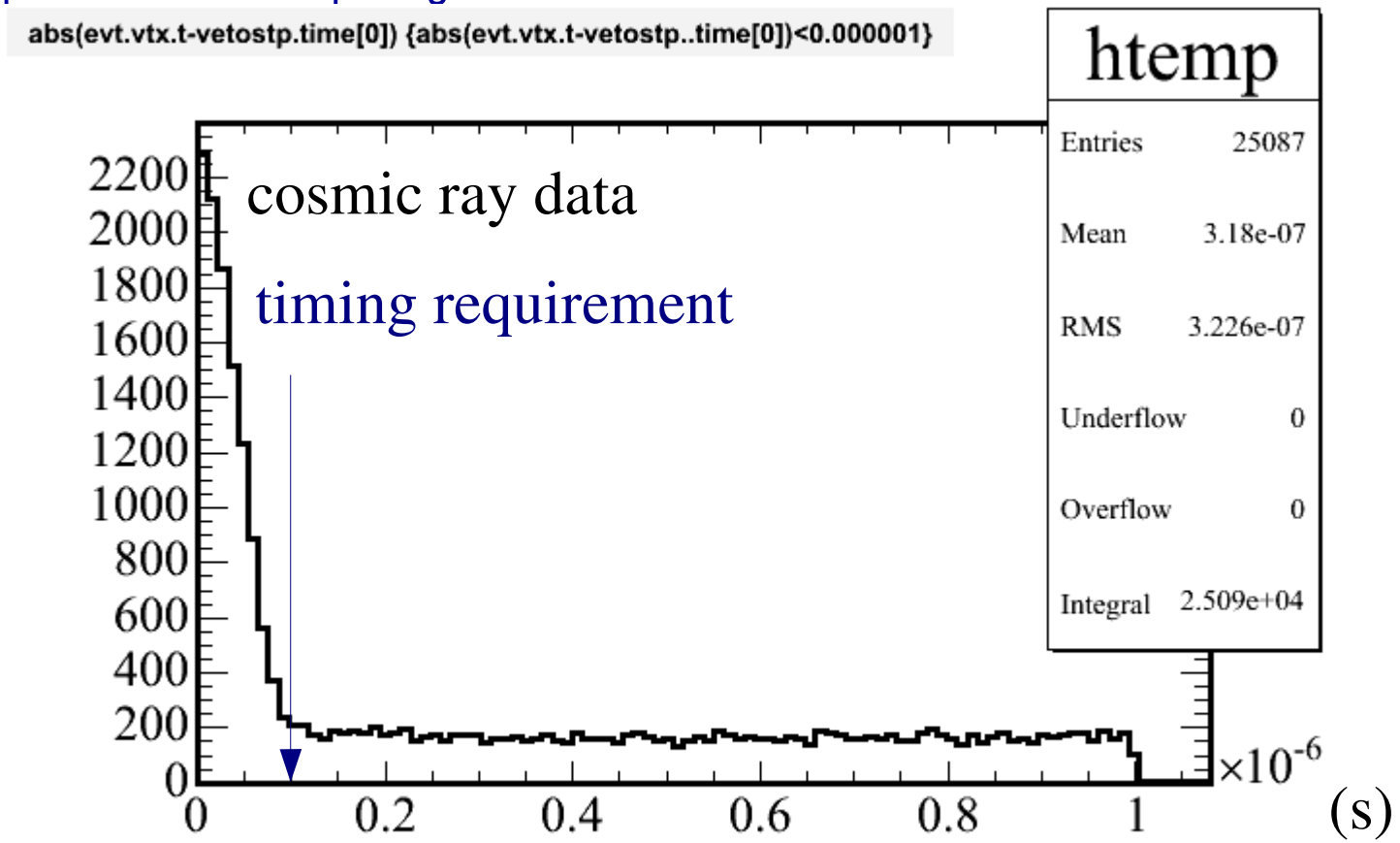
Update on Cosmic Ray Background for FD ν_e

