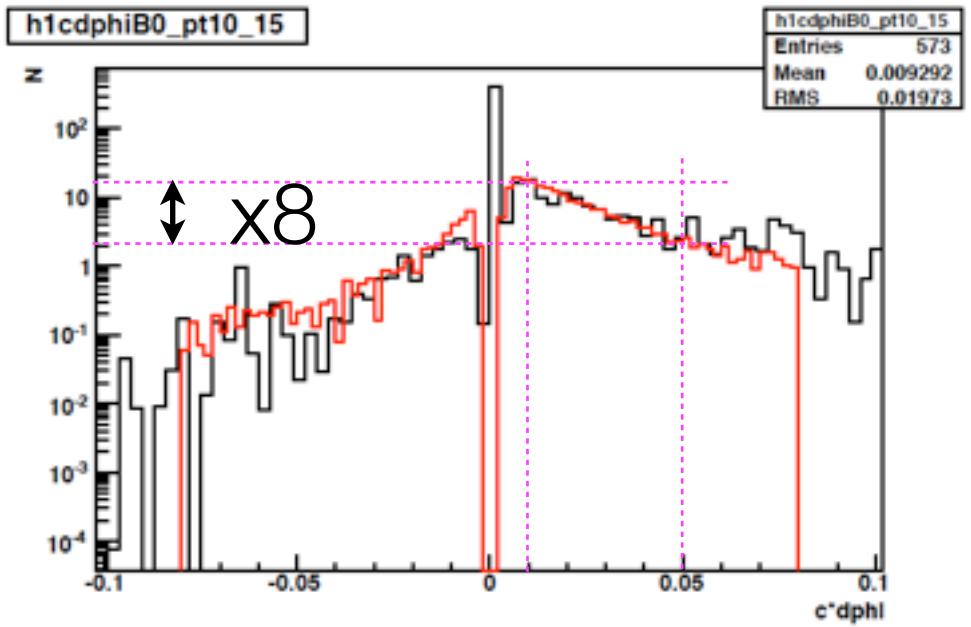
- Rejection fraction is calculated from p_T distribution with/without isolation cut.
- Rejection fraction is consistent with that in analysis note.
- Rejection fraction increases by embedding due to random matching to another track.

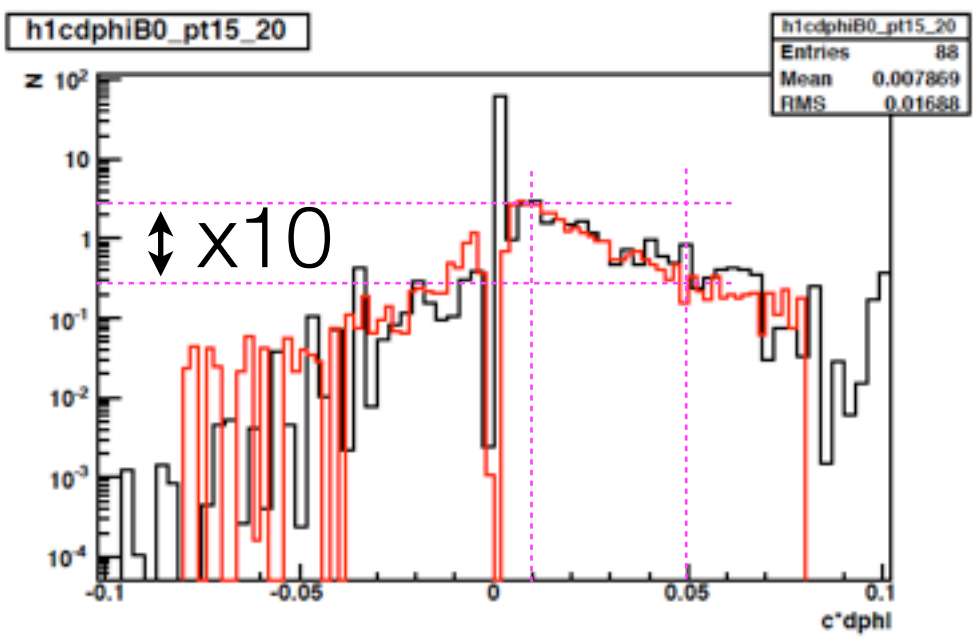
Backup

Near-hit distribution (Barrel-0)









