Gamma-conversion Tomography of STAR Silicon Detector

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For the STAR Collaboration

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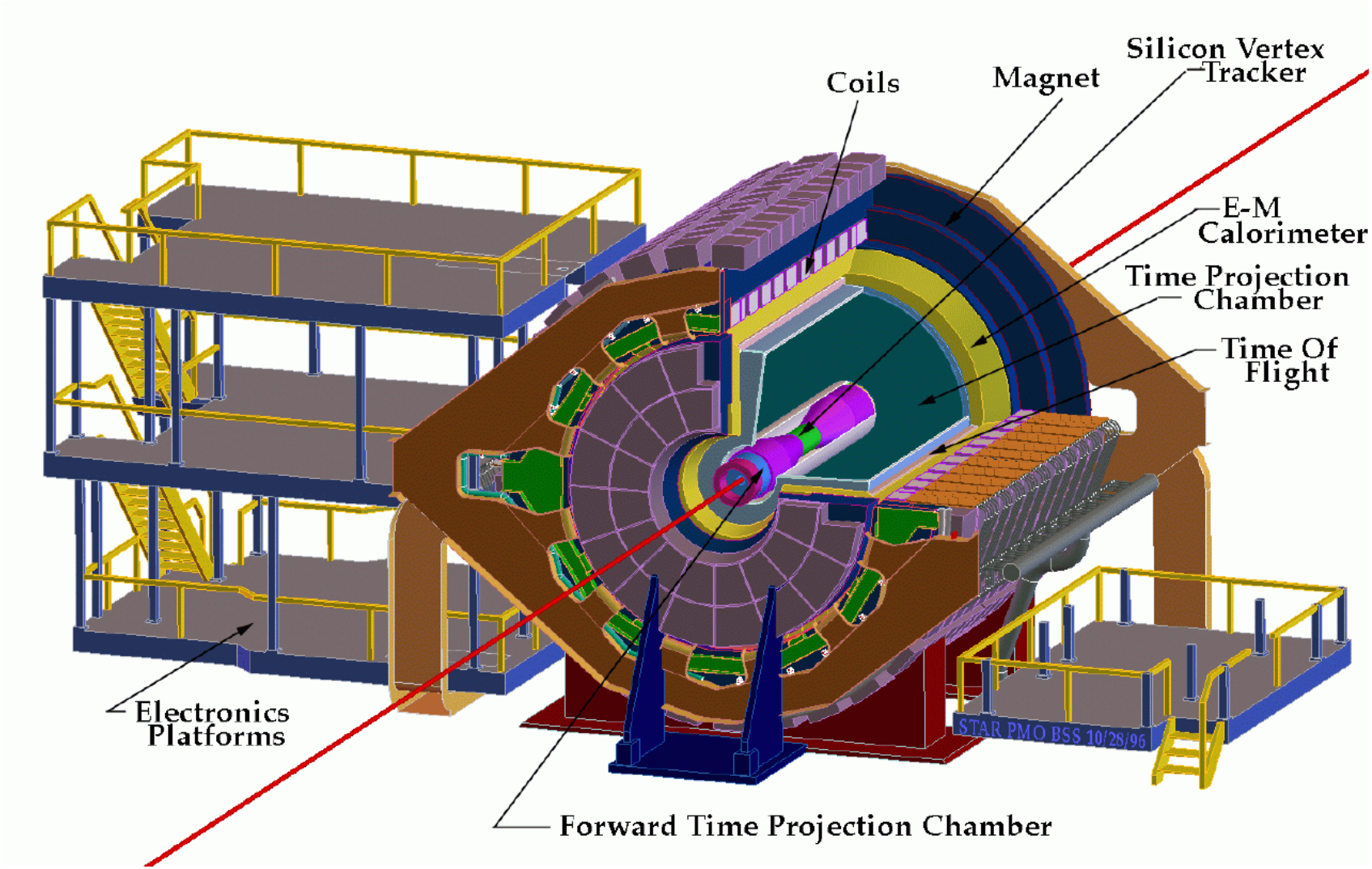
October 14 , 2008

PUSAN NATIONAL UNIVERSITY

Outline

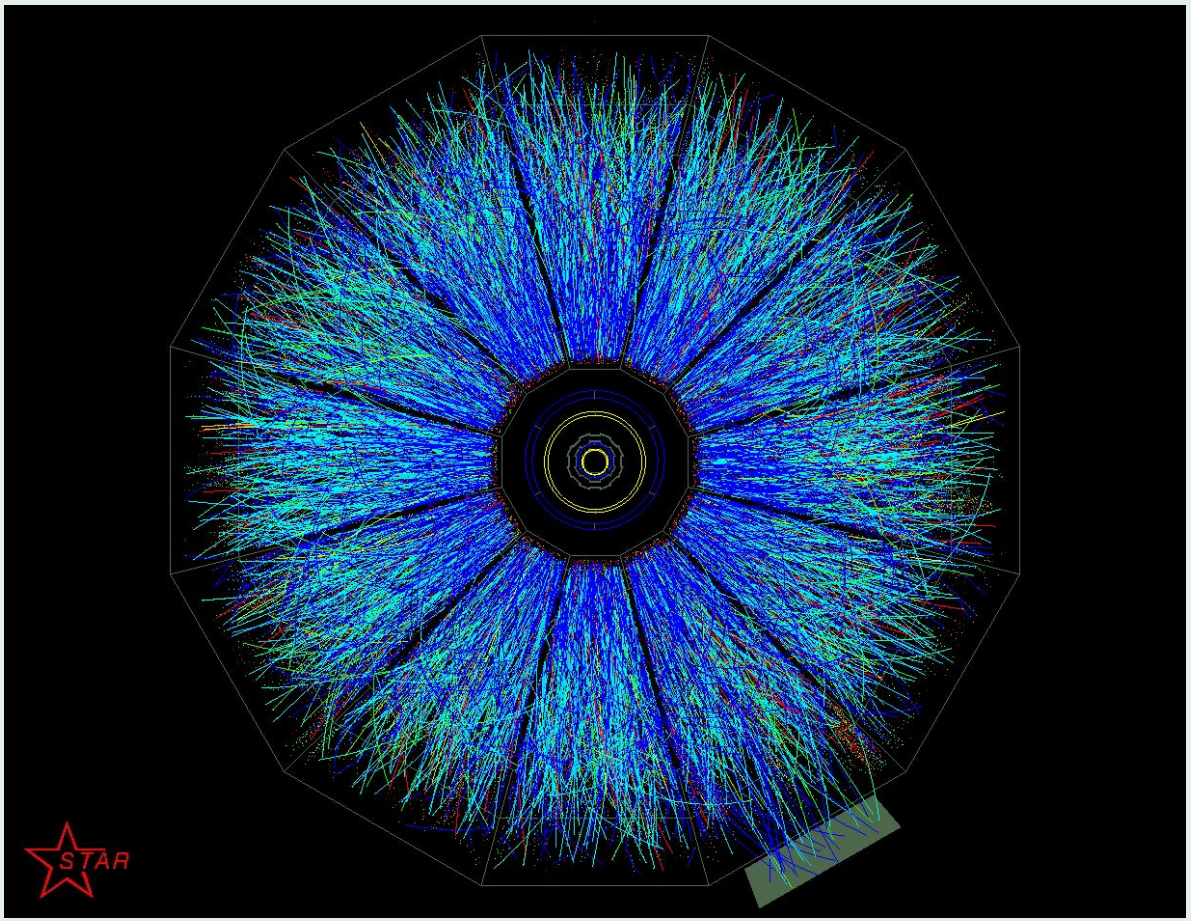
Outline

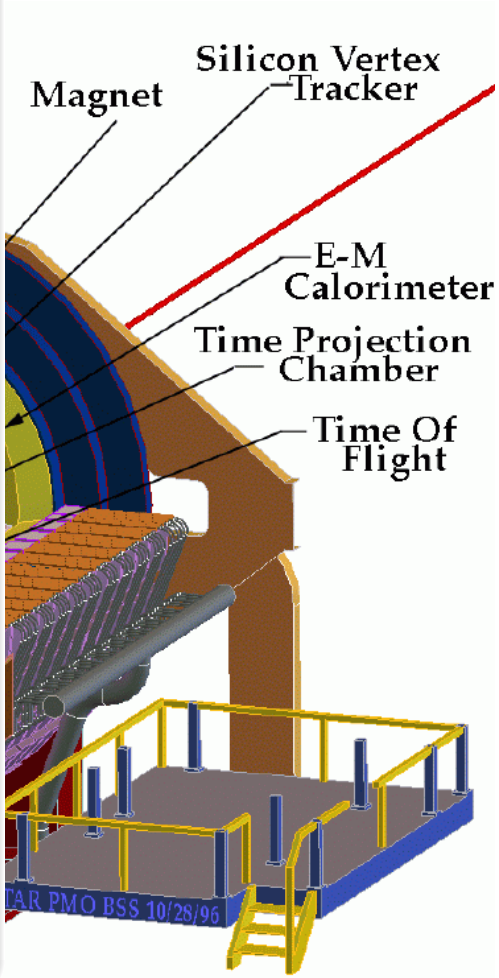
STAR Detector System



STAR Detector System

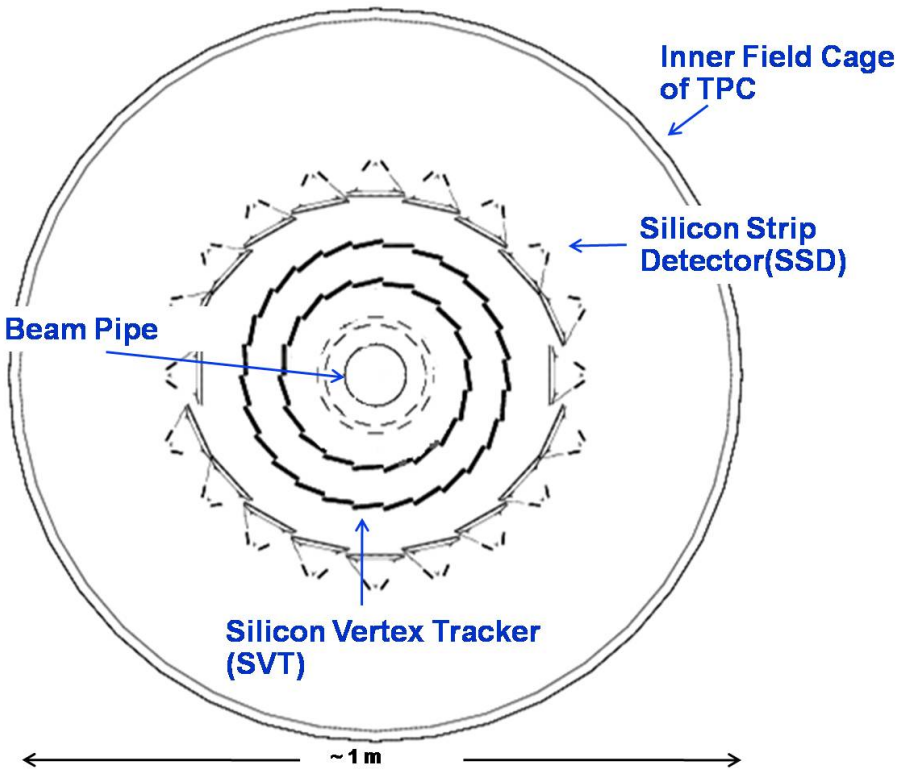
Tracks at the STAR TPC

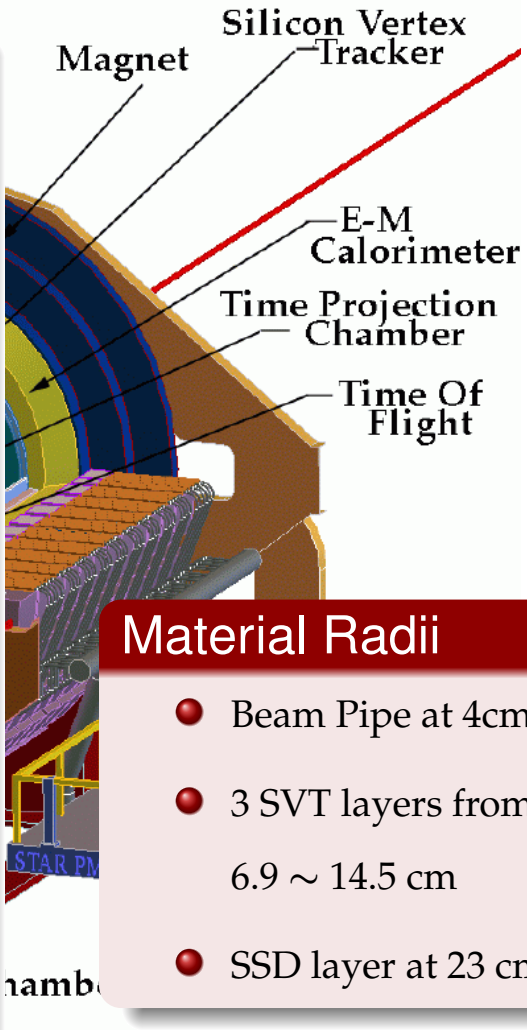




STAR Detector System

Inner Part of TPC



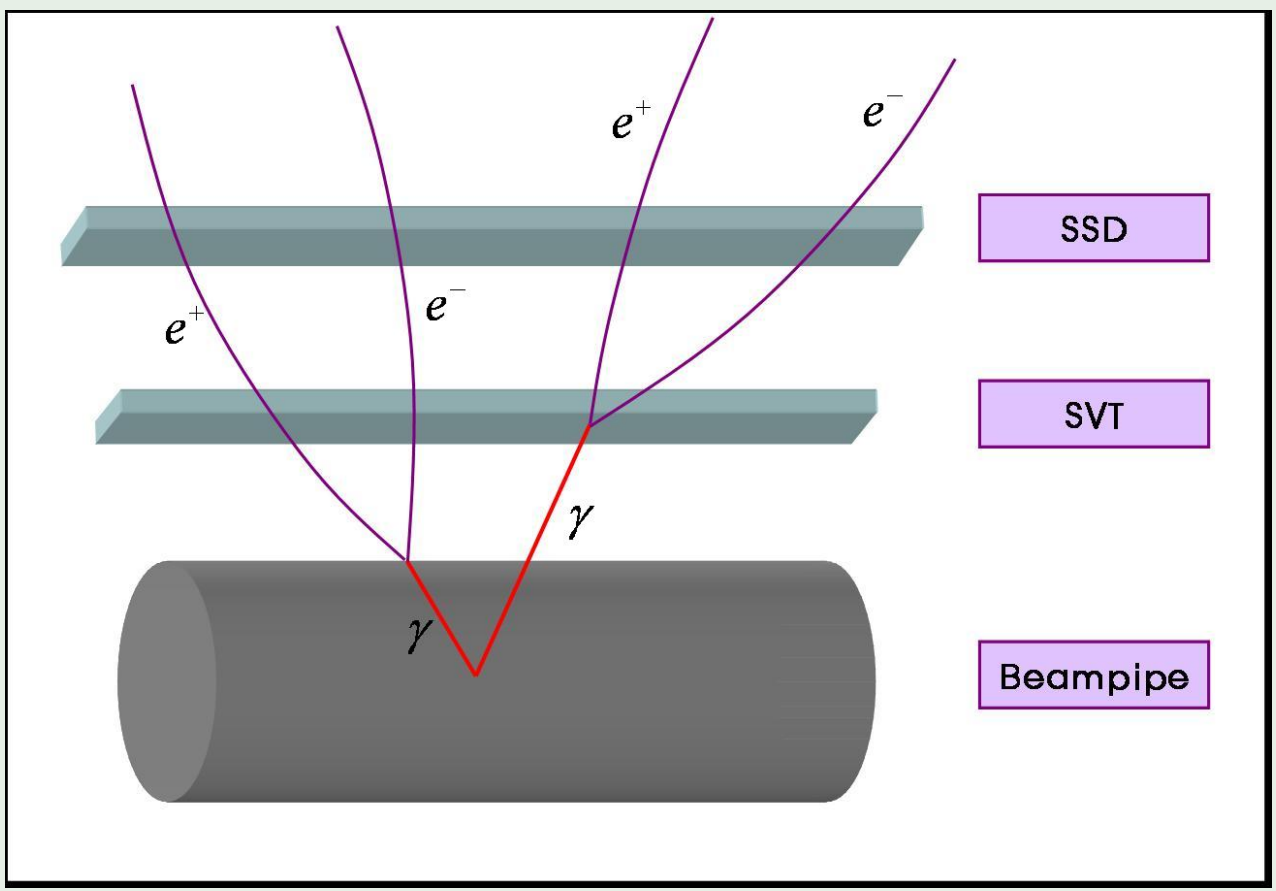


Material Radii

- Beam Pipe at 4cm
- 3 SVT layers from 6.9 ~ 14.5 cm
- SSD layer at 23 cm

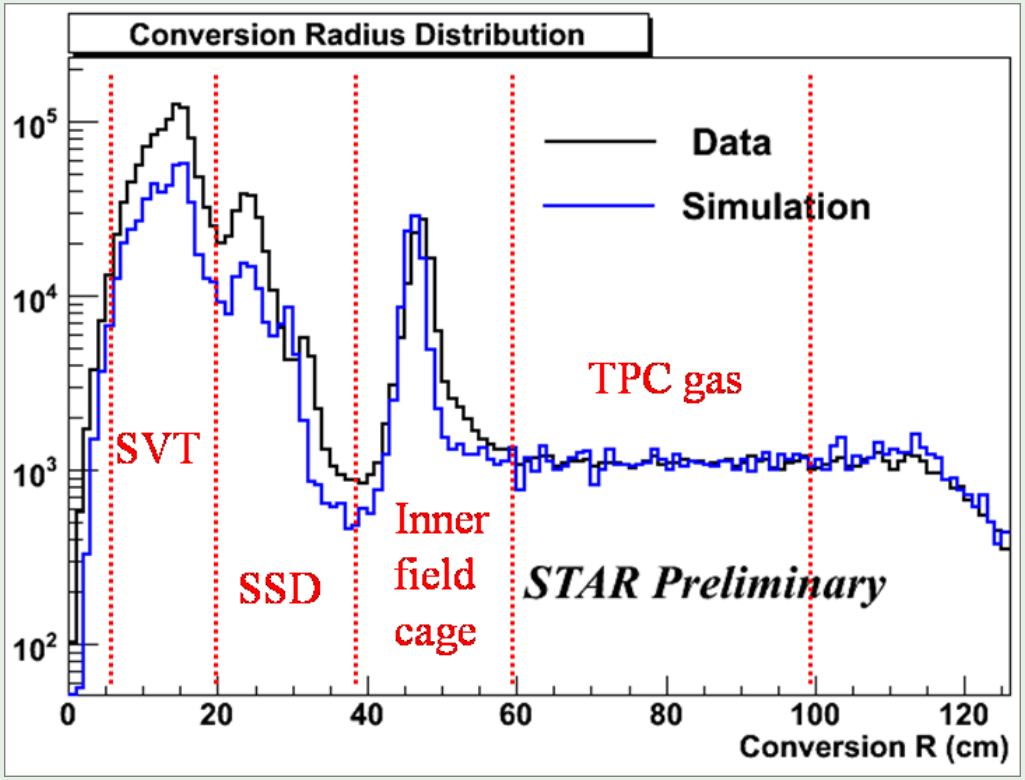
STAR Detector System

γ-conversions in the material



Motivation

Underestimation of silicon detector's material budget in MC (by Guoji, QM2008)