Hai Zheng

12/13/05

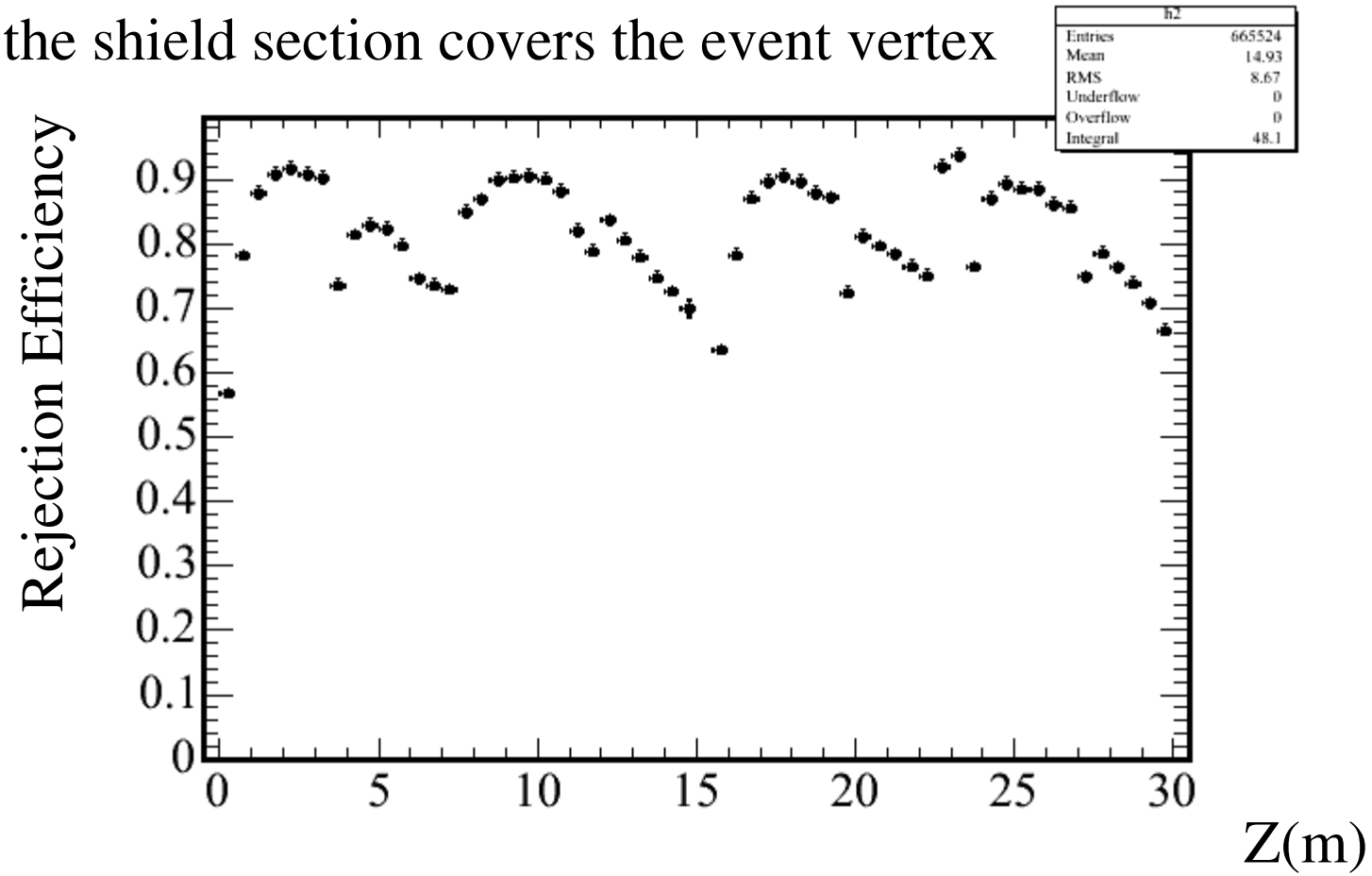
Shield Cut

- Different methods to determine whether shield hits present in the event, using Pedro's CandShield package
  - vertex timing within 100ns of shield hit
  - event spacial vertex comparing to shield section



Shield Cuts 1

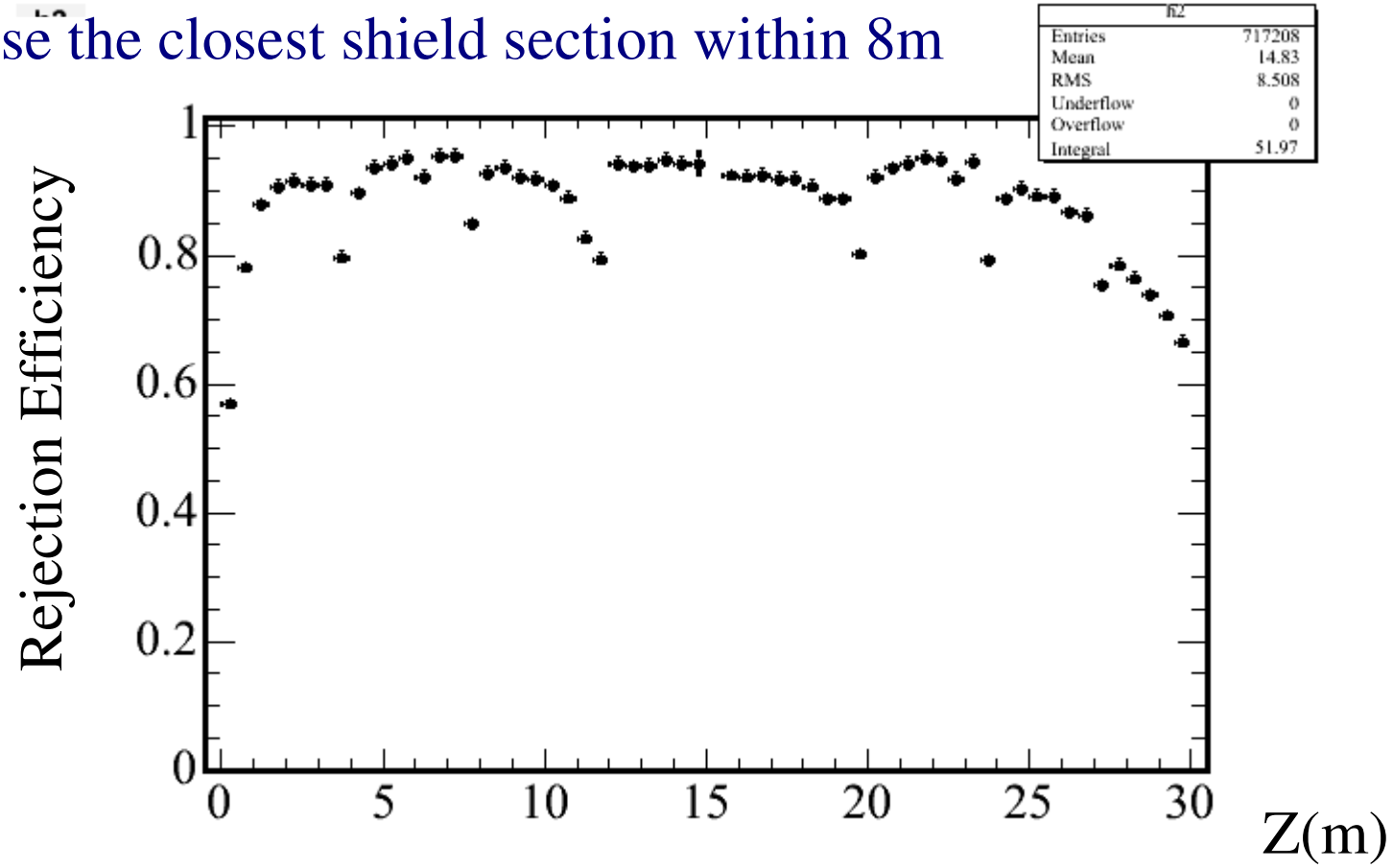
Choose the shield section covers the event vertex



Rejection efficiency (%)	No Cuts	Fiducial Cuts	Basic Cuts	Reco Energy	PID Cut
ShieldHit=0	80.0	86.9	88.9	94.0	96.5