Problem in current embedding module

- Sasha made a embedding module before QM2012.
  - SvxRawhits in real data are dumped into text file for the embedding.
    - ✓So, handling many real events is difficult.
- Sasha and I talked and I updated to be able to handle DST of real data.
  - made a new module since it needs special setup.
- What want to do by the embedding study
  - evaluate DCA distribution of mis-association tracks.
  - evaluate DCA resolution including multiplicity effect.

Problem in embedding 1

There are two problems in embedding

- difference of VTX geometry
  - Geometries of VTX in simulation and in real data are different.
  - Simulation geometry is used for embedding and hit in real data are thought as “background”.
  - It is fine for the evaluation of mis-association track and multiplicity effect.
- difference of primary vertex in simulation and in real data
  - In the current embedding code, get reconstructed primary vertex position in real data (only z-direction), and then run PISA and reconstruction.

Problem in embedding 2

- To get flexibility, I updated to move SvxGhit of simulation track in z-direction so that the primary z vertices are the same.

  ✓ignore the difference of vertices difference in xy-direction.

    - DCA calculation is done using simulation vertex.

- Multiplicity effect on DCA resolution which does not includes primary vertex resolution can be evaluated.

  ✓Primary vertex resolution is needed to be evaluated by other way.

- It is fine for the evaluation of mis-association track since its DCA distribution is much wider than primary vertex resolution.

What is done in embedding

(1) reconstruct both simulation and real data.

(2) calculate primary z vertex difference between simulation and real data.

(3) move SvxGhits of simulation track by the difference and make SvxRawhit from the moved SvxGhits.

- If a moved SvxGhit gets out of VTX acceptance, it is not saved.

(4) save SvxRawhits of real data.

(5) run SvxReco (clustering) and SvxCentralTrackReco (tracking).

- Only PHCentralTrack (seed of tracking) in simulation is used.