1. This information can be crucial for many analysis
2. Detail study of Material budget in SVT/SSD region is needed
3. Spatial Resolution of our detector system

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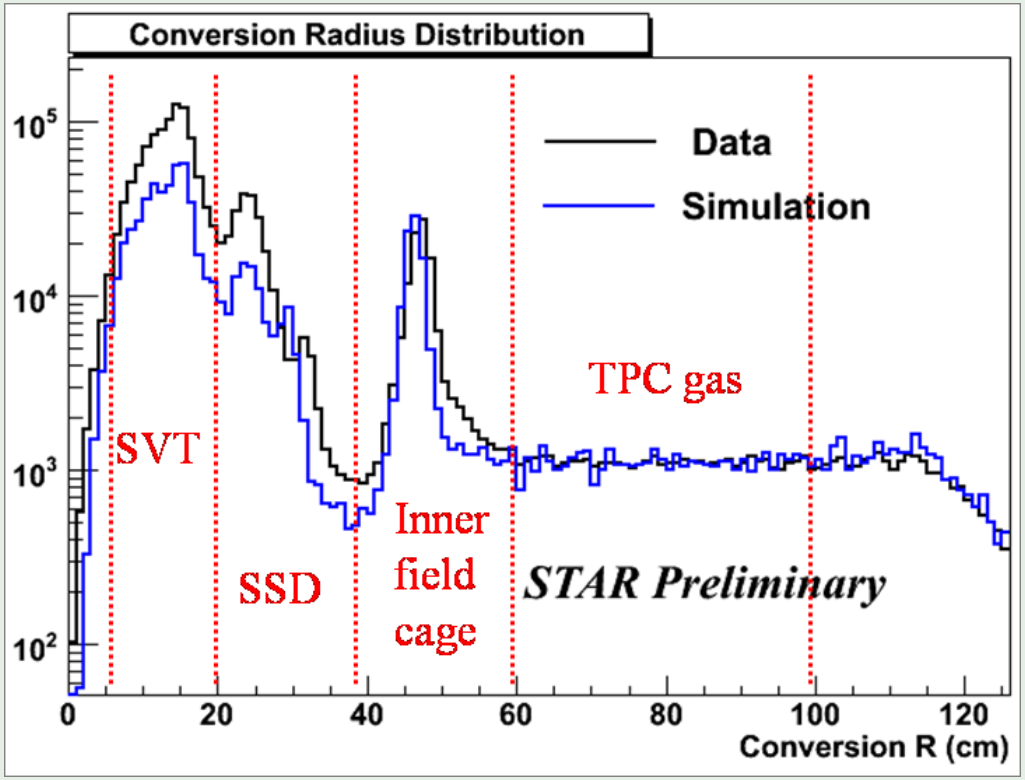

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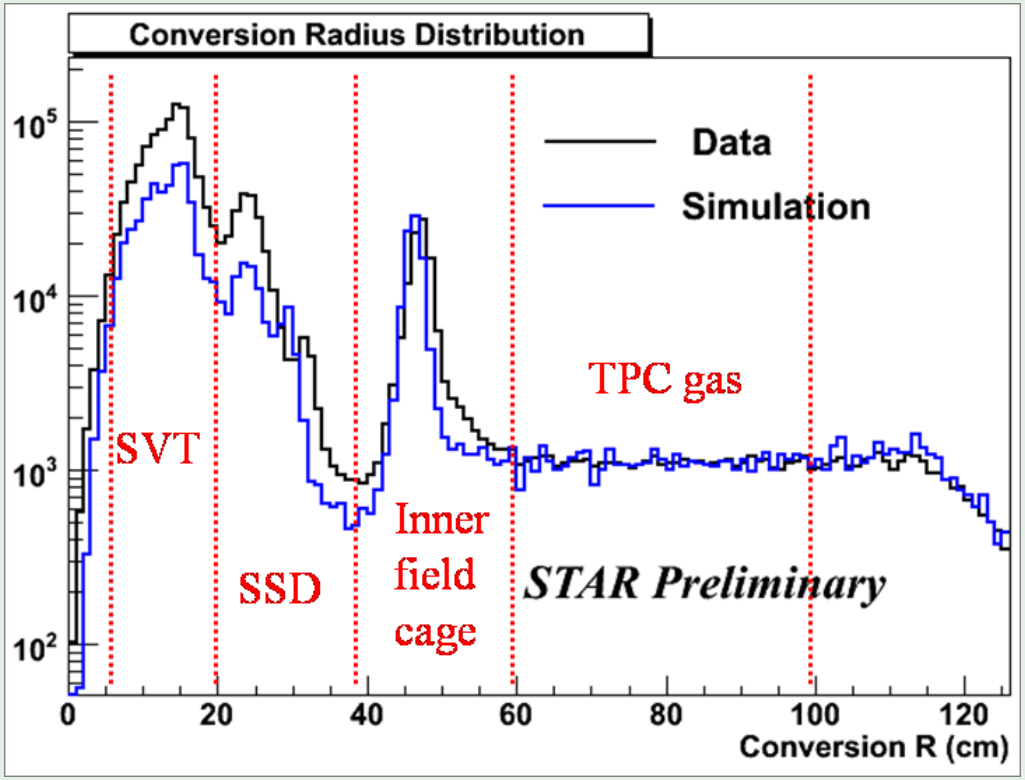

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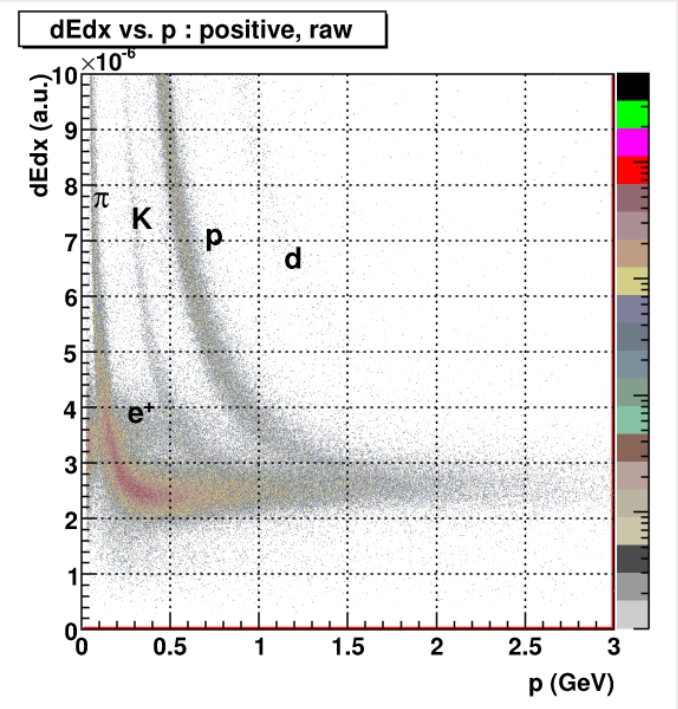
Data set & Cuts

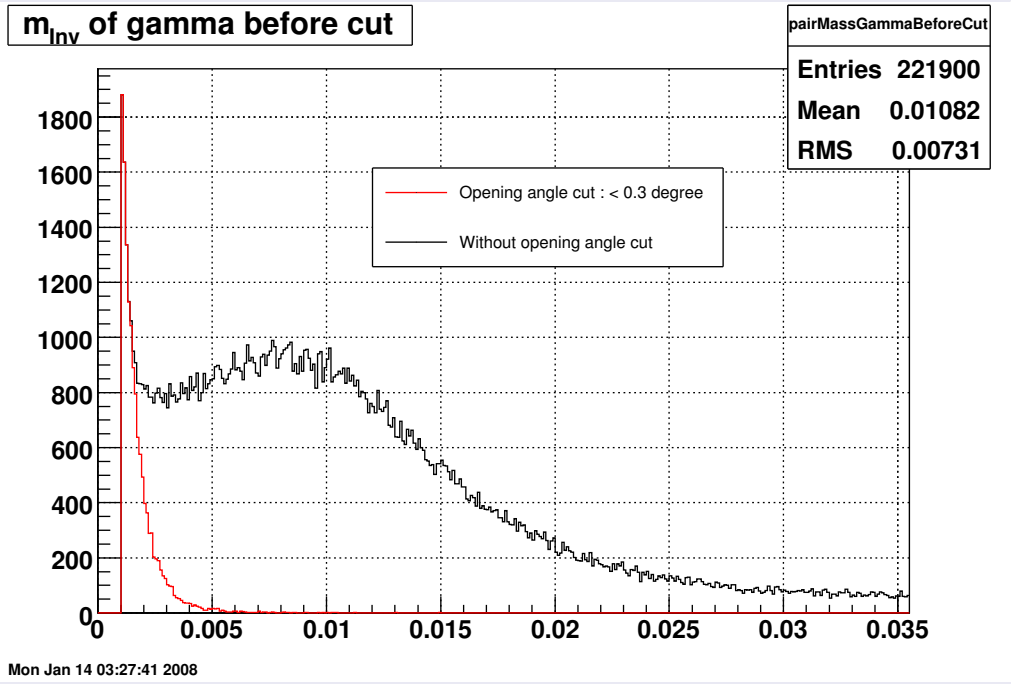
Data set

- Real Data : Cu+Cu @ 200GeV, 49M events with SVT/SSD informations
- MC Data : Hijing, 380k events

dEdx vs. p distribution



m_{inv} of e^+e^- hypothesis



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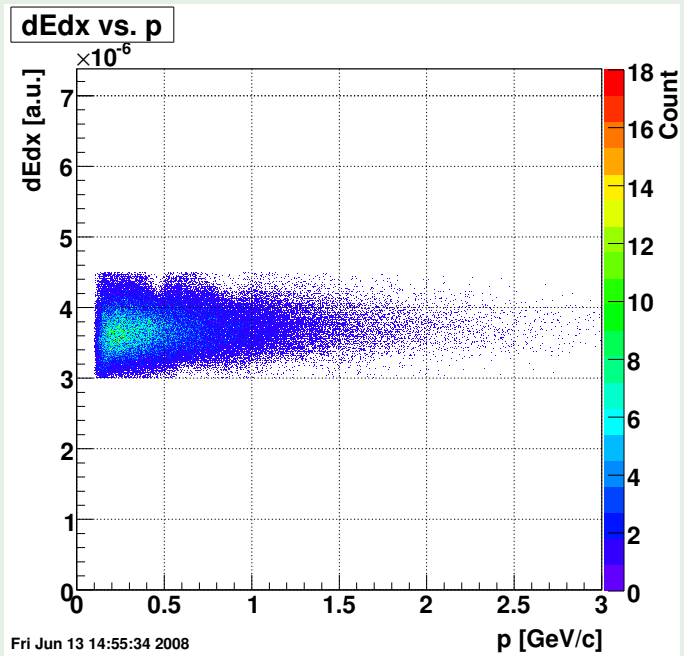
e^+e^- Candidates



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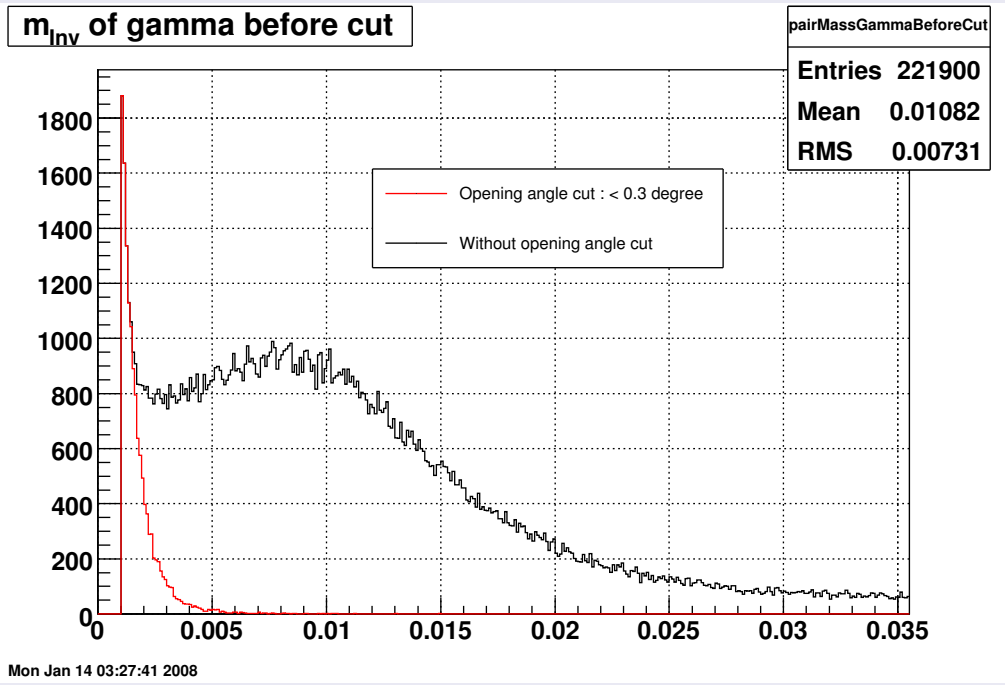
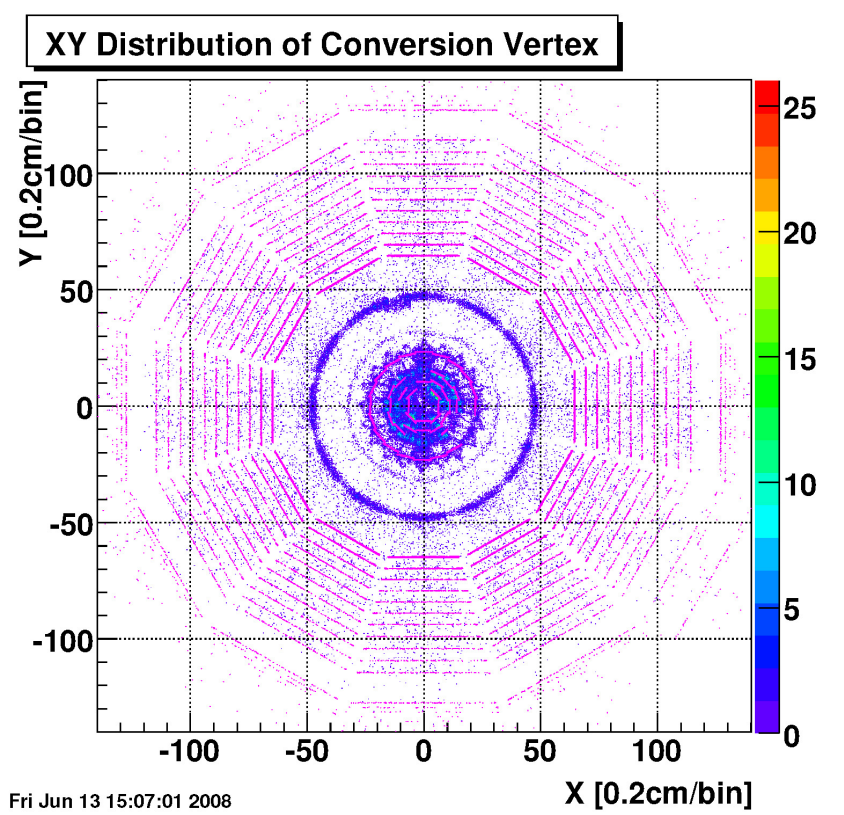


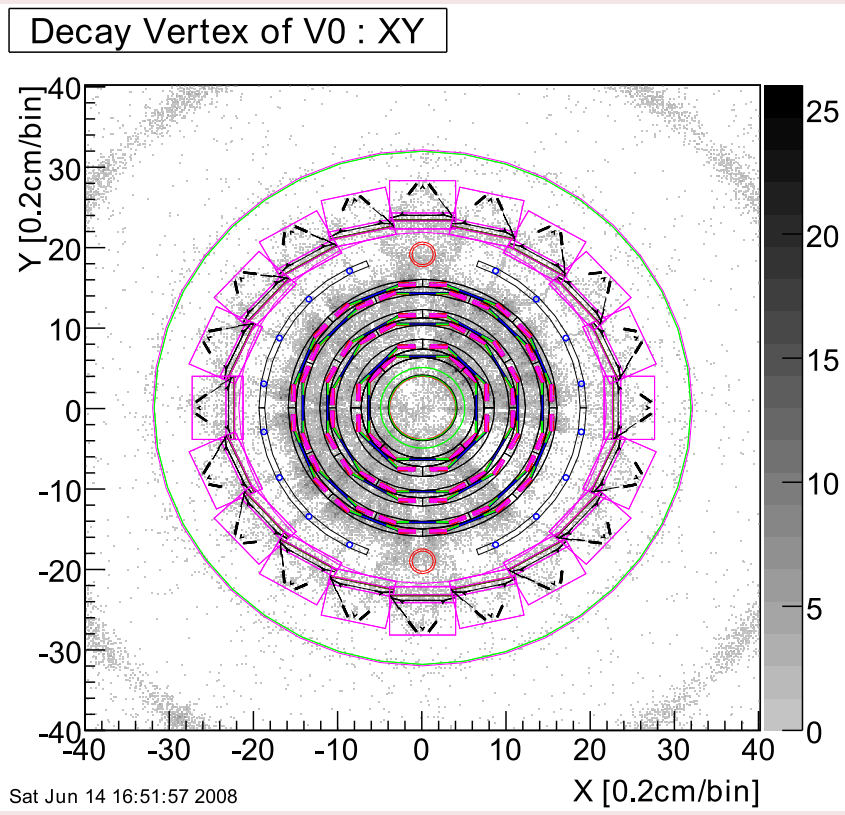
Transverse distribution of conversion vertex