Shield Cuts 2

Choose the closest shield section within 8m



Rejection efficiency (%)	No Cuts	Fiducial Cuts	Basic Cuts	Reco Energy	PID Cut
ShieldHit=0	86.2	88.3	89.6	94.6	97.7

higher efficiency and more uniform

Result

- MC (MDC) assuming 1 year running with 2.5e20 pot
  - $\Delta m^2 = 2.5e\text{-}3\ eV^2$ $(U_{e3})^2 = 0.01$
- Data used: 1 month no-beam data (total 17.536 live days)
  - scaled to 1 year with trigger window size: 100 μs/1.9 s

	All Cuts	Selection Efficiency	Shield Cuts 1	Shield Cuts 2
QE nue CC	0.70	0.321		
nue CC	1.85	0.141		
numu CC	1.98	0.002		
nutau CC	0.53	0.061		
nue NC	0.05	0.016		
numu NC	5.18	0.021		
nutau NC	1.50	0.017		
beam nue	1.63	0.077		
cosmics	3.15	0.003	0.05	0.03

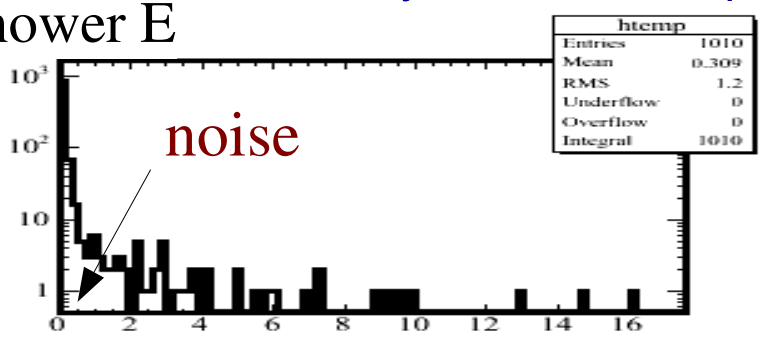
cosmic ray background not negligible with no additional cuts

cosmic ray background down to nue NC level with new fid. and shield cuts

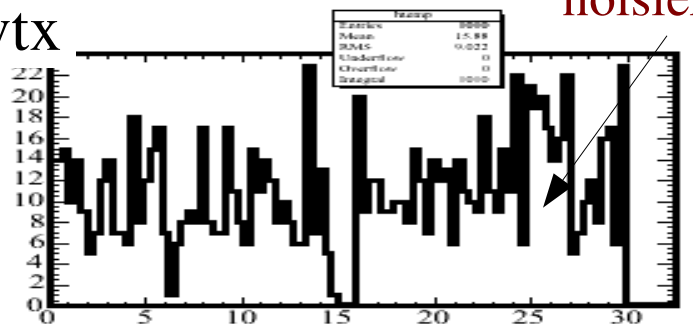
A Quick Look at Fake Spill Data

- Fake Spill data used: 2 months (Thanks to Caius)
- Data composition: mainly noise within spill window (low energy)

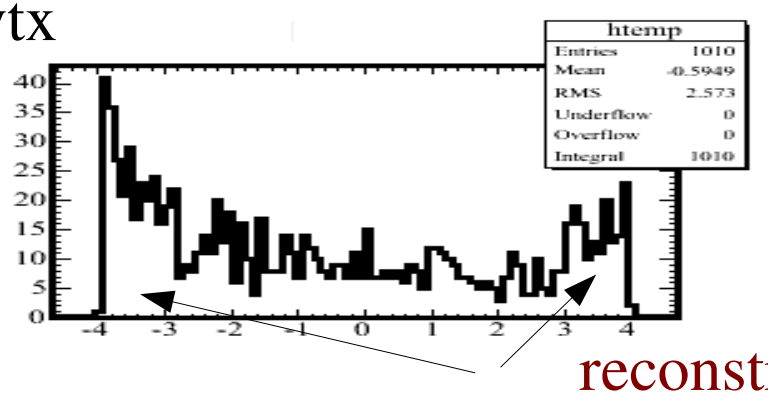
Shower E



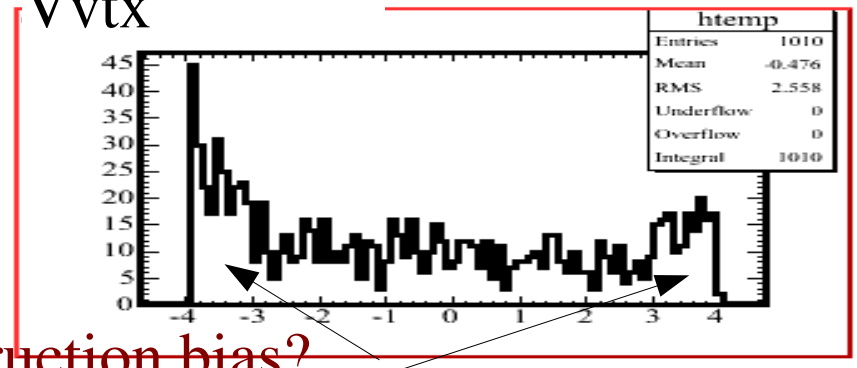
Zvtx



Uvtx



Vvtx



reconstruction bias?

Coincidence Rate (%)	No Cuts	Fiducial Cuts	Basic Cuts	Reco Energy	PID Cut
ShieldHit=0	7.5	4.5	4.1	80.0	

cosmic ray events selected (next couple of slides)

- using shield cuts 2
- 735197 fake spills -> 1010 snarls -> 0 in final sample

Cosmic Events in Fake Spill

Run: 33003, Snarl: 119943, Slice: 1(/1), Event 1(/1)