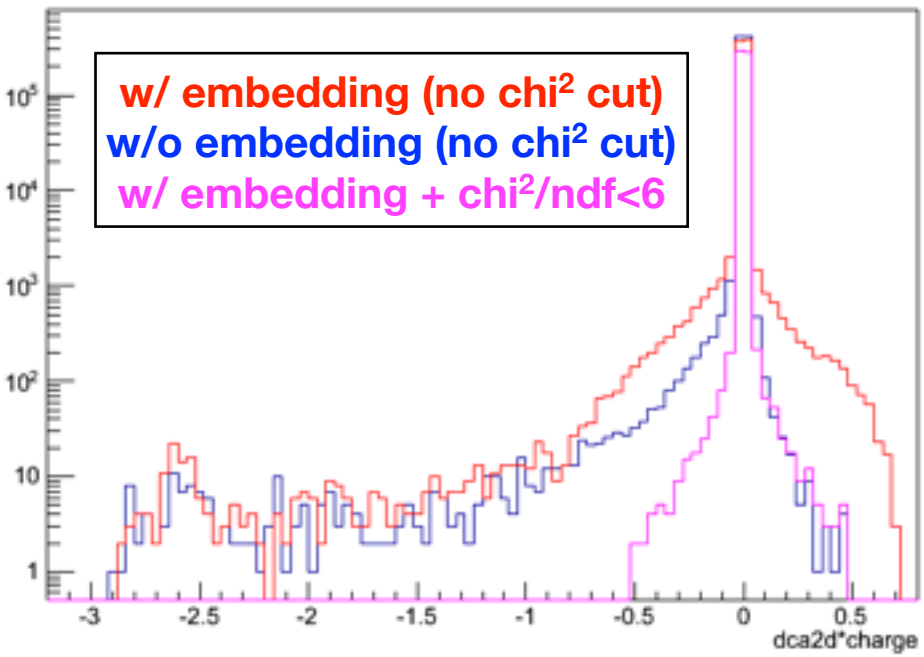
Necessary nodes

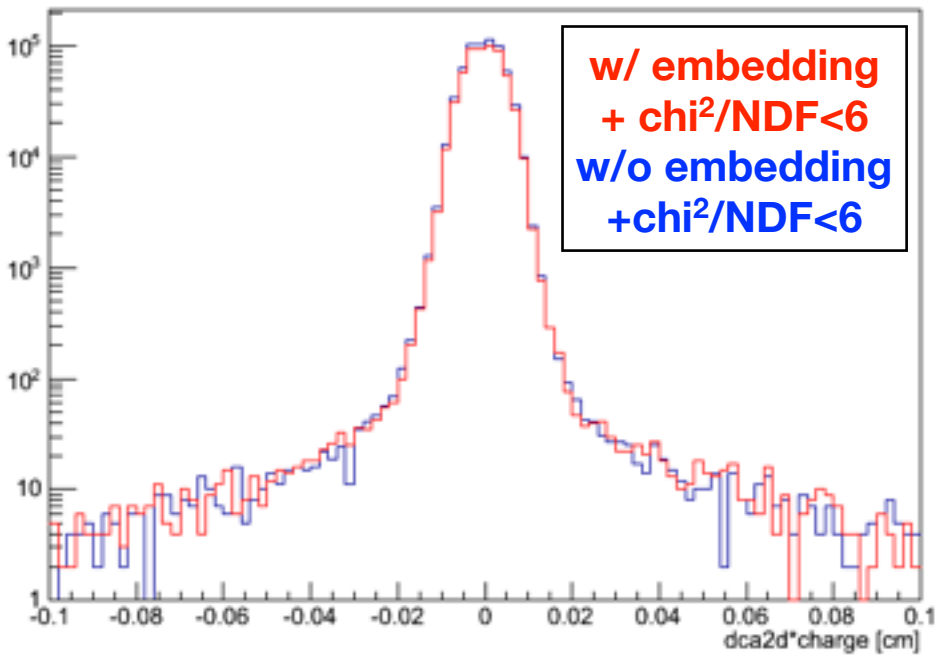
- real data
  - SvxRawhitList
  - VtxOut
  - RunHeader
    - ✓used in SvxCentralTrackReco
  - BbcOut
    - ✓used in SvxCentralTrackReco
  - PHGlobal
- simulation
  - SvxGhitList
  - VtxOut
  - PHCentralTrack
  - McSingle

Vertices in VtxOut

- following vertices are saved in VtxOut
  - event vertex in simulation : saved as “SIM”
  - reconstructed primary vertex in real data : saved as “SVX_PRECISE”
  - reconstructed beam center in real data : saved as “SVX”
  - combination of simulation and real data
    - ✓XY : simulation
    - ✓Z : real data
    - ✓saved as “FORCED” (when vertex is gotten from VtxOut without any argument, this vertex is returned.)

2D-DCA distribution (charged pion)