SVT + SSD + Inner TPC Region



- Purple : Detector hit of Tracks

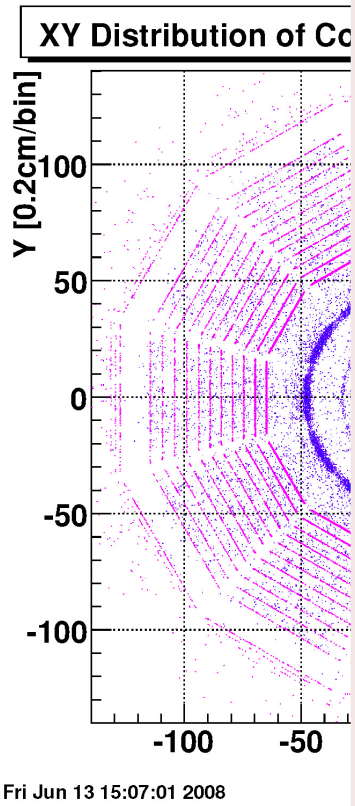
SVT + SSD Region



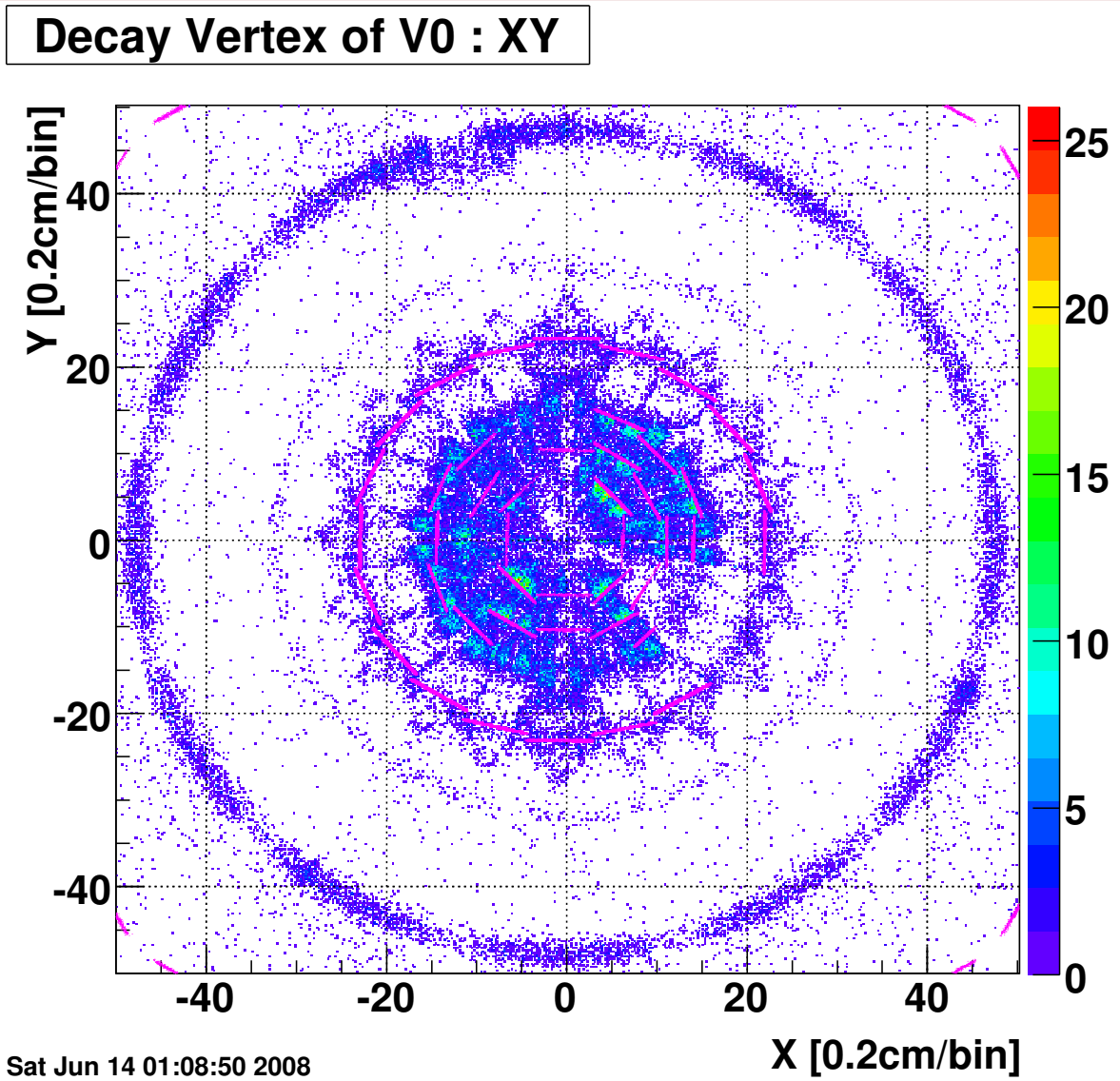
- Color : Material by GEANT

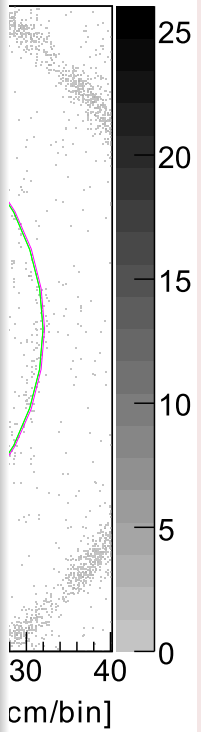
Transverse

SVT + SSD + In



Zoom





- Purple : D

ANT

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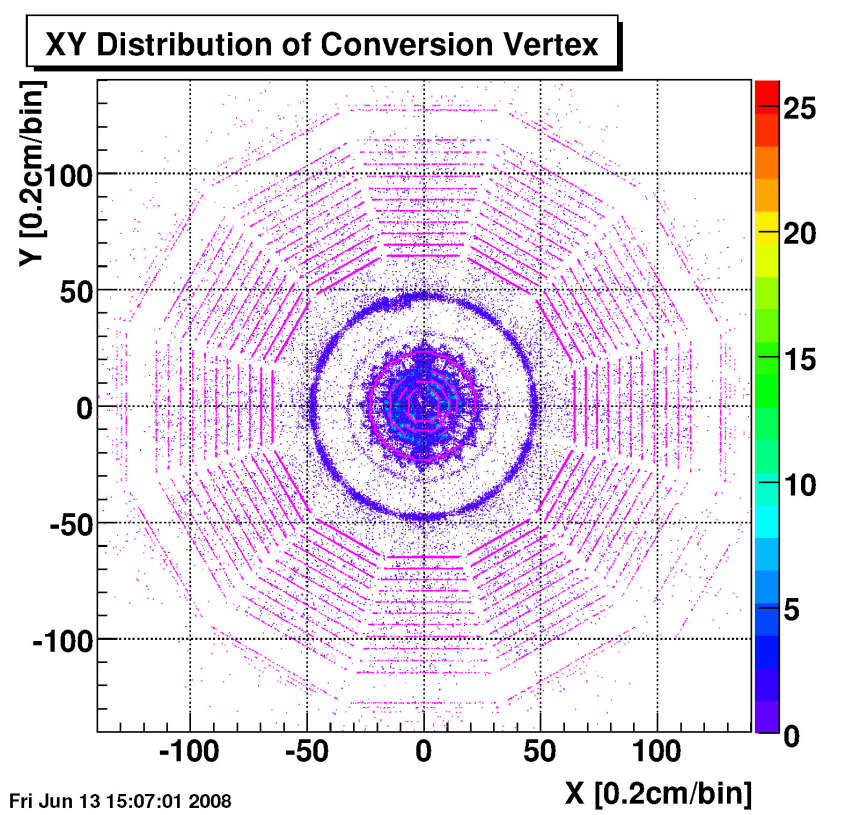

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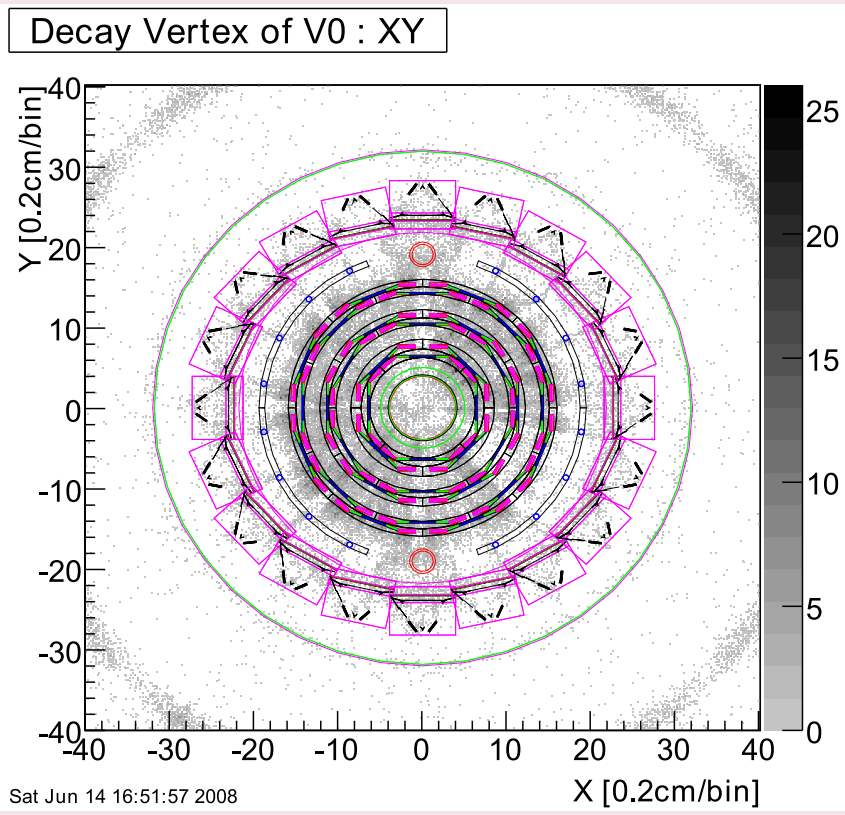
SVT + SSD Region



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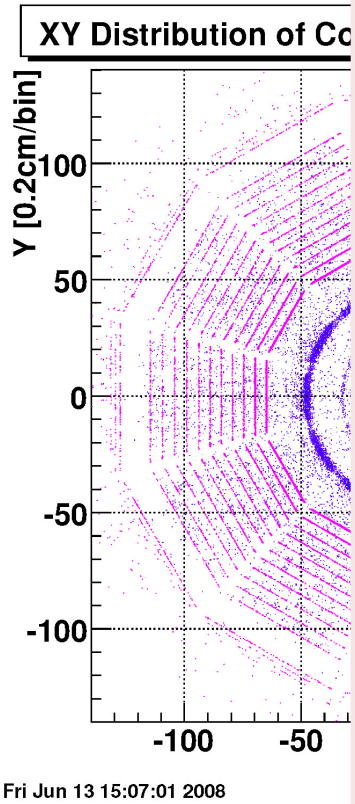

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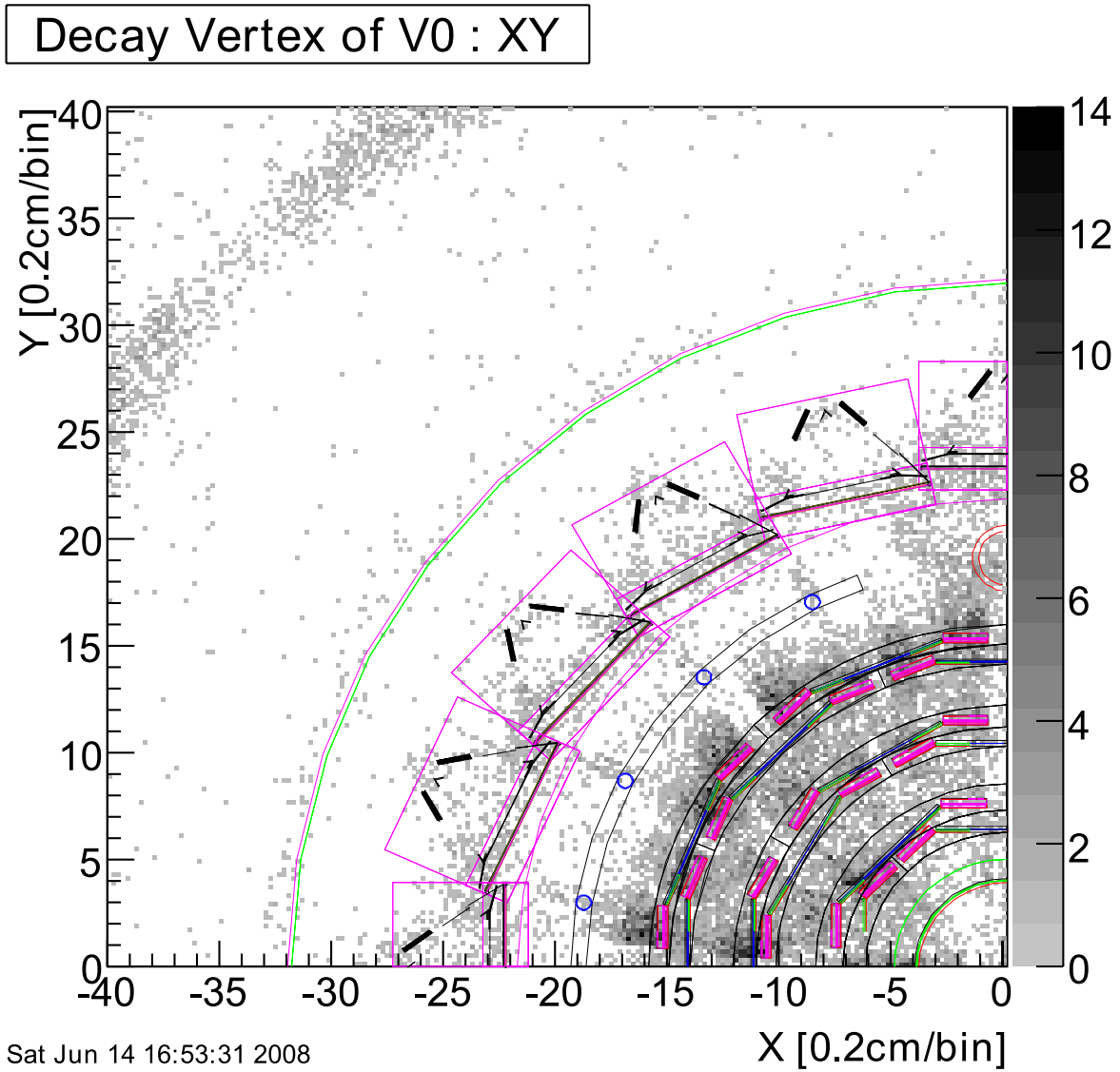

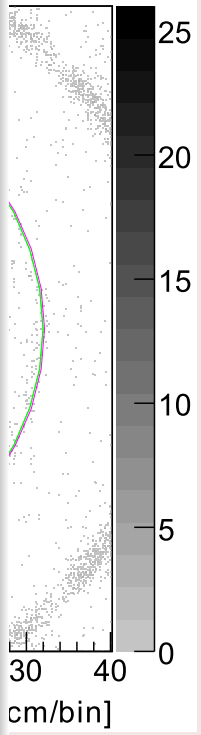

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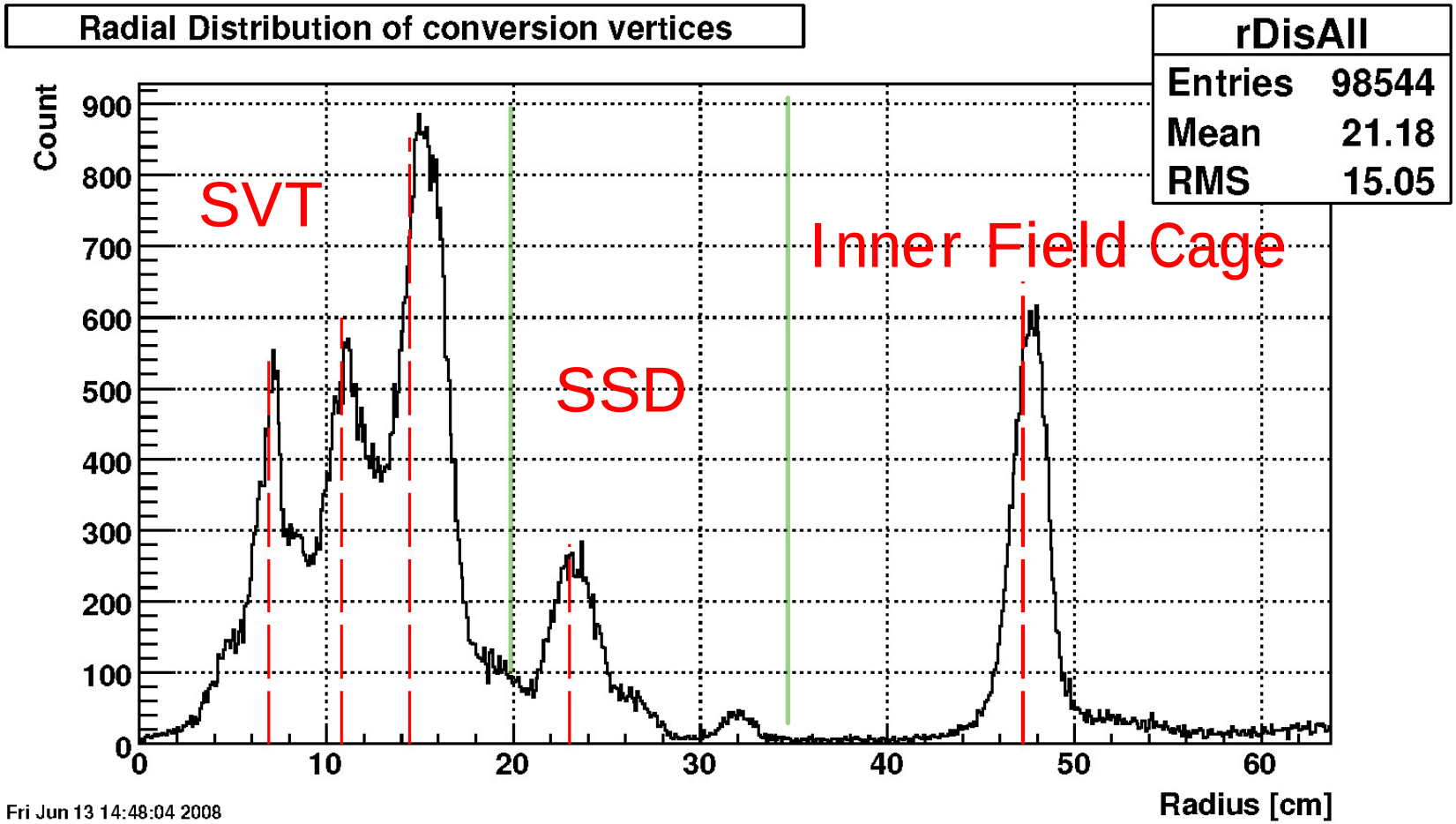
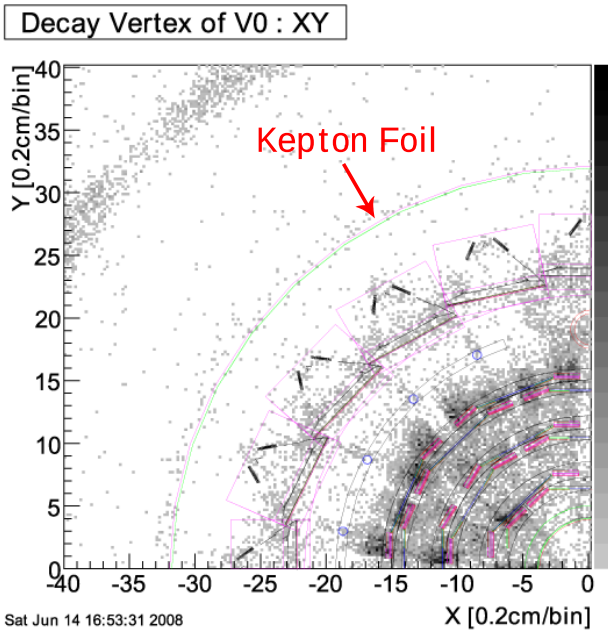
Radial Distribution of conversion vertex