Reco

#Trks: 1

#Shws: 1

q/p: 0.005 +/- 0.010, p/q: 210.860

TrkRangeEnergy: 5.374 RecoShwEnergy: 2.255

Vtx: 0.58, 3.79, 23.58

Truth

N/A

N/A

N/A

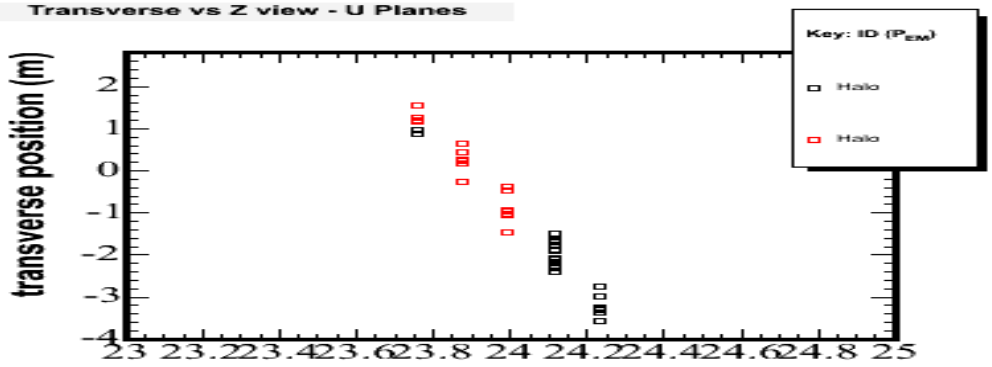
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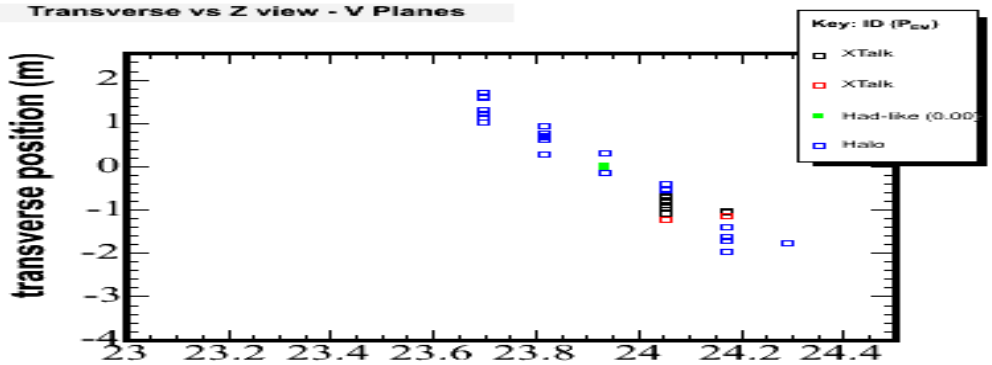
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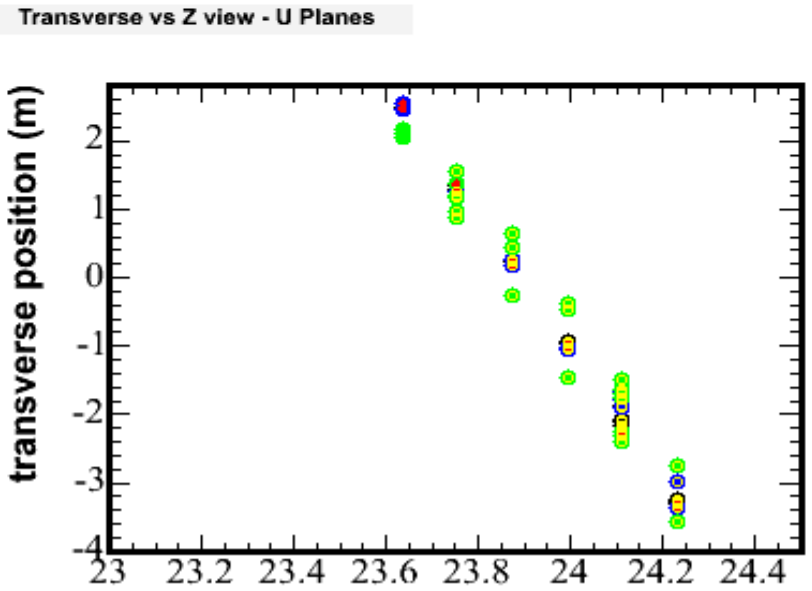
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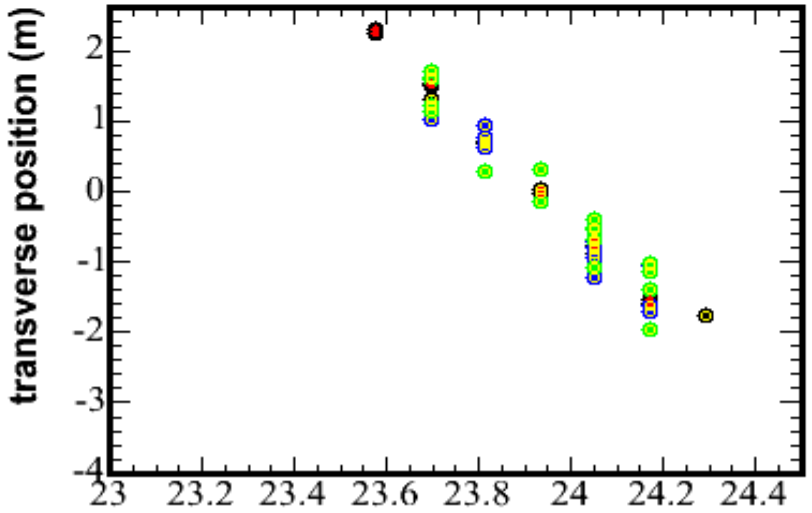
clearly cosmic ray

3 shield hits found









Cosmic Events in Fake Spill

Run: 32675, Snarl: 196915, Slice: 1(/1), Event 1(/1)