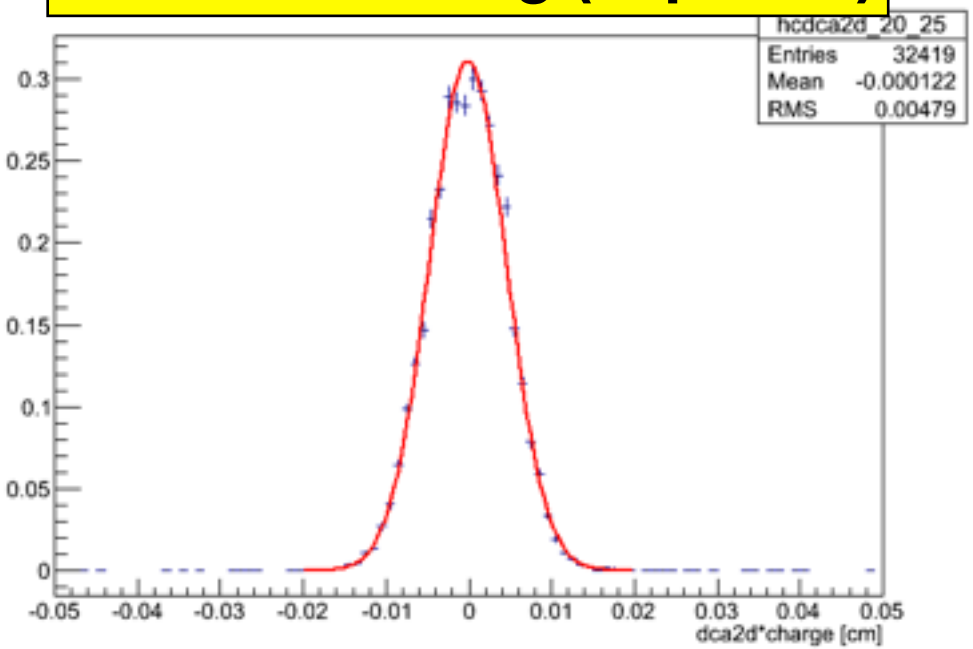




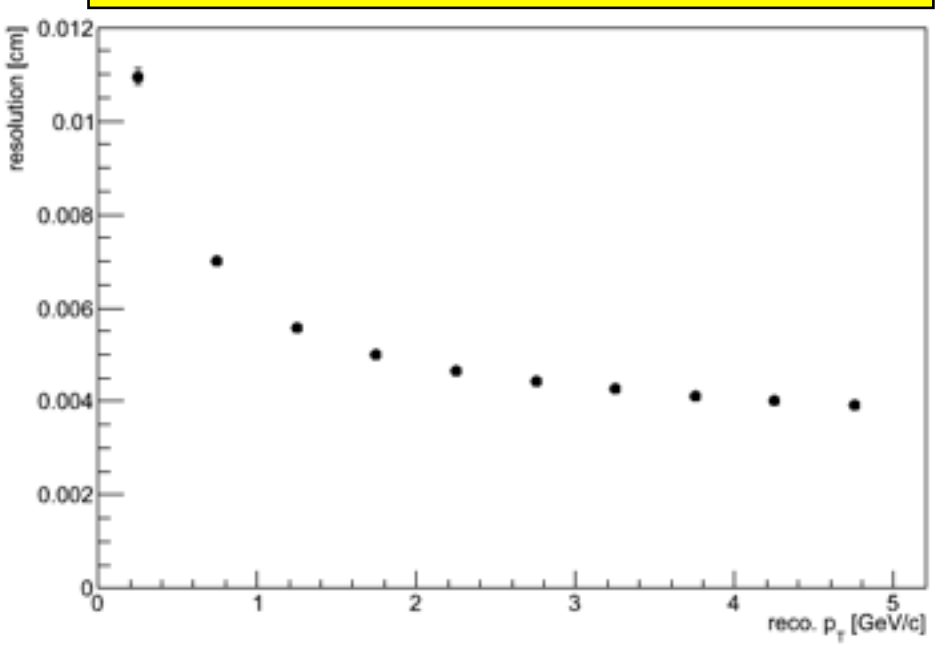
- requirement
  - (B0 & B1 hits) + (at least one hit at stripixel layers)
  - reconstructed p_T>1GeV/c (no weight)
  - does not decay (generation==1)
- Changing of tail is small after chi^2 cut.
- Changing of width of the main peak is small.
- Source of large tail (DCA : 2~3) is not clear.