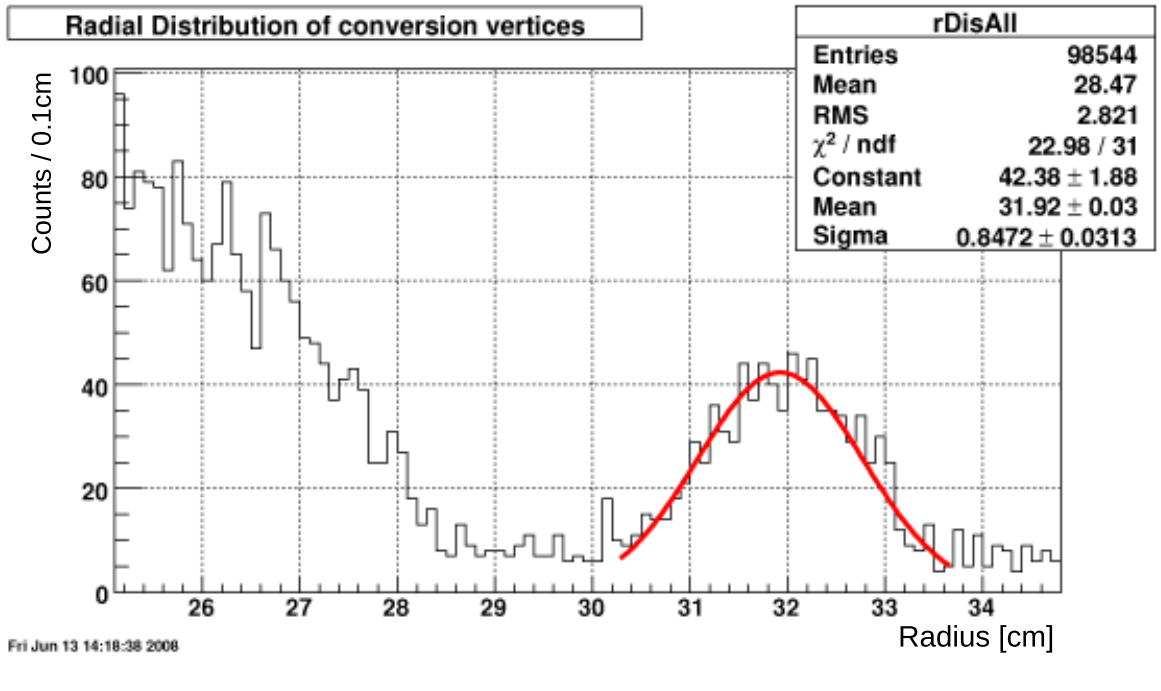


Position

- We can "clearly" distinguish Three SVT, One SSD and Inner Field Cage of TPC
- Detector positions : SVT(6.9 cm, 10.8 cm, 14.5 cm) SSD(23 cm) IFC(47.25 cm)

Spatial Resolution of Secondary Vertex by TPC

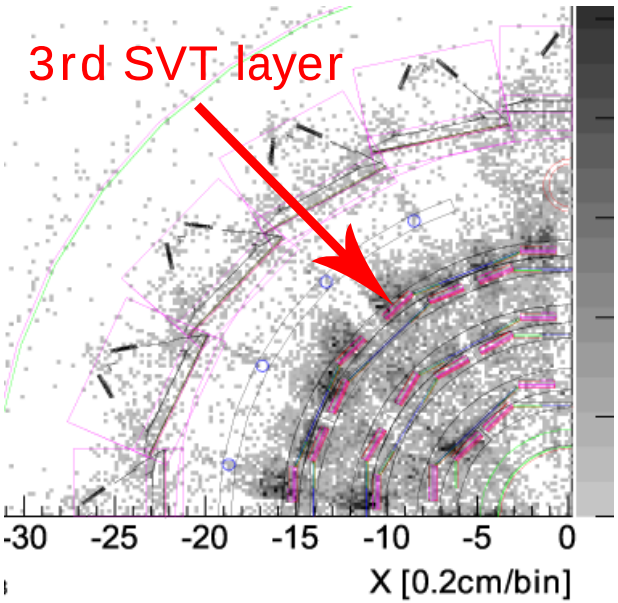


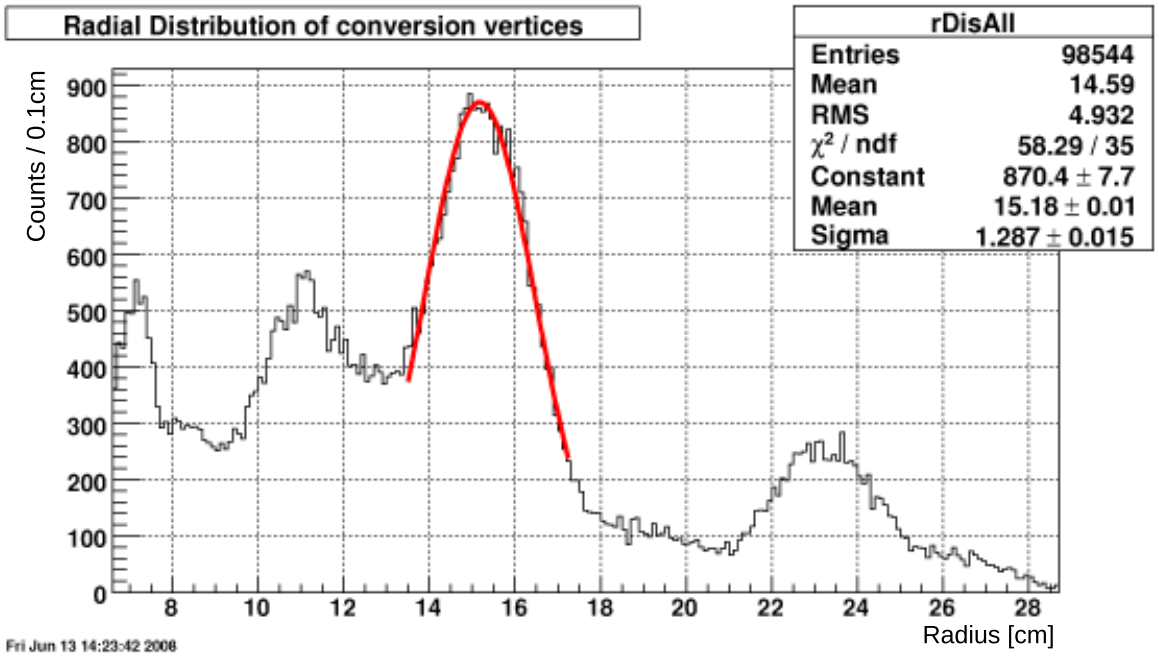


Circular Kapton foil around SSD

- Real thickness : 0.2 mm, Reconstructed(FWHM) : 19.9 mm

Spatial Resolution of Secondary Vertex by SSD + TPC

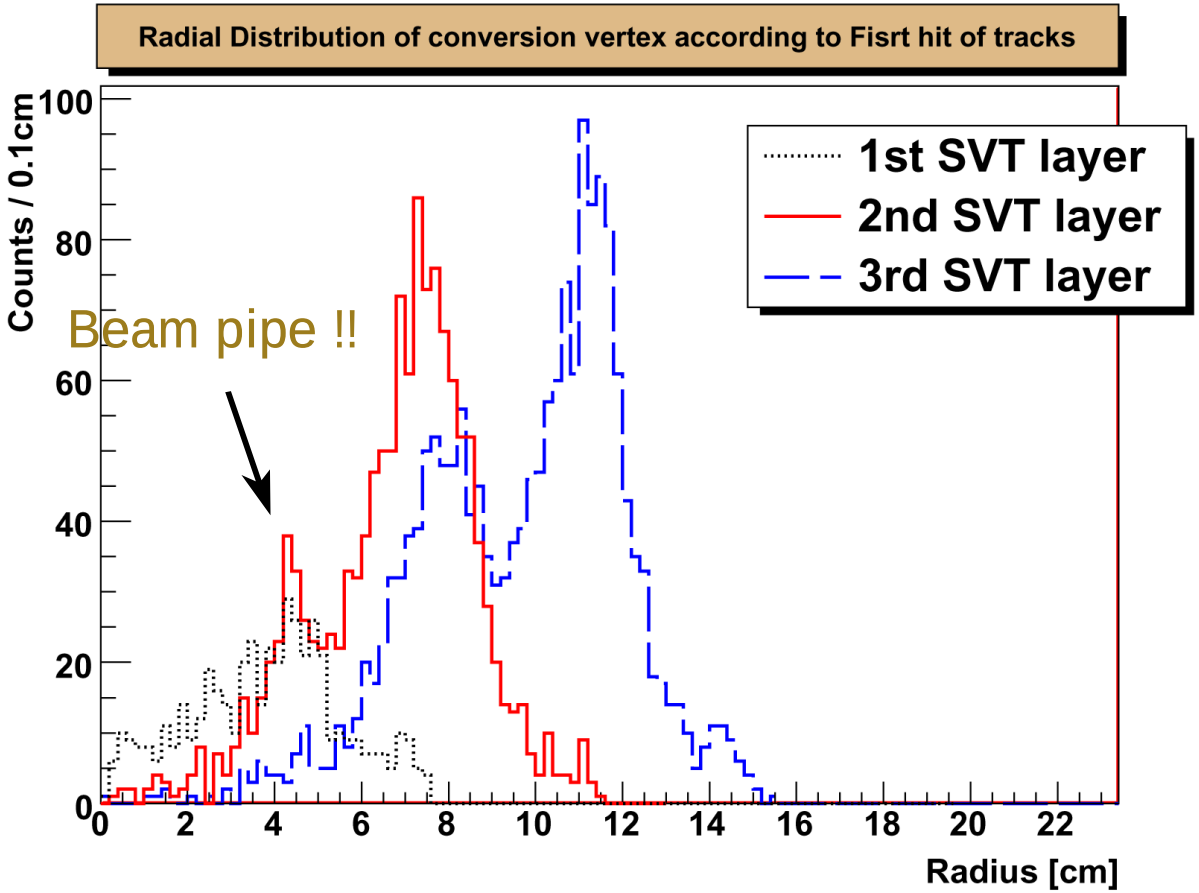




3rd SVT layer

- Real thickness : ~2 cm, Reconstructed(FWHM) : 3.02 cm

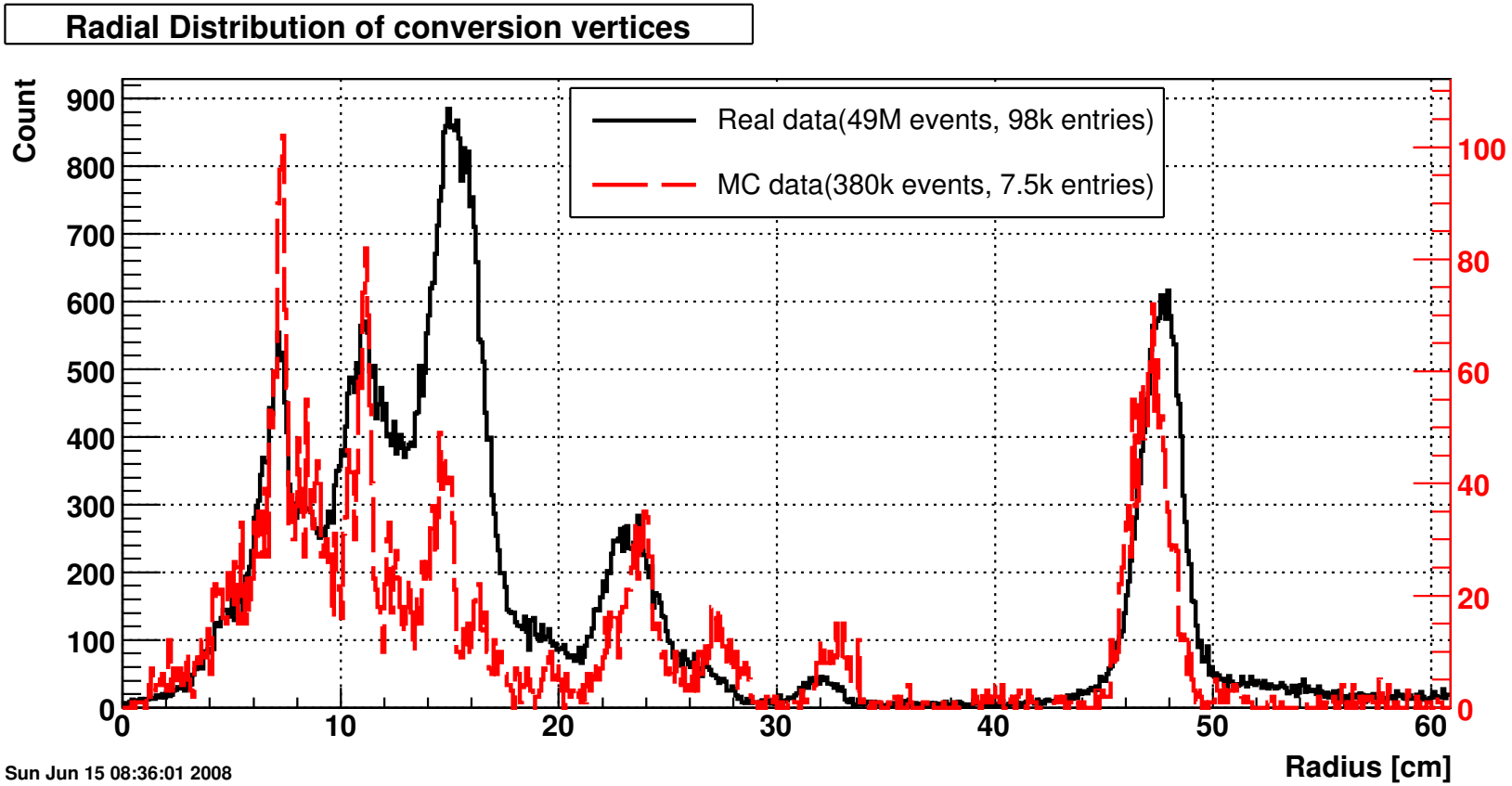
Radial Distribution according to First hit on Tracks



Most inner material of STAR detector system : Beampipe at 4cm

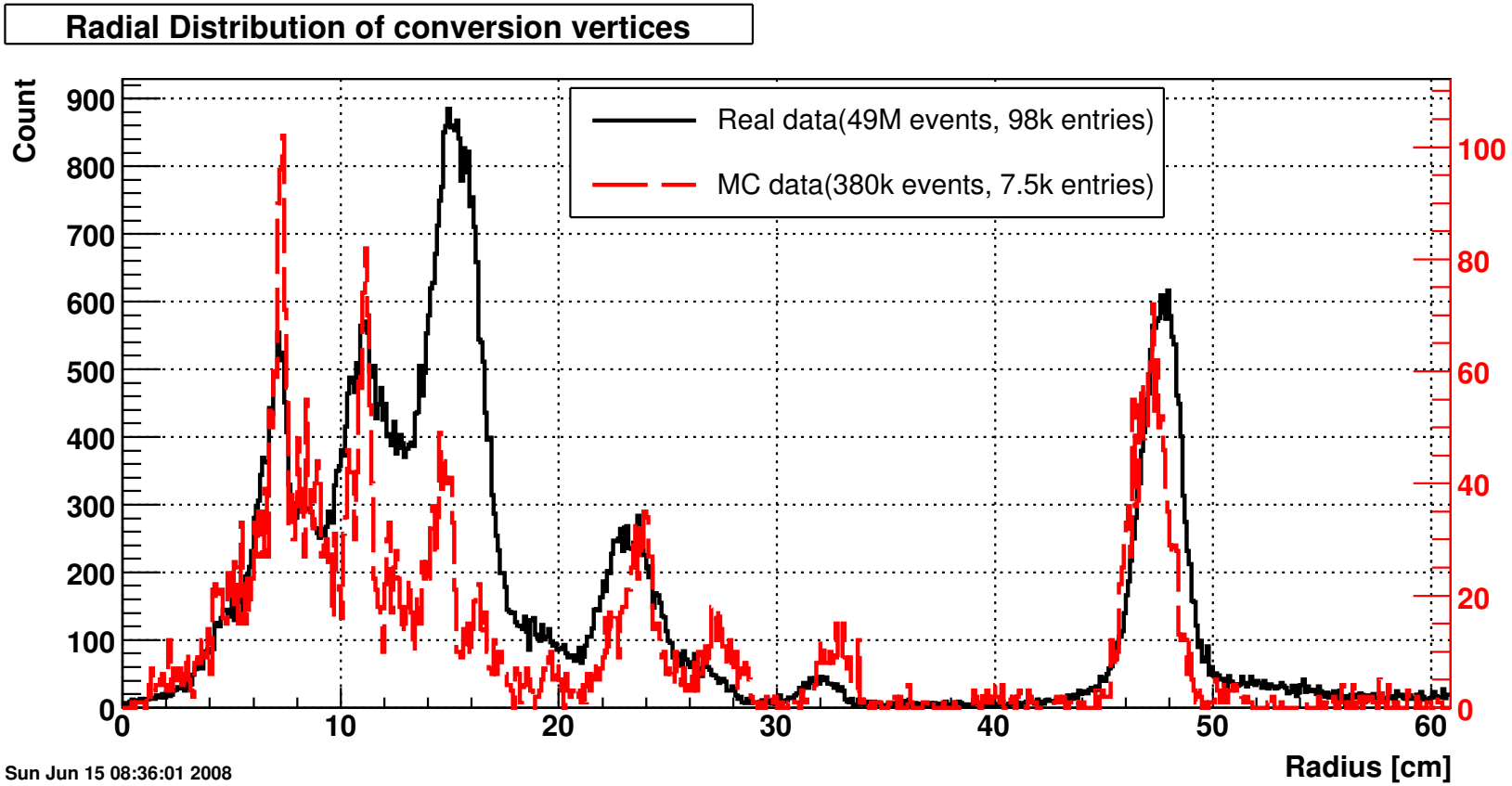
- Our Silicon detector enable us to see the Beam-pipe !!

Real data vs. MC data



1. Distribution is systematically different on SVT region!
2. Relative height can be different between SVT, SSD and TPC : Cut dependence
3. Relative height should be similar between Real and MC data!