Reco

#Trks: 0

#Shws: 1

q/p: 0.000 +/- 0.000, p/q: 0.000

TrkRangeEnergy: 0.000 RecoShwEnergy: 6.023

Vtx: 0.00, 0.00, 0.00

Truth

N/A

N/A

N/A

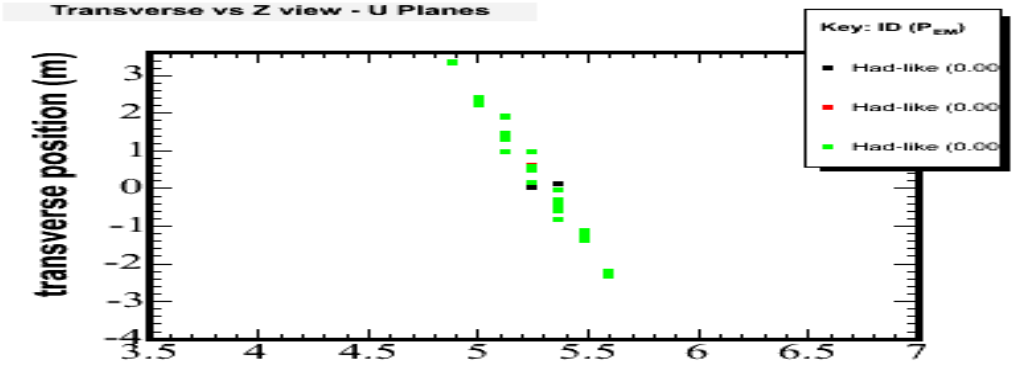
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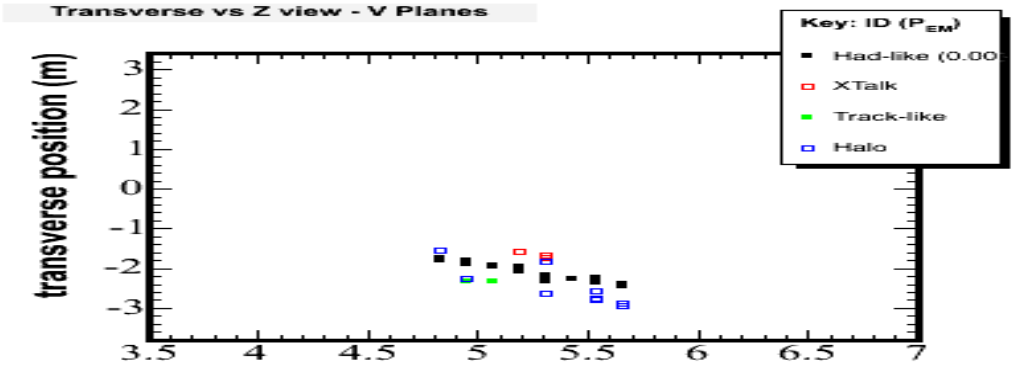
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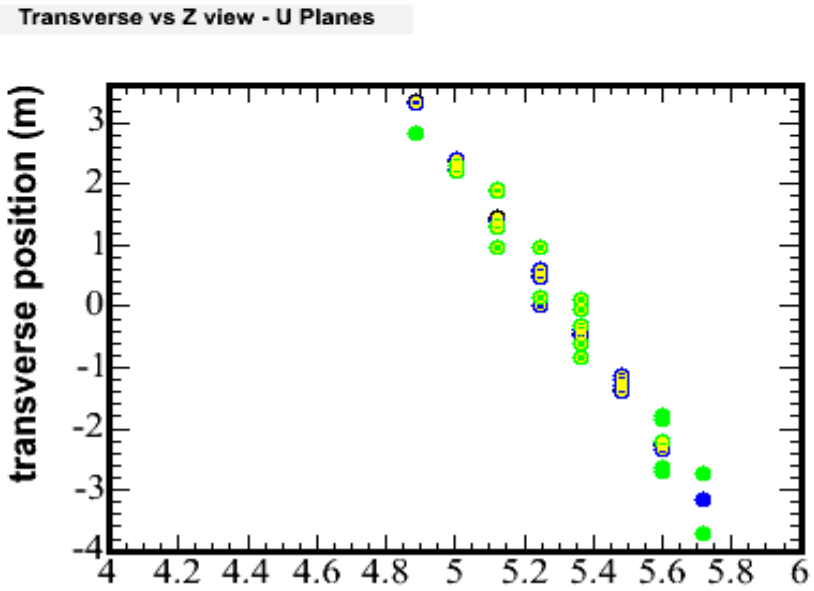
N/A

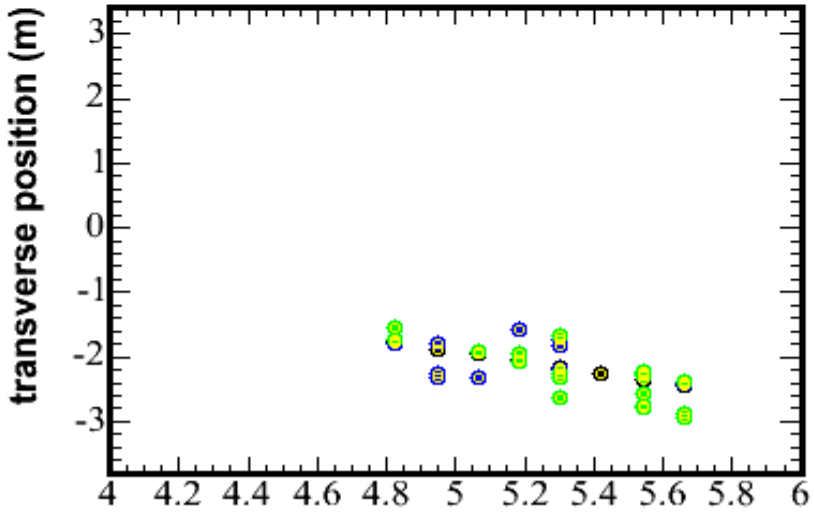
clearly cosmic ray

1 shield hit found









Cosmic Events in Fake Spill

Run: 32889, Snarl: 188138, Slice: 1(/1), Event 1(/1)