2D-DCA width (charged pion)

Gaussian Fitting ($2<p_T<2.5$)

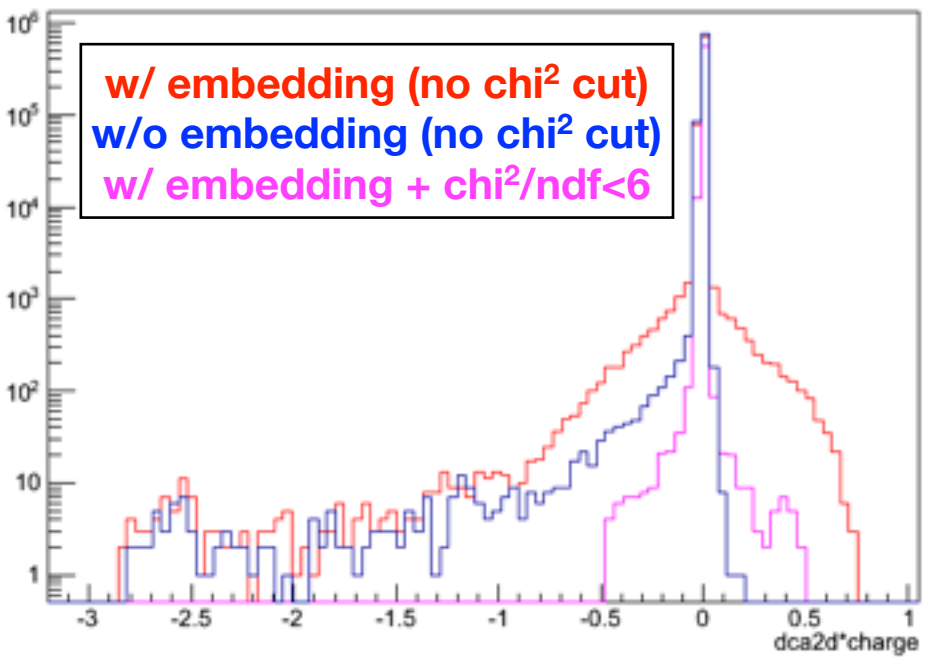


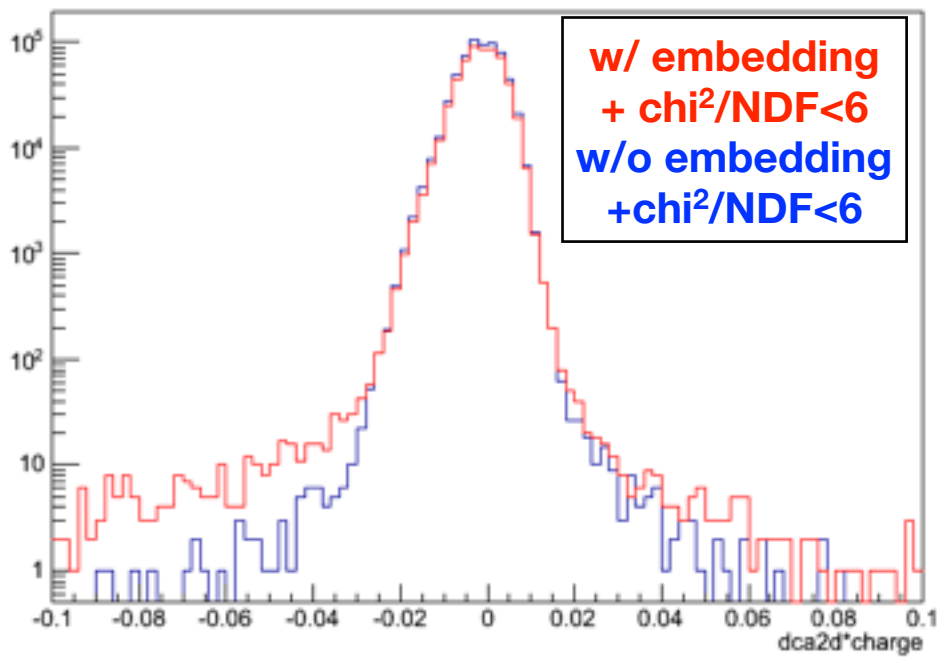
DCA width of charged pion



- weight as a function of p_T(MC)
  - p_T*pow(exp(-0.42172*p_T-0.21329*p_T*p_T)+p_T/0.70972,-8.34158)
- Widths are narrower than those in real data. (as expected)
- Gaussian fitting is not good at the peak.

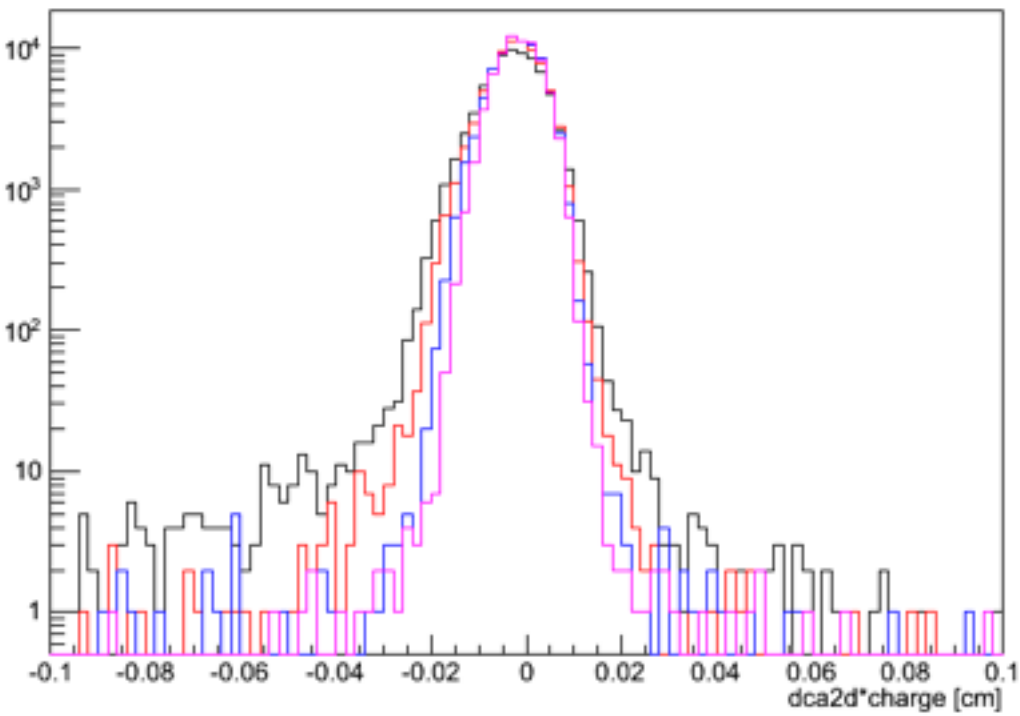
2D-DCA distribution (electron)





- requirement
  - (B0 & B1 hits) + (at least one hit at stripixel layers)
  - reconstructed p_T>1GeV/c (no weight)
  - does not decay (generation==1)
- Tail increases by embedding.
- Tail is smaller than that in pion (due to small multiple scattering?)
- DCA shape is asymmetric both for the case w/ or w/o embedding.

2D-DCA distribution (electron) : pT dependence



1< p_T (GeV/c) <2
2< p_T (GeV/c) <3
3< p_T (GeV/c) <4
4< p_T (GeV/c) <5

- Requirements listed p.11 & chi^2/ndf<6 are applied.
- Asymmetry in DCA shape decreases as p_T increases.