Real data vs. MC data



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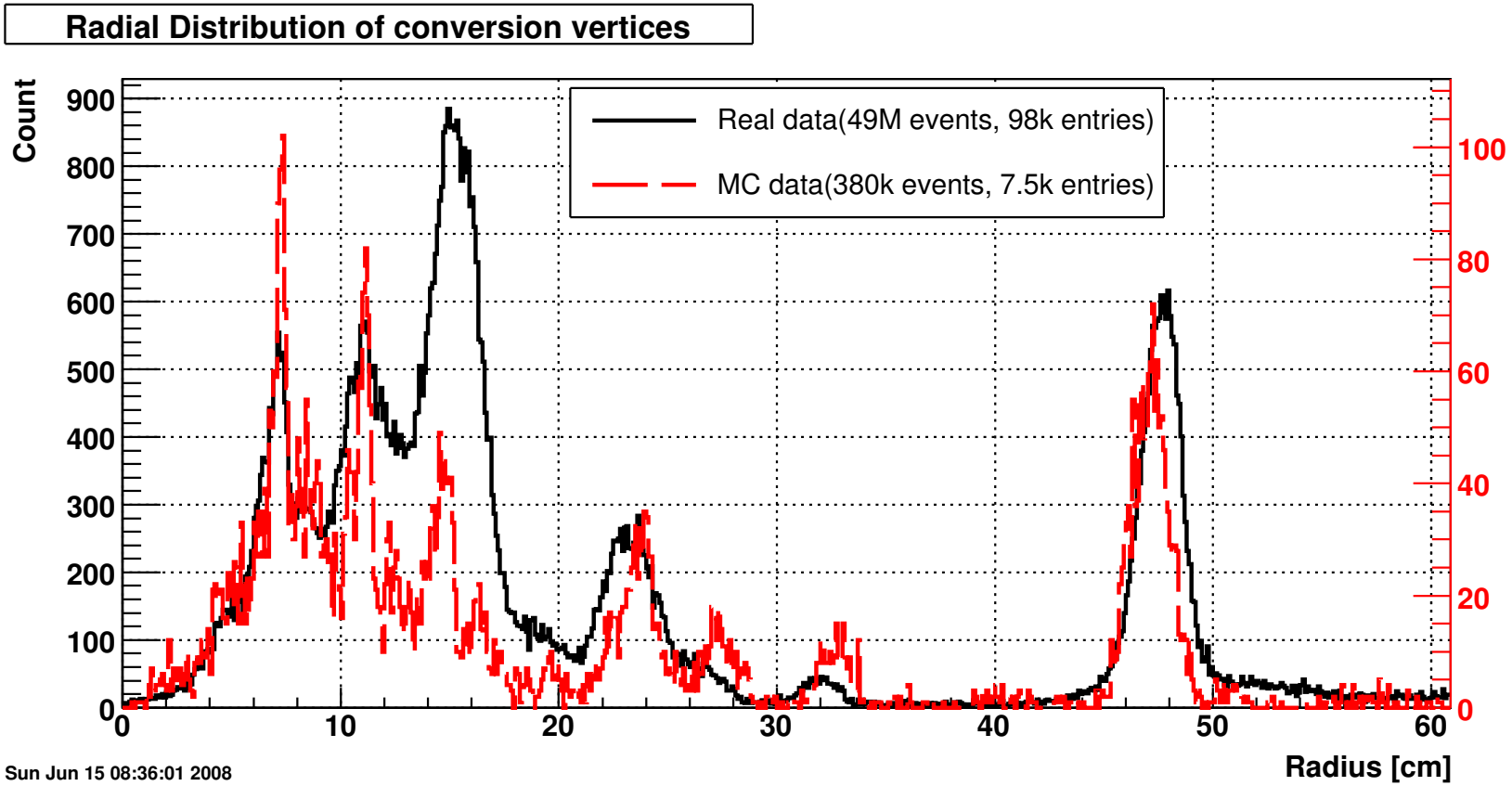

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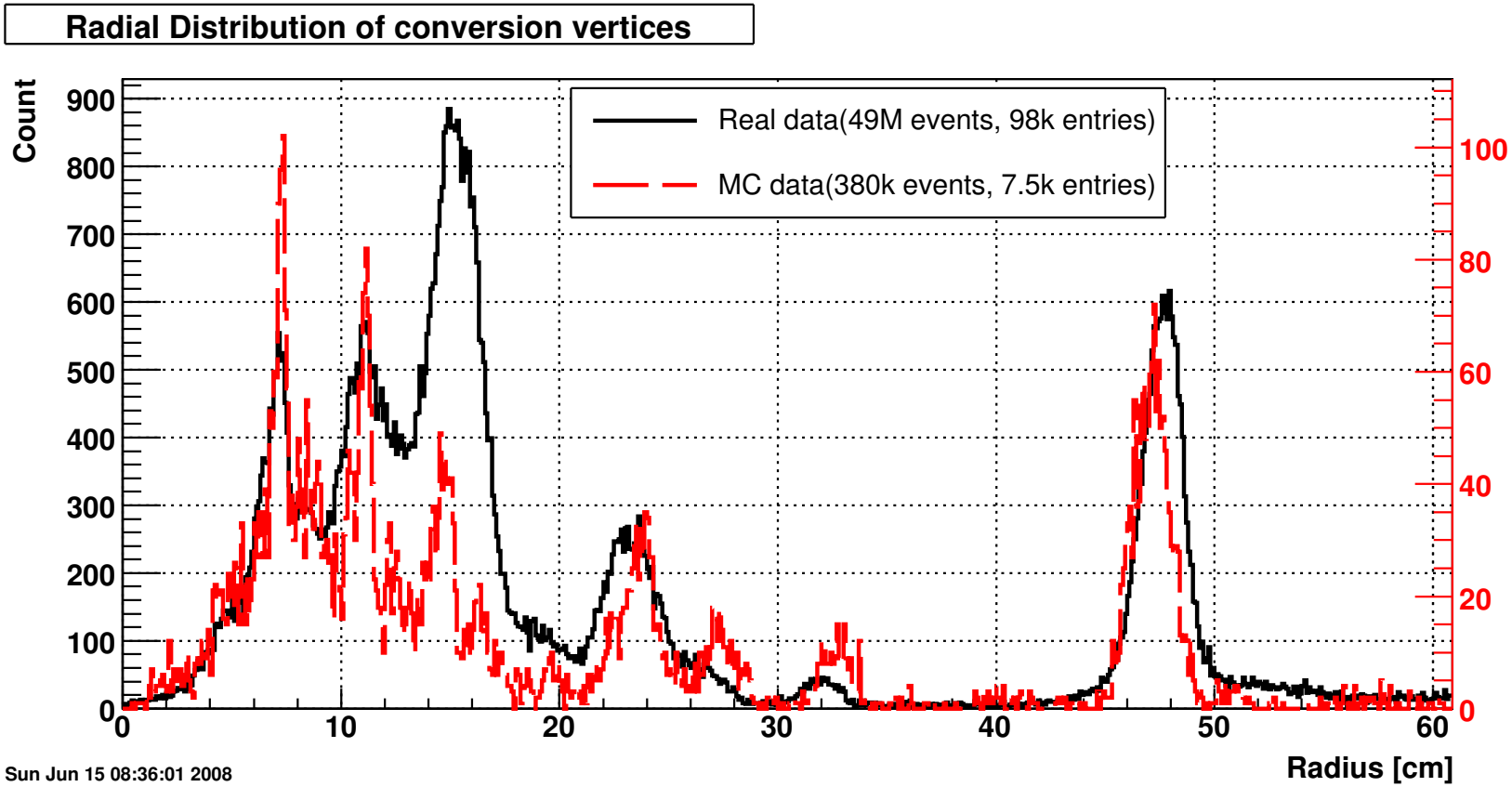

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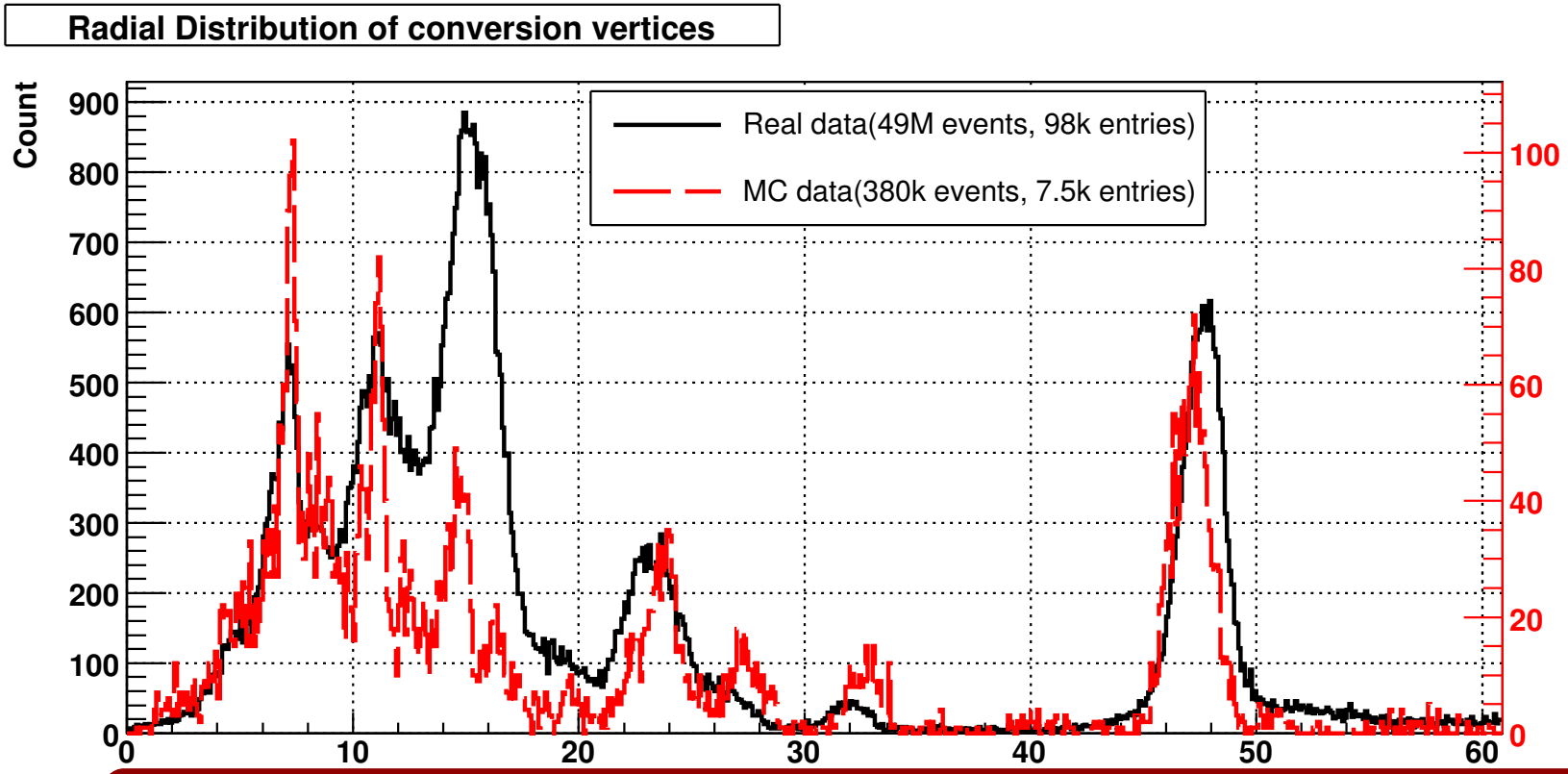

Sun Jun 15

Efficiency of silicons

- MC data : generated by fast simulation which assumes 100 % efficiecy of silicons
- Real data : efficiency of silicons are about 50 % (by V.L.Rykov)

Outline

Conclusion & Outlook

Conclusion

1. Our resolution is good enough to see each SVT layers, SSD and other materials
2. Silicon detector is essential to see most inner side of STAR
3. "Fast simulation" MC data doesn't reproduce our data

Outlook

1. Remove Combinatorial background from data
2. Efficiency correction : γ - embedding MC data is needed

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Part II

Appendix

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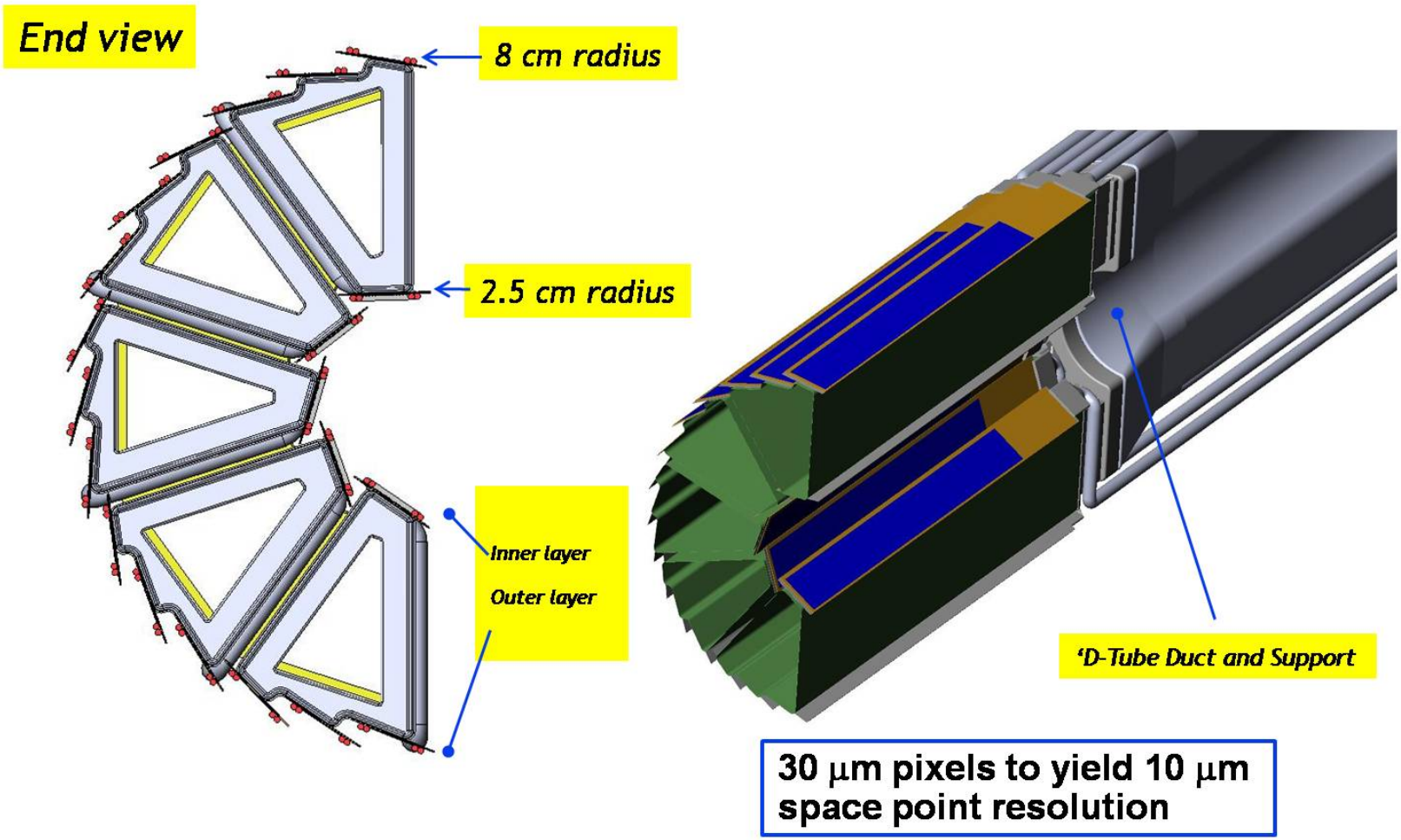
Heavy Flavor Tracker : HFT



Data set

Real Data

- Cu+Cu @ 200GeV
- Production : P07ic
- Trigger : cuProductionMinBias
- Number of events : 49M events

MC Data

- Cu+Cu @ 200GeV, Hijing D^0 embedding Data
- Production : P06id, rcf1272
- Number of events : 380k events

Cuts

Event Cut

1. |Primary Vertex Z| < 20 cm
2. refMult > 14

Track Cut

1. PID cut for e^+ / e^-
2. $p_T > 100$ MeV

V^0 Cut

1. m_{inv} of $\gamma < 10$ MeV
2. DCA of daughters < 0.05 cm
3. DCA of V^0 and PrimVert < 0.8 cm
4. Collinearity cut < 1 degree
5. Opening Angle < 0.5 degree
6. η of $\gamma < 0.7$

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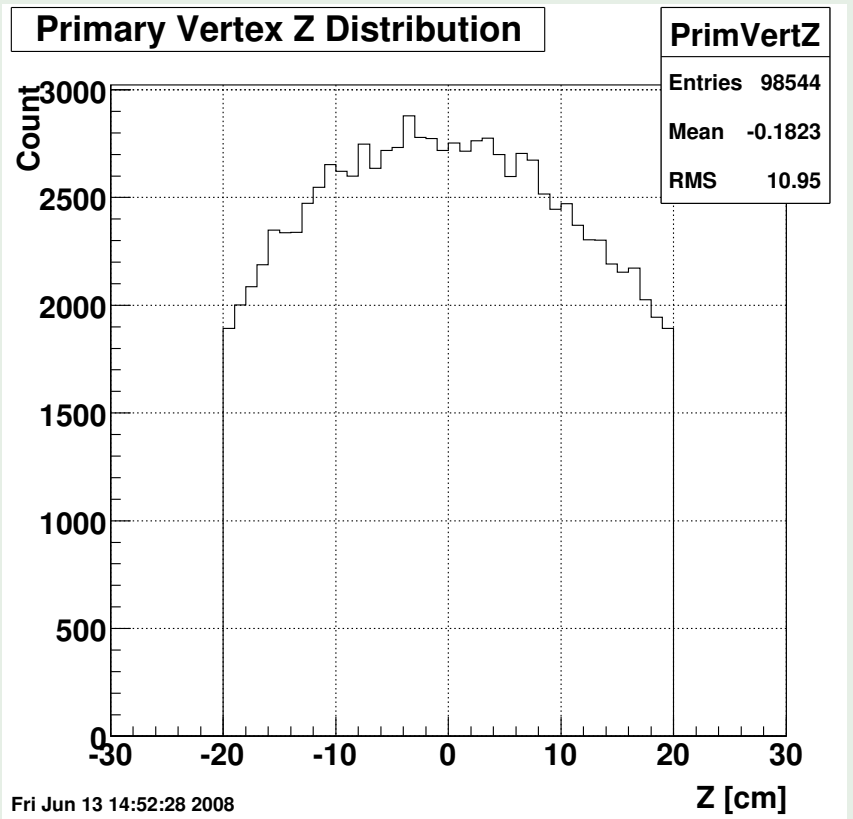
Primary vertex Z