Reco

#Trks: 0

#Shws: 1

q/p: 0.000 +/- 0.000, p/q: 0.000

TrkRangeEnergy: 0.000 RecoShwEnergy: 5.495

Vtx: 0.00, 0.00, 0.00

Truth

N/A

N/A

N/A

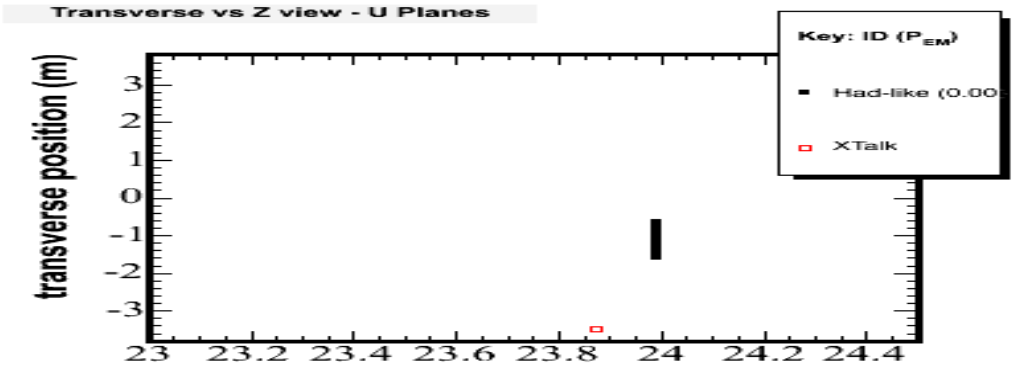
N/A

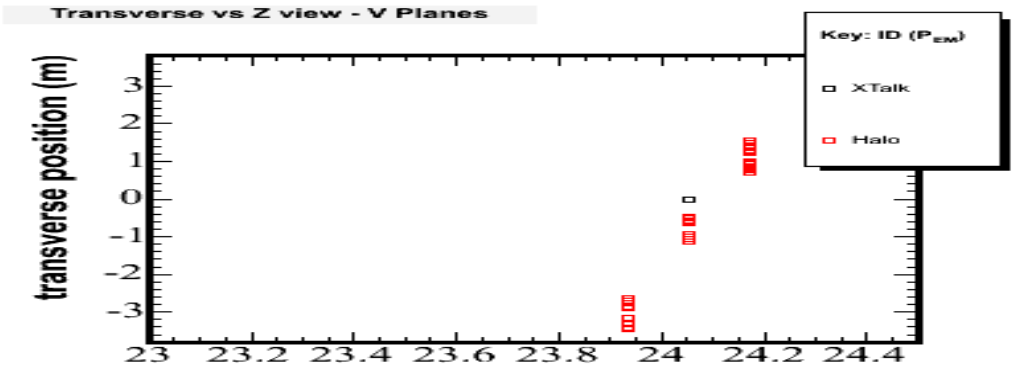
N/A

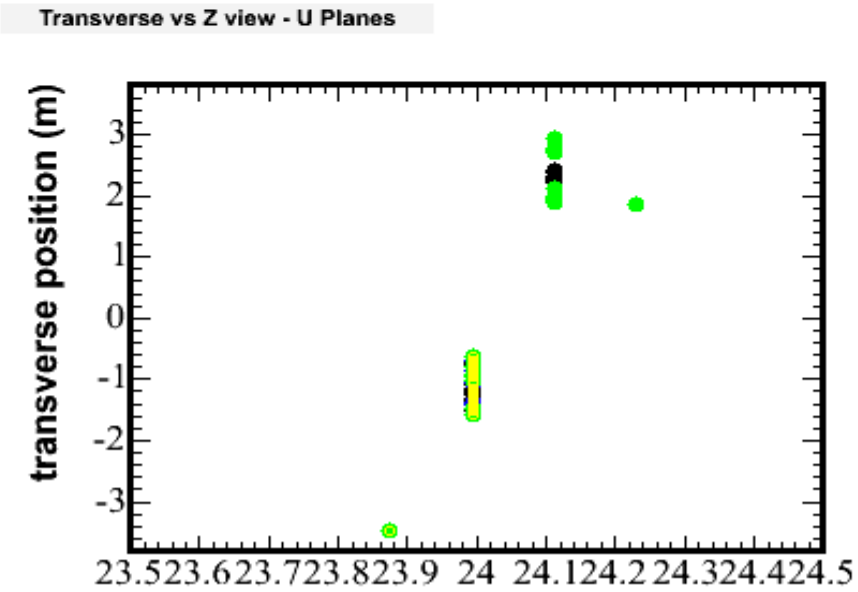
N/A

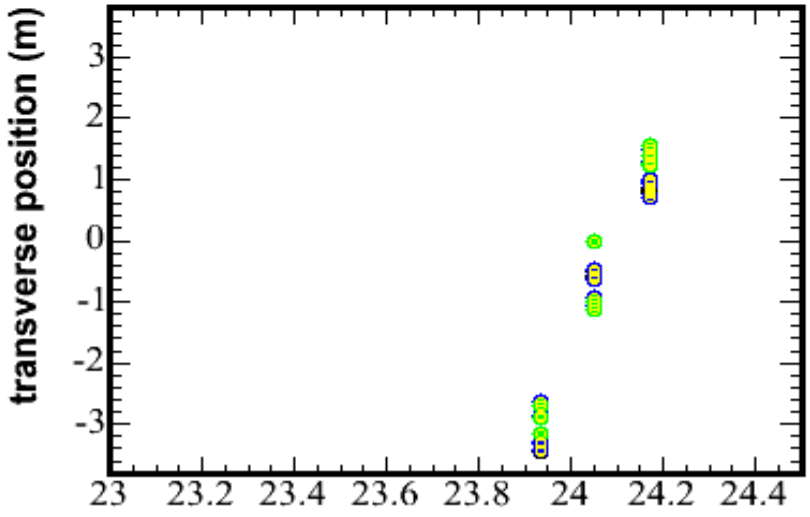
clearly cosmic ray

1 shield hit found









Cosmic Events in Fake Spill

Run: 32794, Snarl: 68274, Slice: 1(/1), Event 1(/1)

Reco

#Trks: 0

#Shws: 1

q/p: 0.000 +/- 0.000, p/q: 0.000

TrkRangeEnergy: 0.000 RecoShwEnergy: 2.895

Vtx: 0.00, 0.00, 0.00

Truth

N/A

N/A

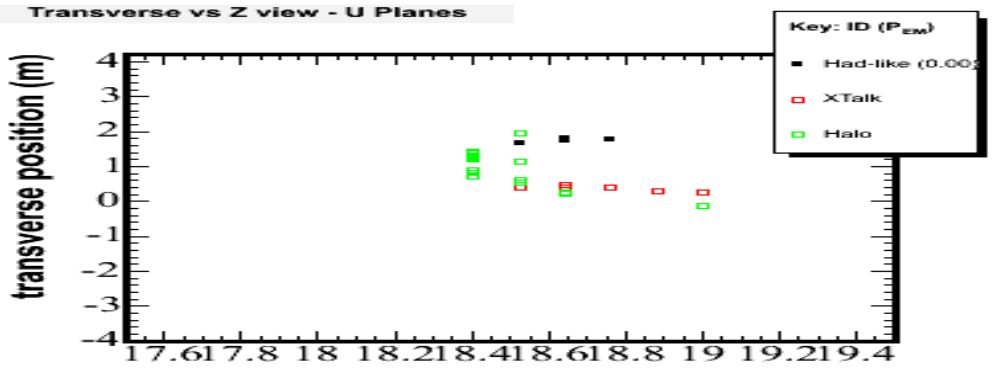
N/A

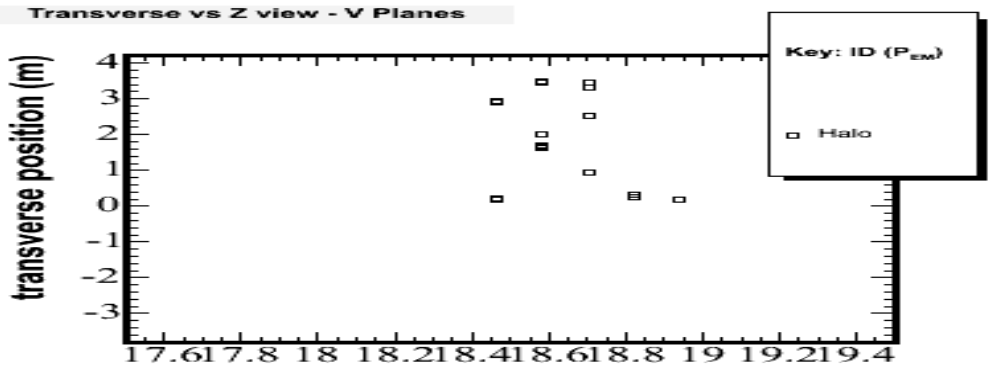
N/A

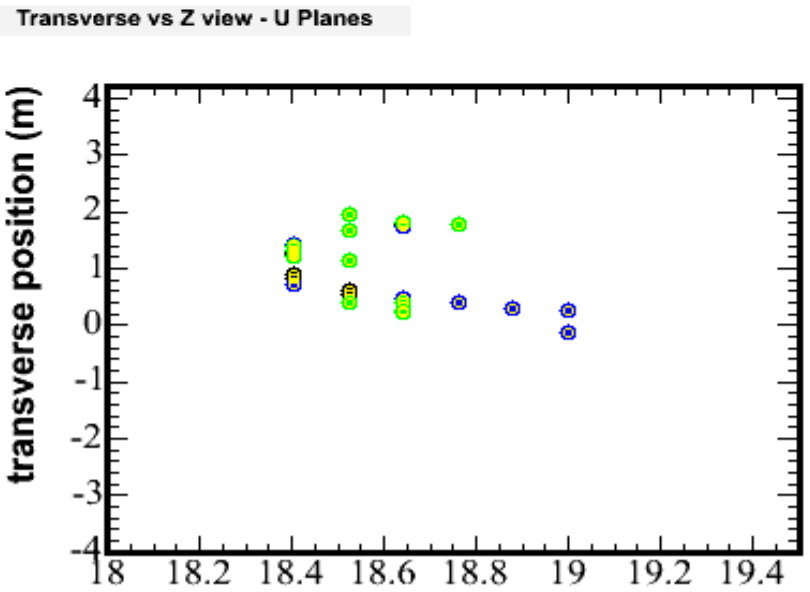
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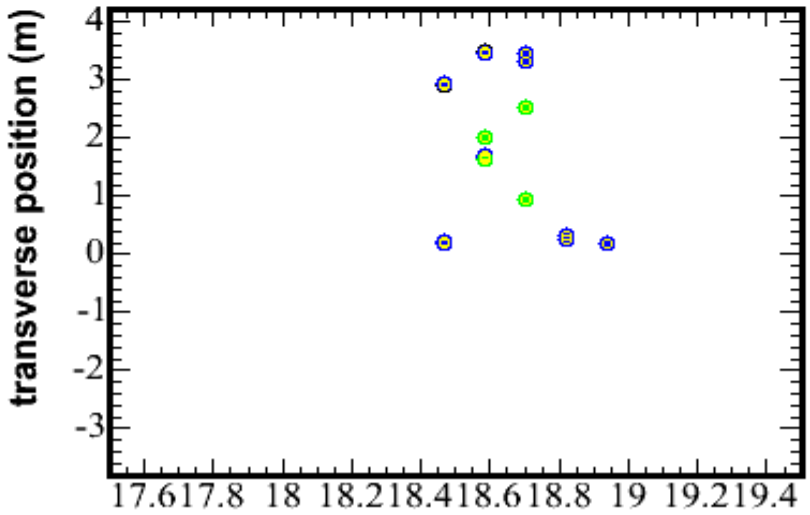
N/A

not clear it is cosmic ray
from event topology
2 shield hits found









Cosmic Events in Fake Spill

Run: 32666, Snarl: 269155, Slice: 1(/1), Event 1(/4)