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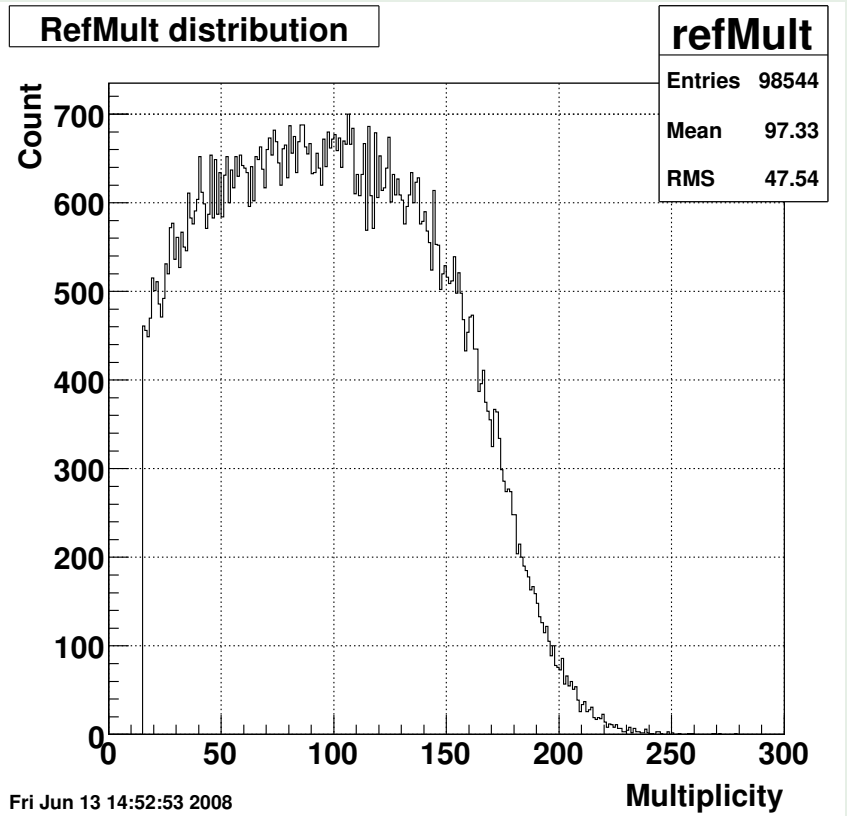

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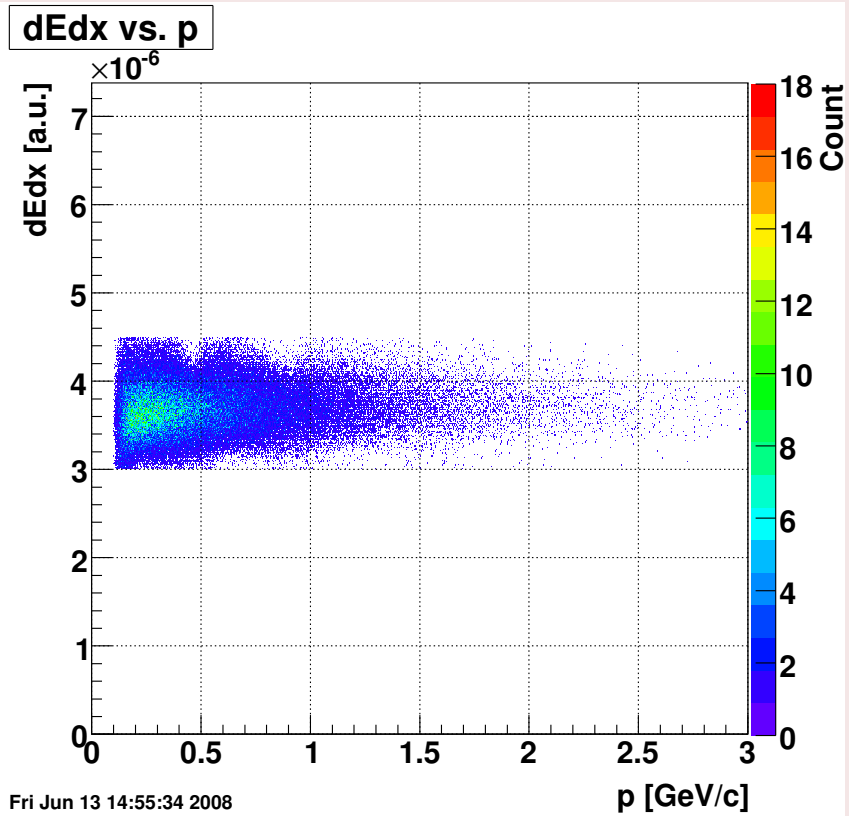

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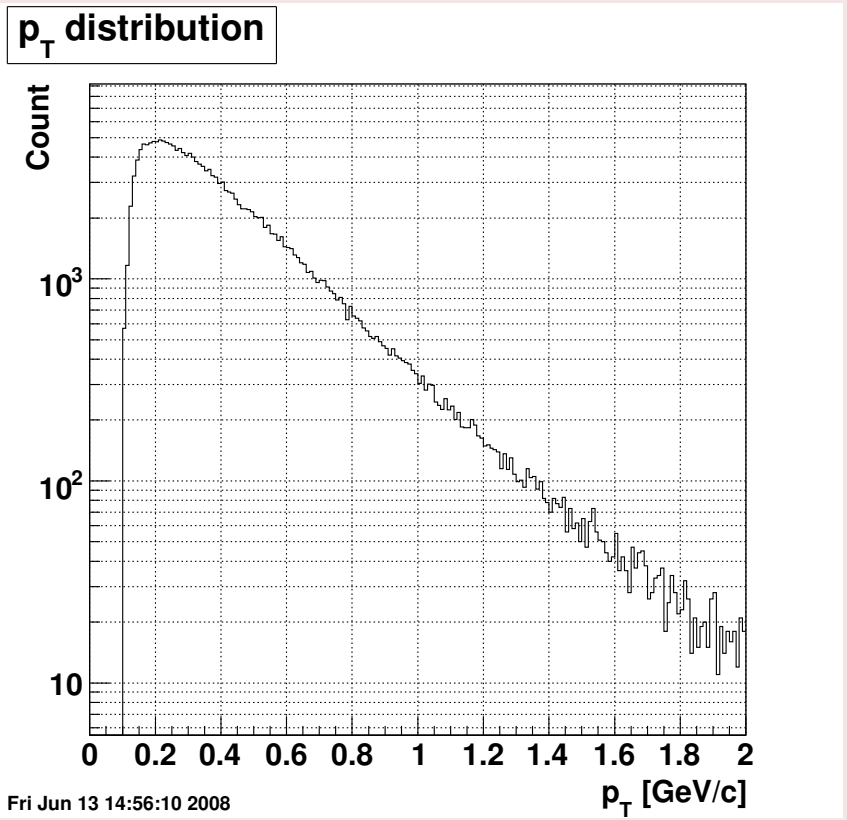
p_T distribution



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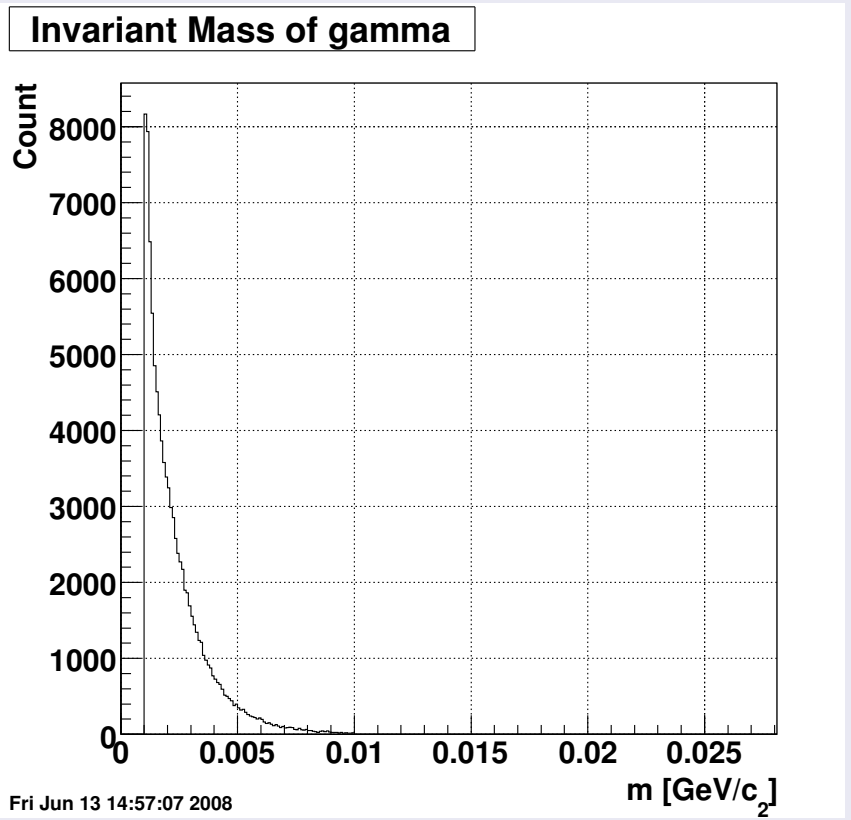
m_{inv} of e^+e^- hypothesis



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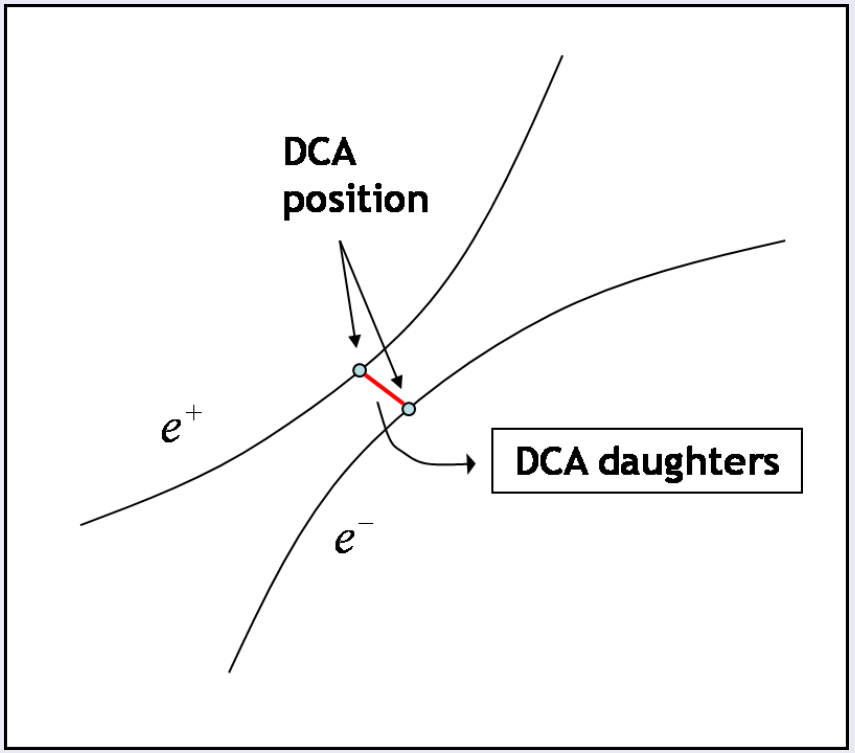
3. DCA of V^0 and PrimVert < 0.8 cm
4. Collinearity cut < 1 degree
5. Opening Angle < 0.5 degree
6. η of $\gamma < 0.7$

DCA of daughters



Cuts

Event Cut

1. |Primary Vertex Z| < 20 cm
2. refMult > 14

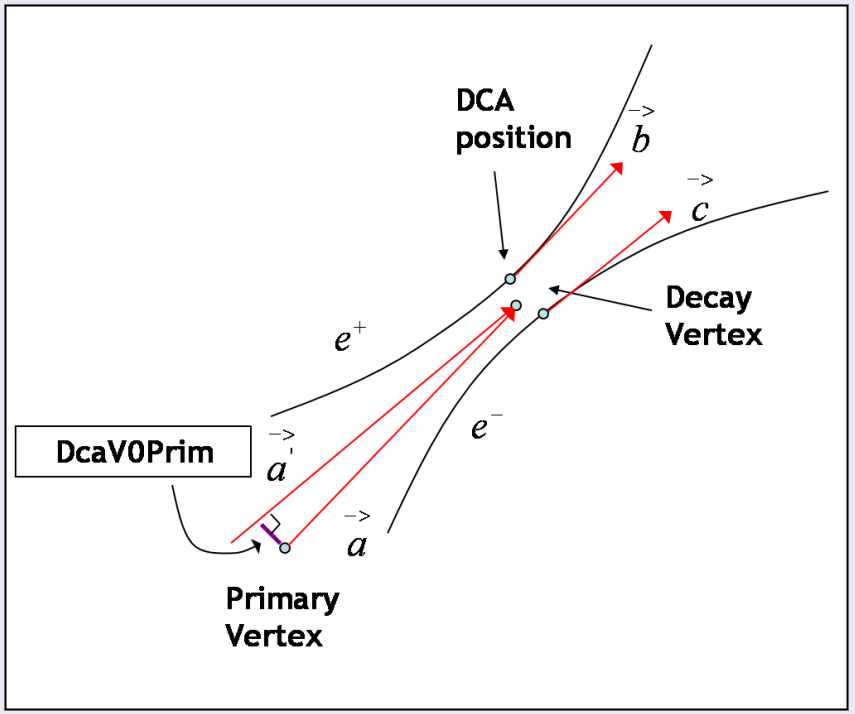
Track Cut

1. PID cut for e^+ / e^-
2. $p_T > 100$ MeV

V^0 Cut

1. m_{inv} of $\gamma < 10$ MeV
2. DCA of daughters < 0.05 cm
3. DCA of V^0 and PrimVert < 0.8 cm
4. Collinearity cut < 1 degree
5. Opening Angle < 0.5 degree
6. η of $\gamma < 0.7$

DCA of V^0 and PrimVert



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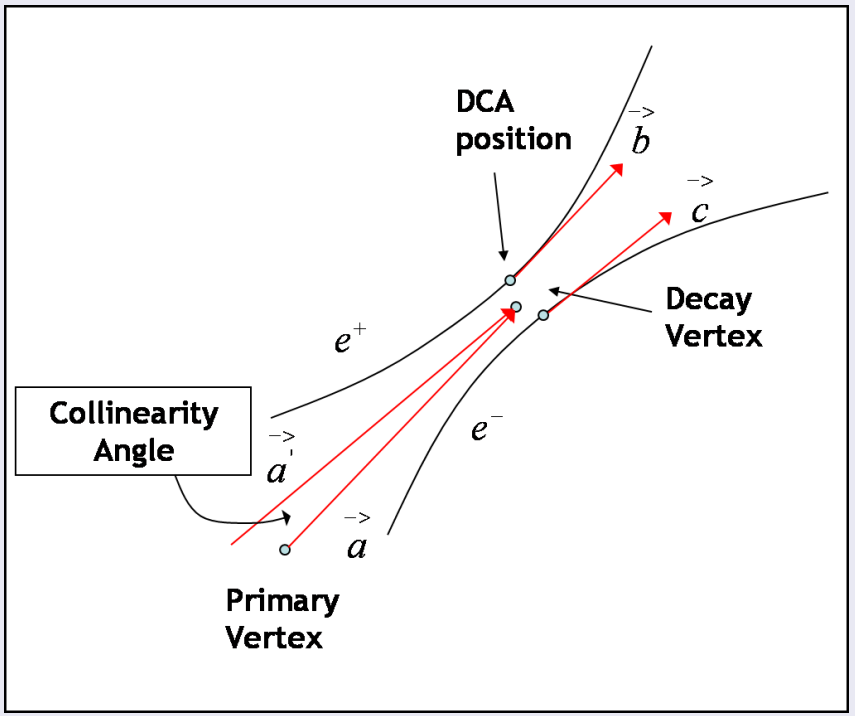
Collinearity cut



Cuts

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Track Cut

1. PID cut for e^+ / e^-
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2. DCA of daughters < 0.05 cm
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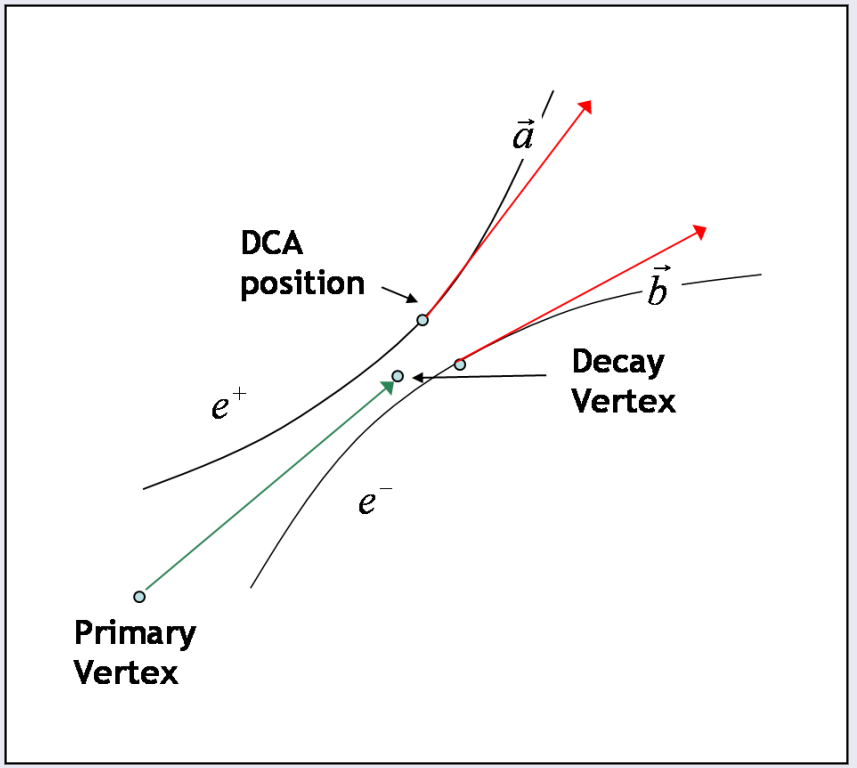
4. Collinearity cut < 1 degree
5. Opening Angle < 0.5 degree
6. η of $\gamma < 0.7$