Reco

#Trks: 1

#Shws: 1

q/p: 0.000 +/- 0.000, p/q: 0.000

TrkRangeEnergy: 9.604 RecoShwEnergy: 7.376

Vtx: 4.69, 0.42, 11.67

Truth

N/A

N/A

N/A

N/A

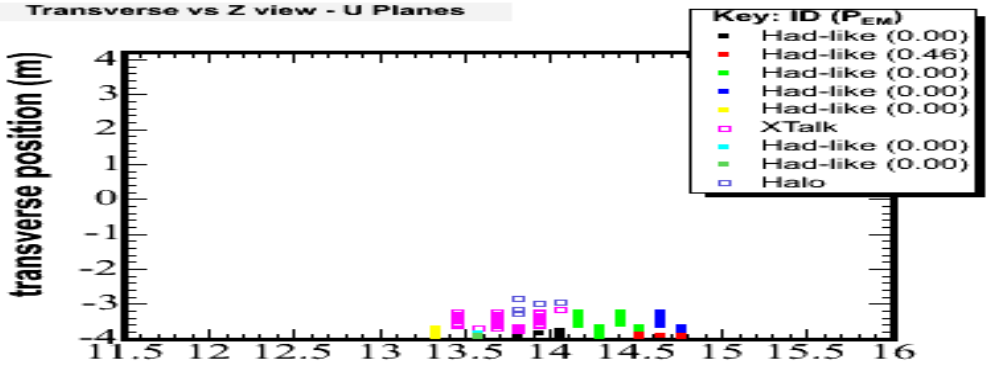
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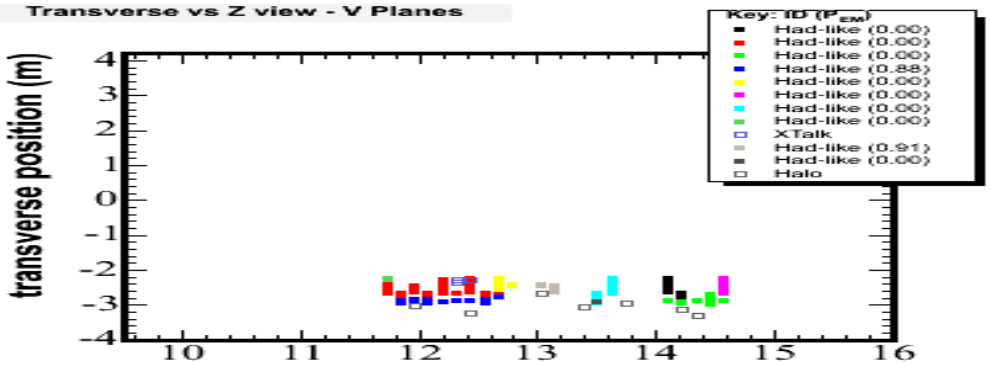
N/A

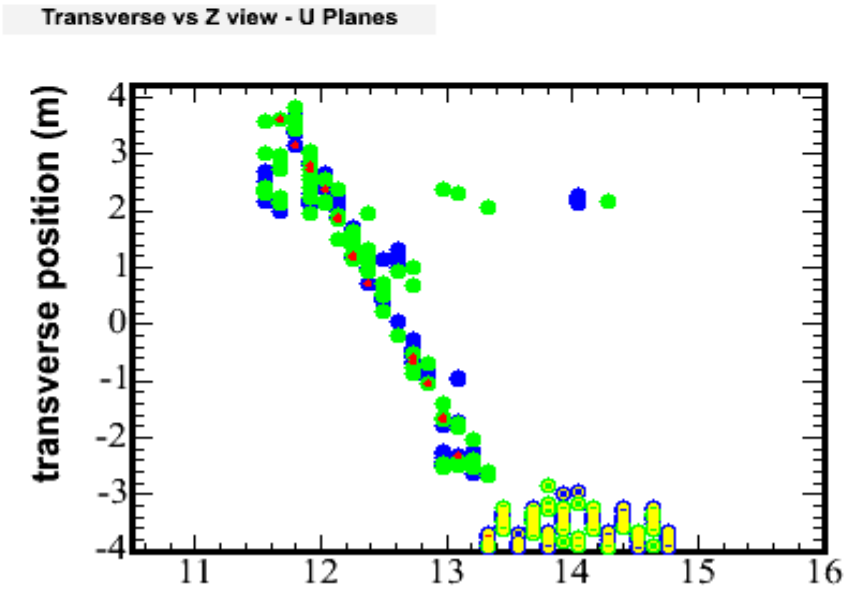
clearly cosmic ray

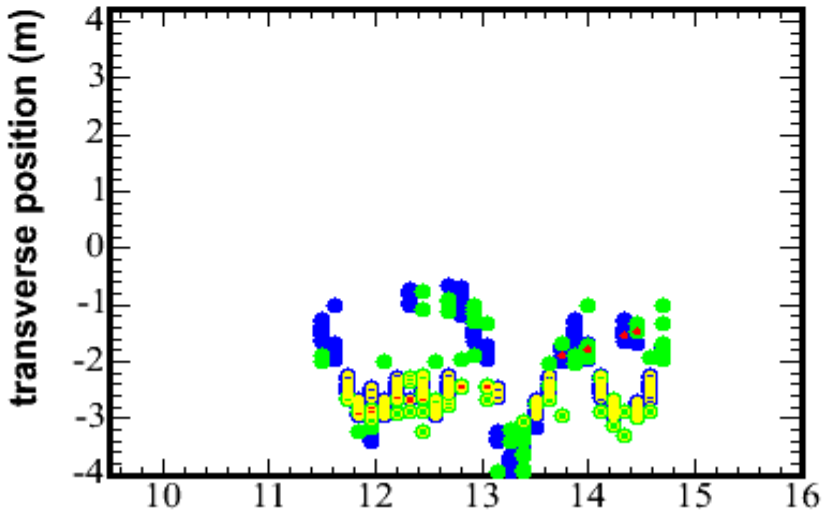
No shield hit found

but removed by PID









Summary

- More efficient shield veto based on event vtx, timing developed
- A quick look at fake spill data agrees with analysis on cosmic ray data set
- What is next?
  - possible reco. improvement will provide more accurate rejection on cosmic ray and the rejection will have less effect on beam events
    - vtx, timing determination
      - 2 cluster vtx timing algorithms developed with similar performance
        - will evaluate after obtain Chris' stp time correction
      - another look at spacial vtx
    - event direction
  - merge cosmic ray data event with beam MC into a new event sample
    - more realistic way to estimate cosmic background
      - looking at two data sets separately mainly provided timing coincidence, not spacial coincidence (should be small)
      - event topology changes if cosmic ray hits overlap with beam hits
    - systematic approach to understand the effect of cosmic rejection has on beam data