Opening Angle cut



Cuts

Event Cut

1. $|\text{Primary Vertex Z}| < 20$ cm
2. refMult > 14

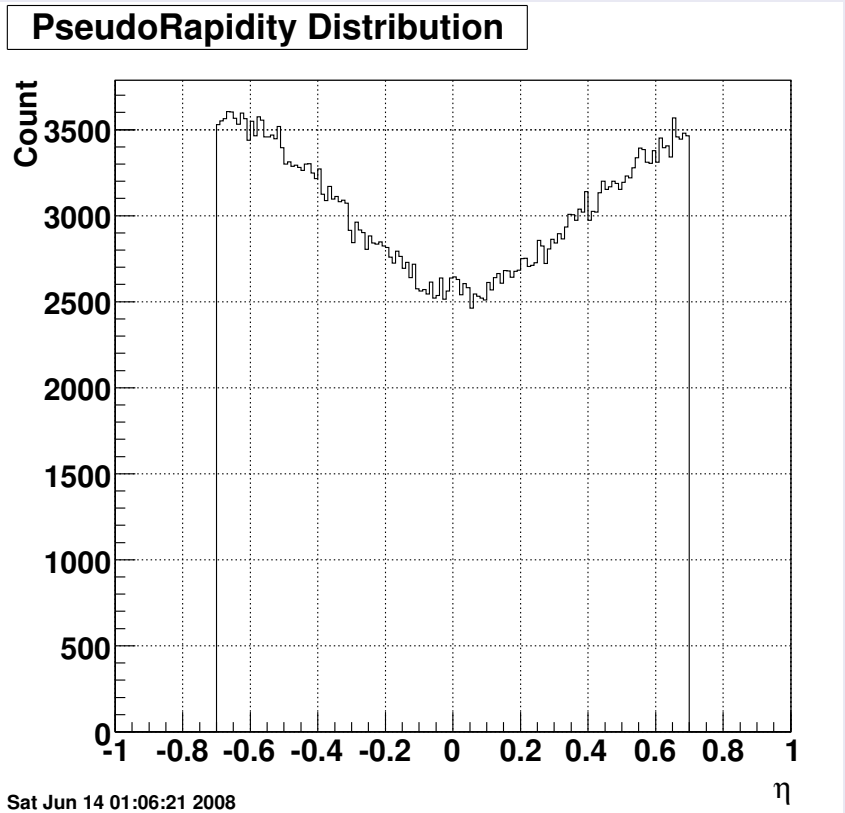
Track Cut

1. PID cut for e^+ / e^-
2. $p_T > 100$ MeV

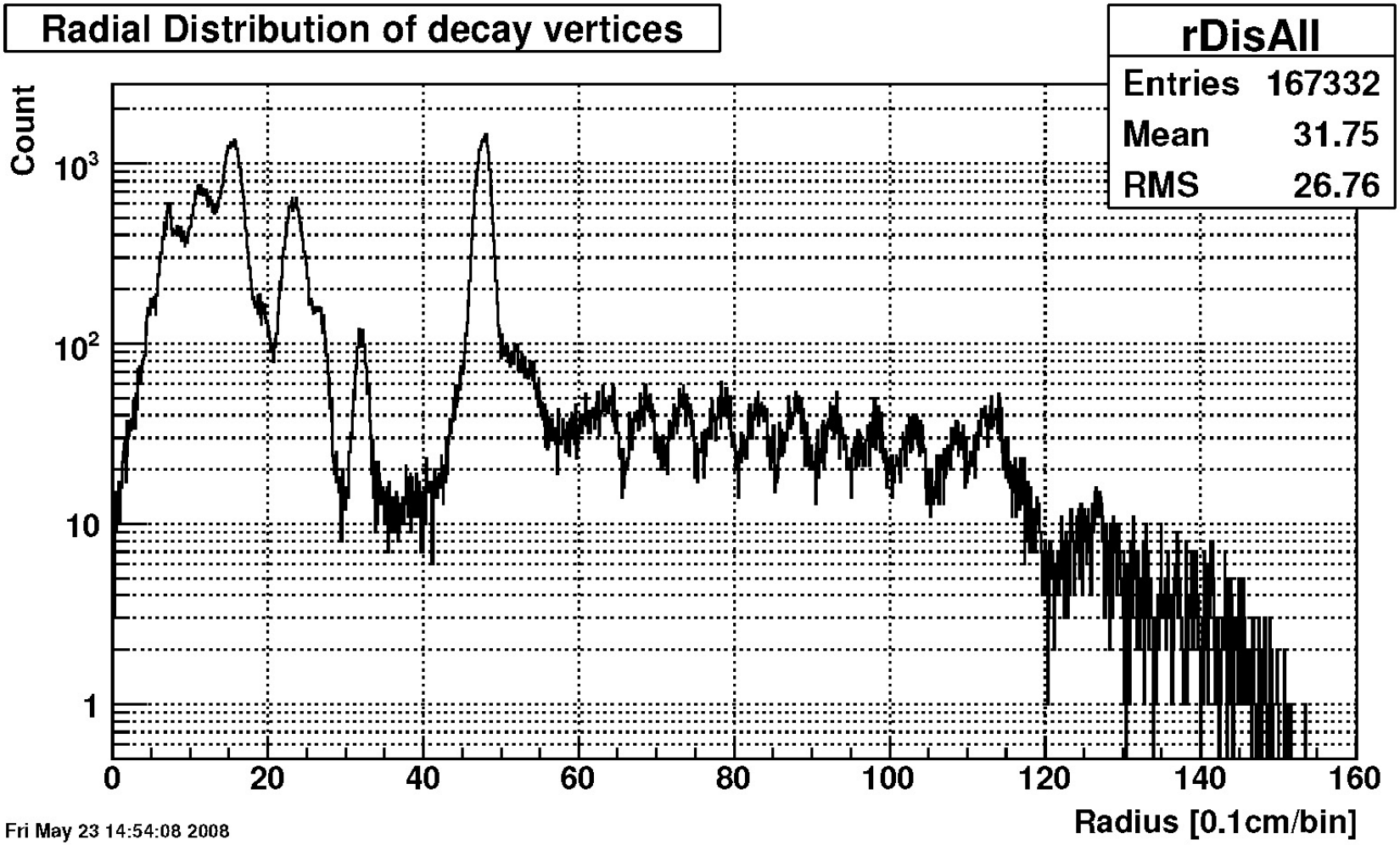
V^0 Cut

1. m_{inv} of $\gamma < 10$ MeV
2. DCA of daughters < 0.05 cm
3. DCA of V^0 and PrimVert < 0.8 cm
4. Collinearity cut < 1 degree
5. Opening Angle < 0.5 degree
6. η of $\gamma < 0.7$

Pseudorapidity distribution



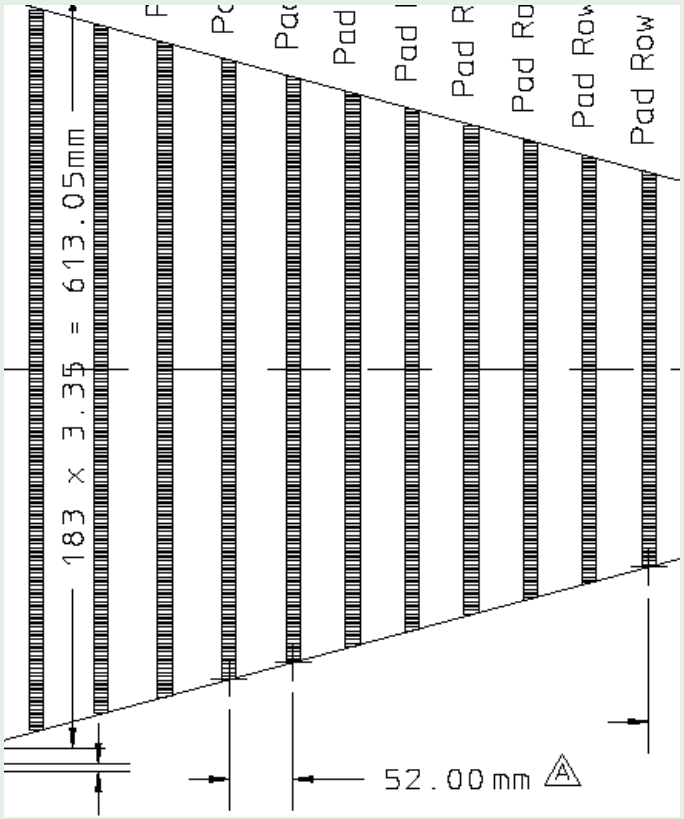
Ripple structure study



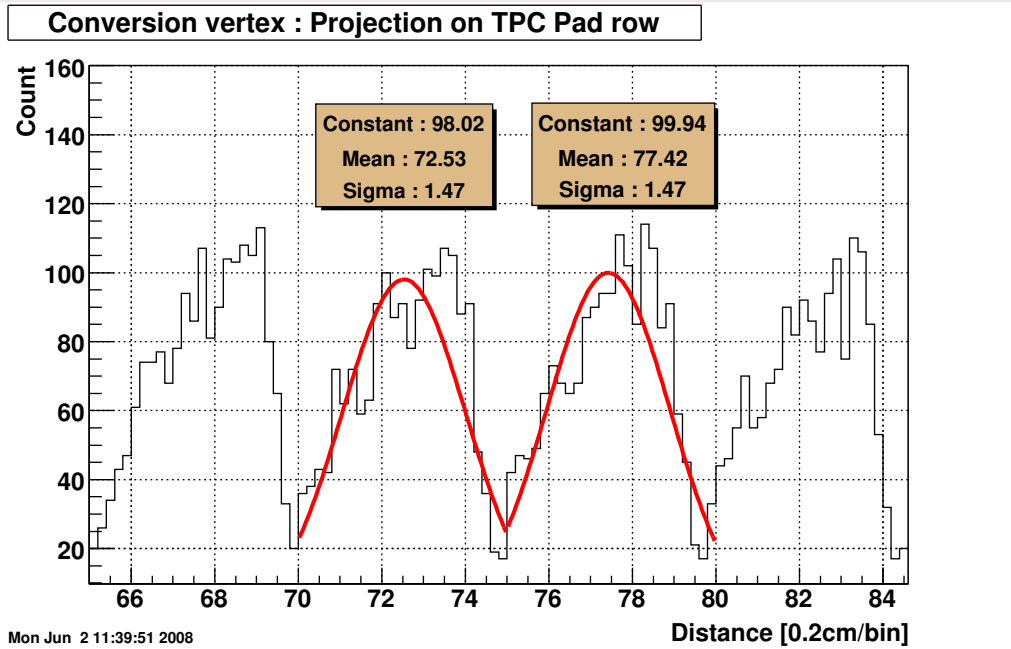
- It's not an error, there's something.

Ripple structure study

TPC Pad

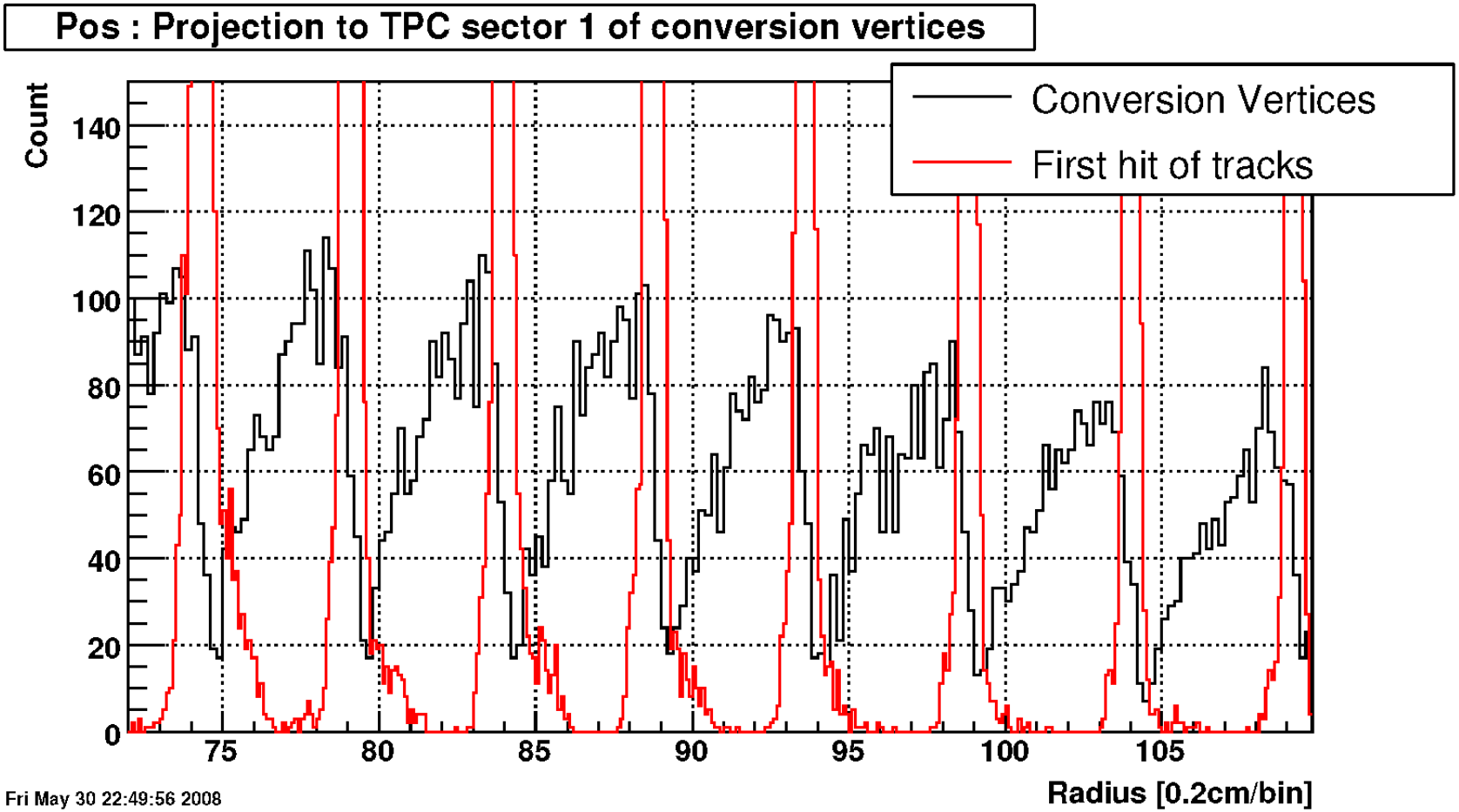


Distance between ripples



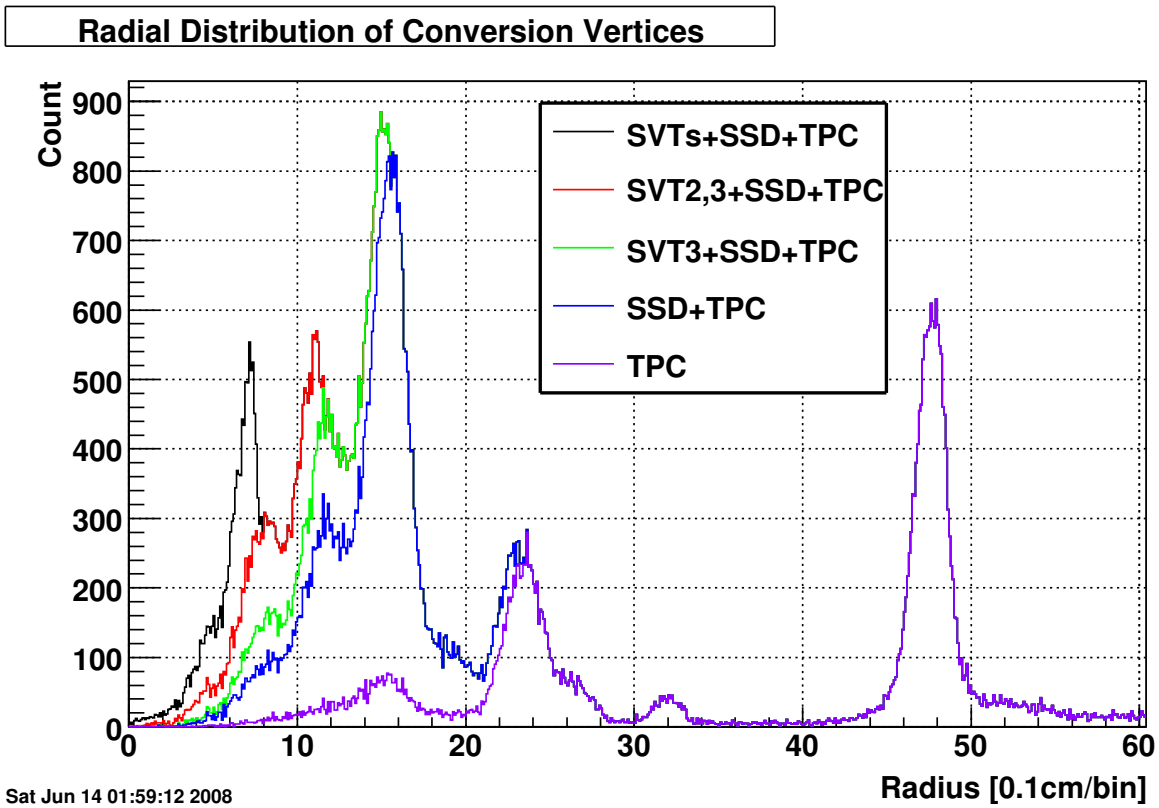
- Distance between two peak is 4.89 cm , pad row is 4.8 cm
- Strong relation with Pad row

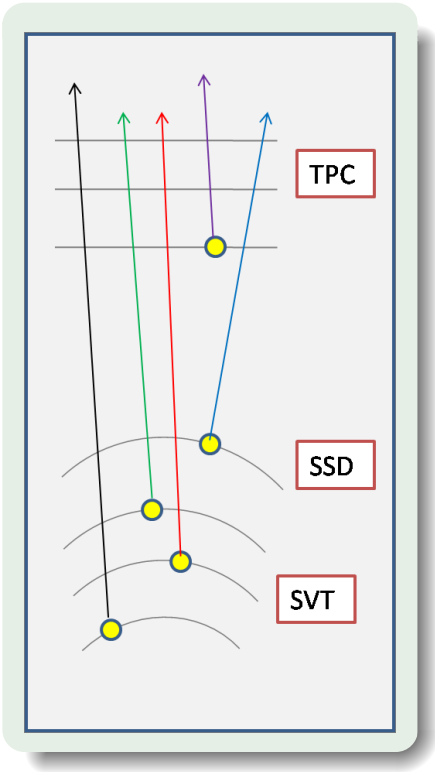
Ripple structure study



- Conversion vertices are just before sensitive area of pad row
- This can be caused by artifact of our reconstruction chain

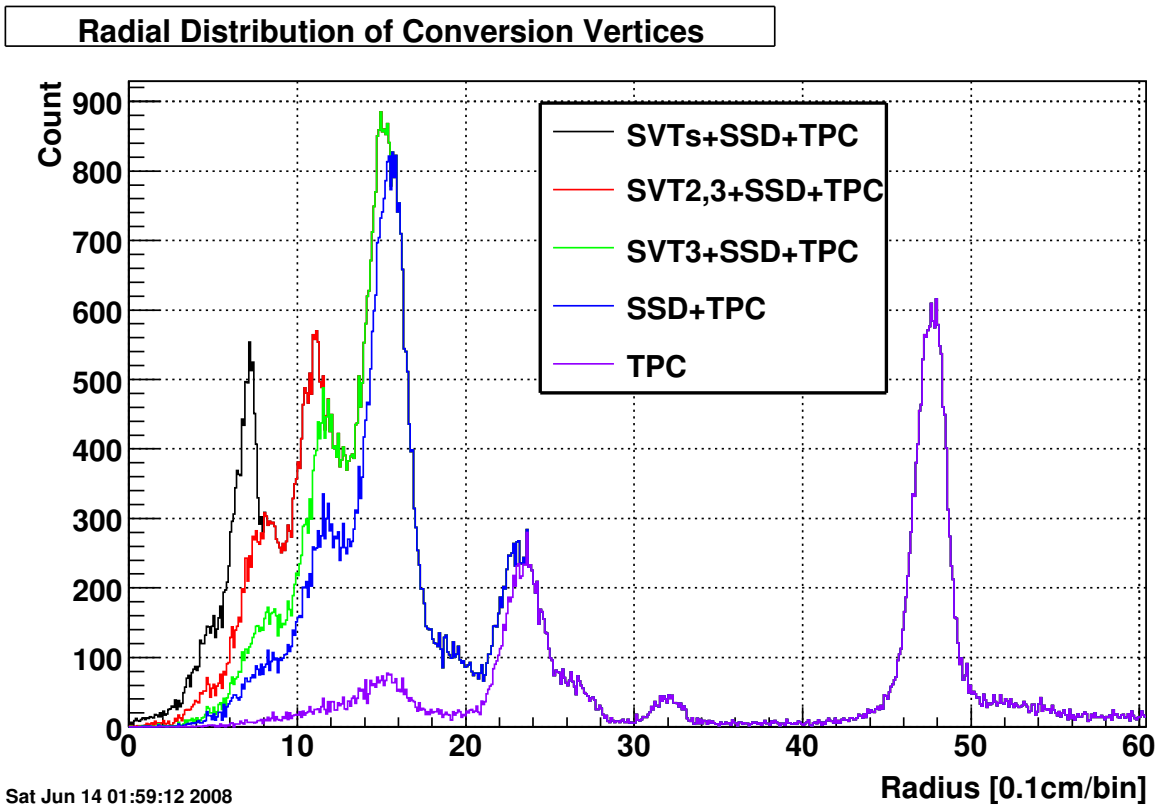
Extreame case : Turn off detectors one by one

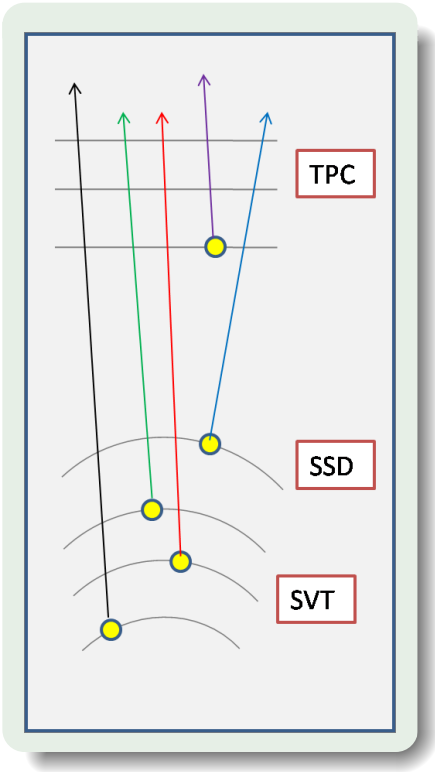




- Efficiency can affect to number of conversions on SVT/SSD material
- With silicon, our resolution gets much higher!

Extreame case : Turn off detectors one by one





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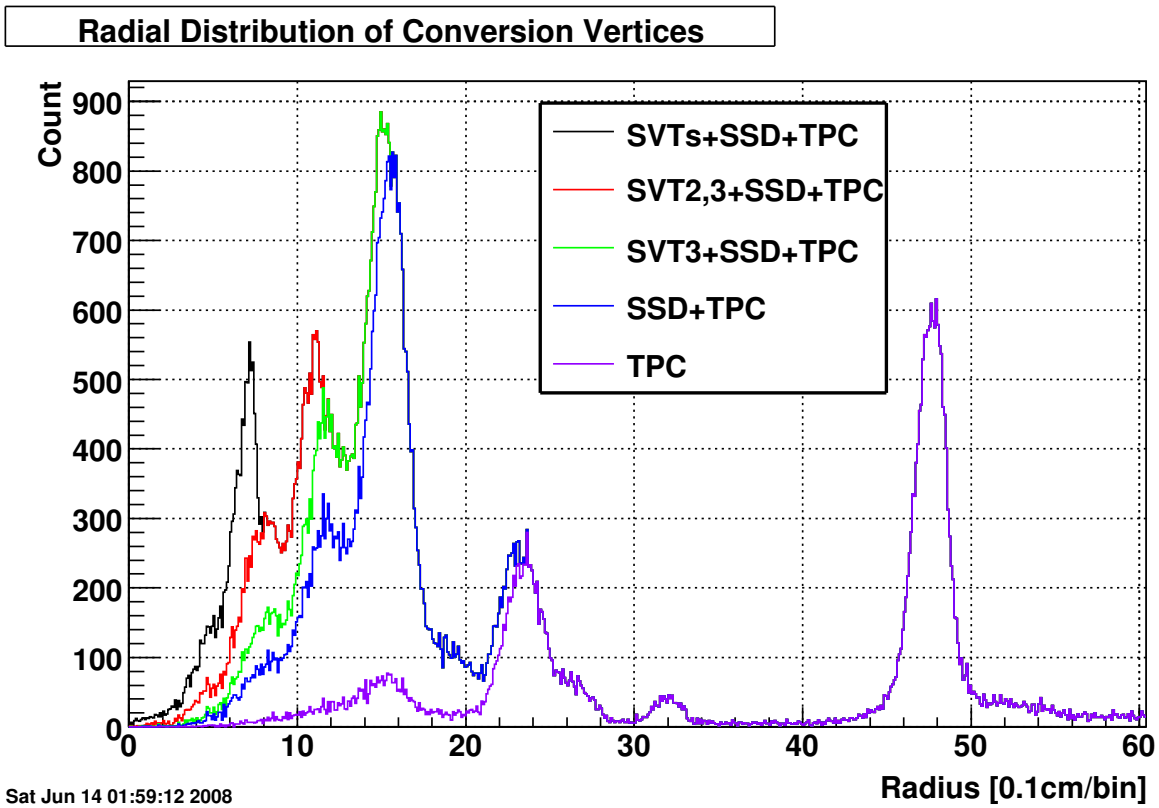

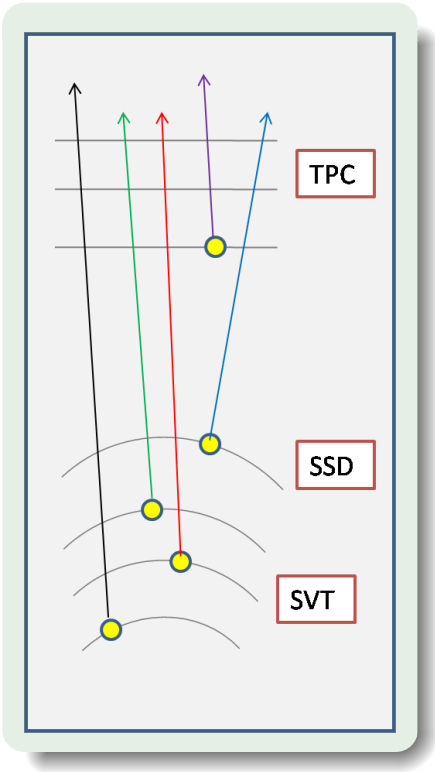

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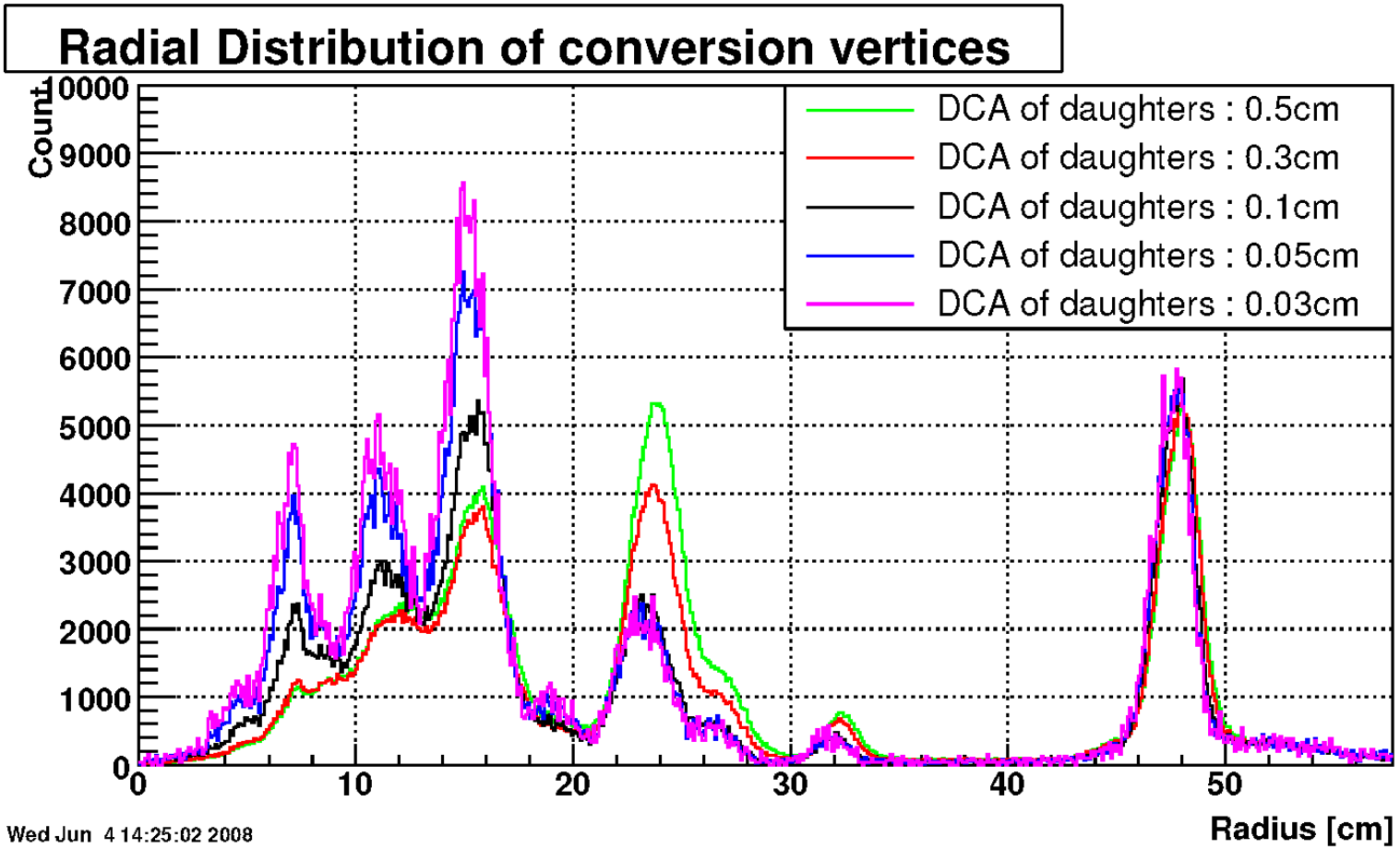
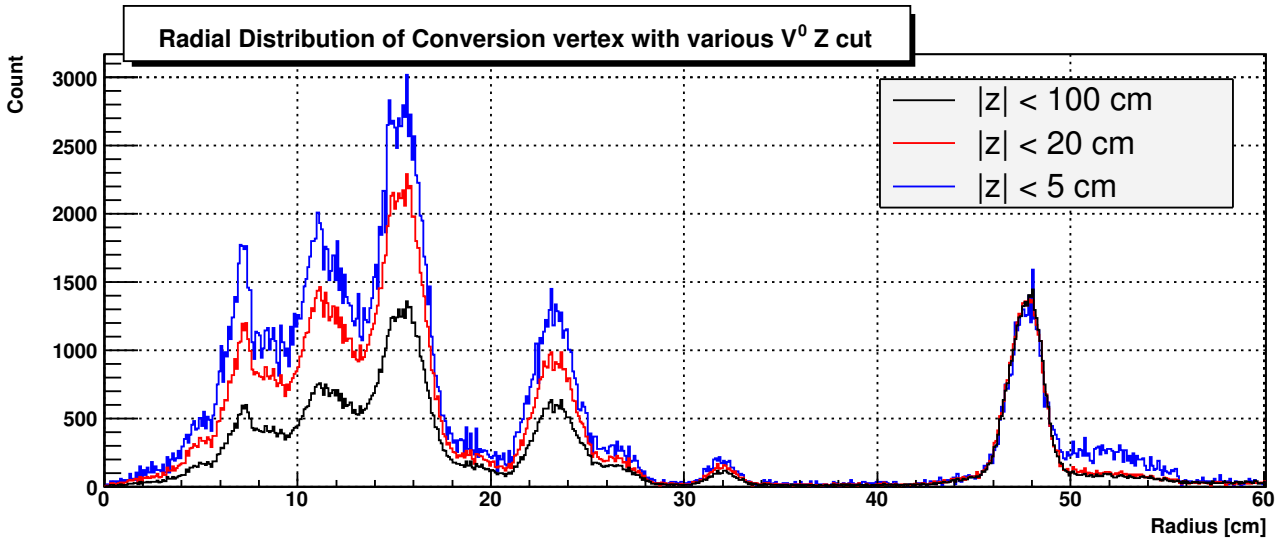
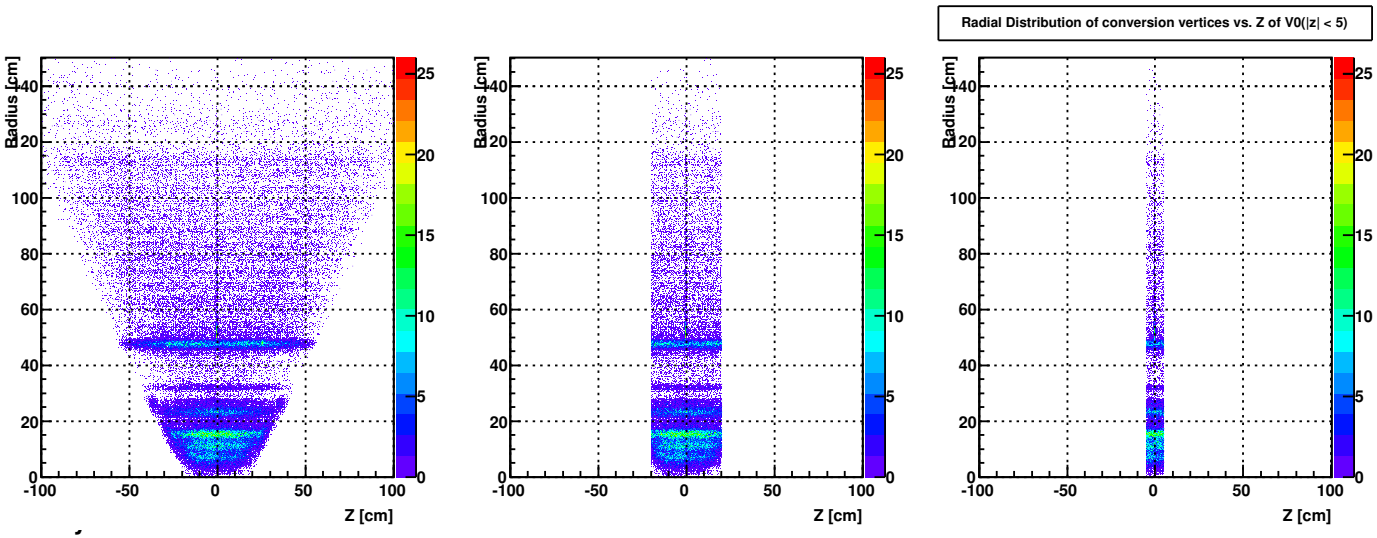
Radial distribution of conversions with various DCA of daughter cut



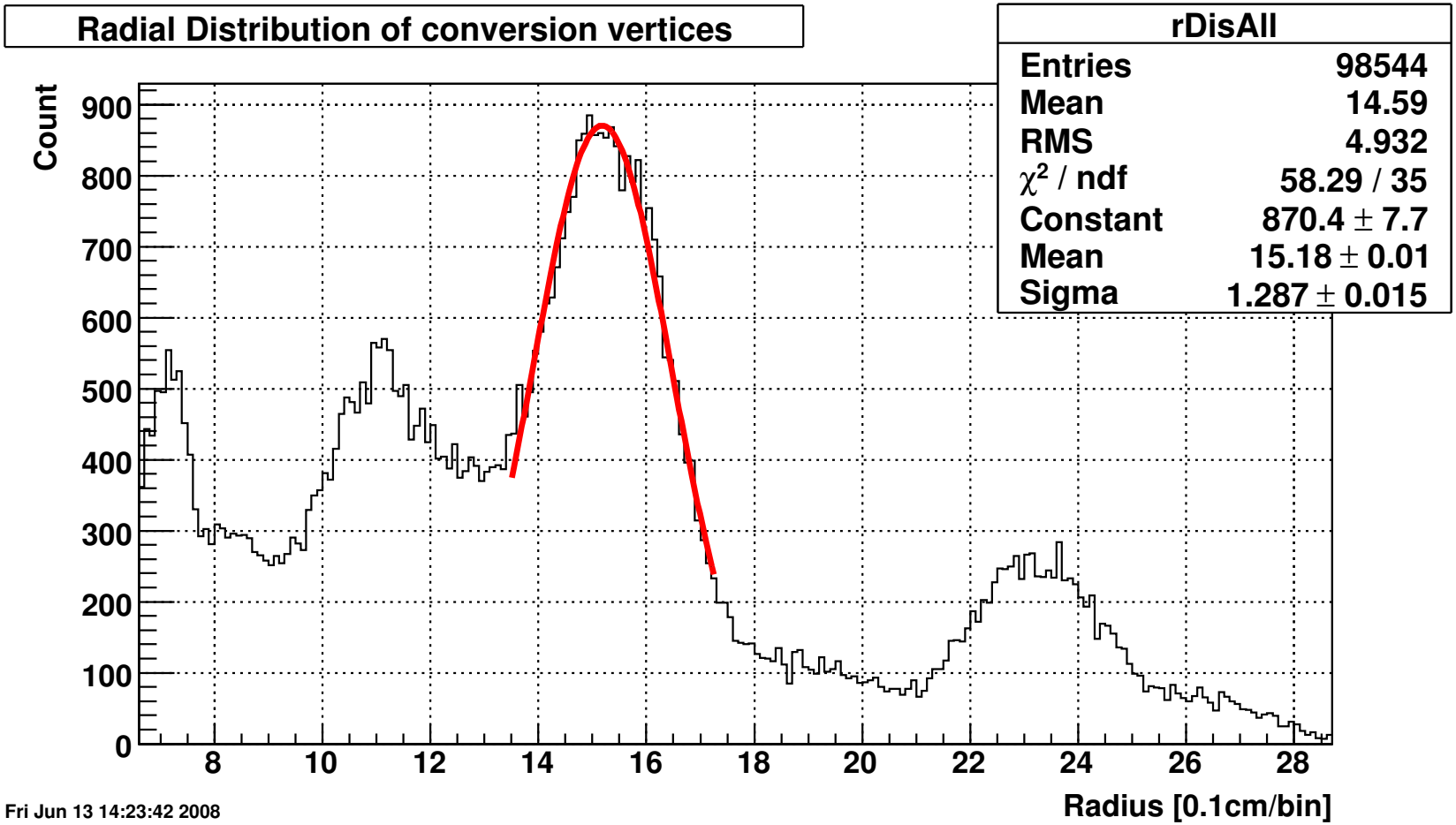
- Relative number of conversions are dependent of cuts especially this cut
- Until 0.05 cm, histogram changes

Radial distribution of conversions : Z of V^0 cut





Resolution of 3rd SVT layer : with silicon information



Resolution of TPC inner field cage : without silicon information