SuperB:

DCH occupancy using FullSim

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Outline

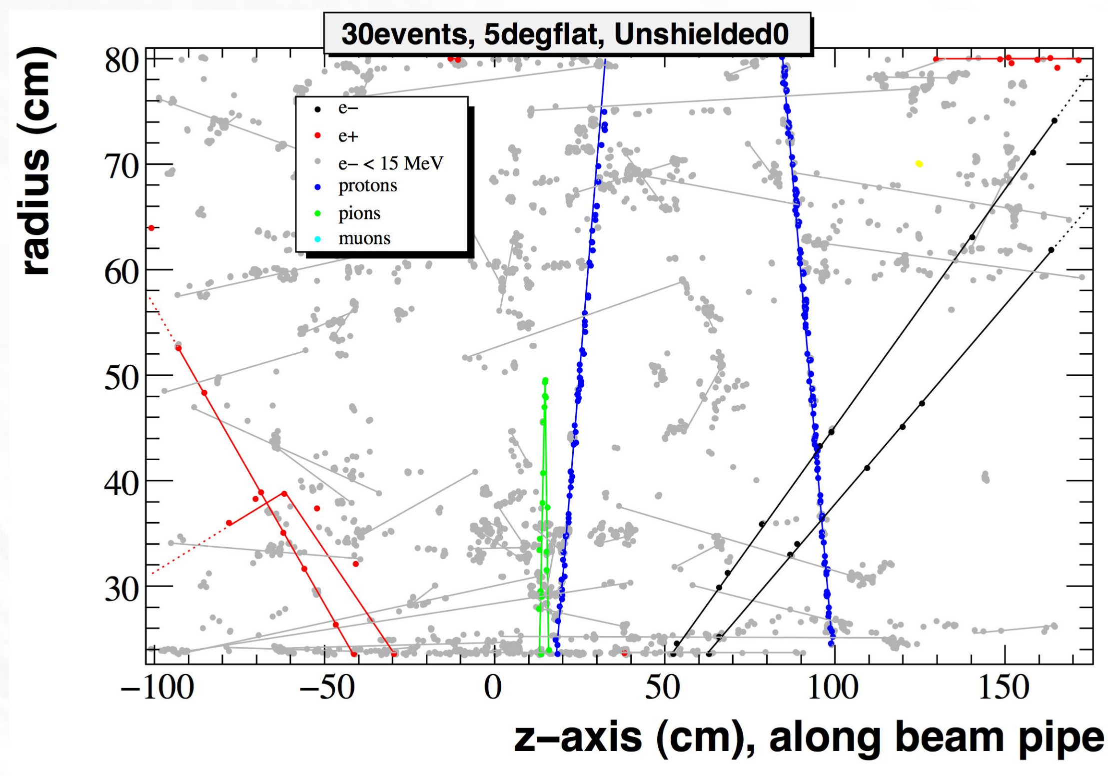
- Analysis/Tracking Procedures
- Effect of Shielding
- Low Energy Hits
- Raw Occupany
- Presence of Neutrons
- Occupany vs. Geometry
- SuperB Production & Low-Angle Bhabhas

Analysis Procedure

- Use Bhwide generator in FastSim
  (There is no Bhwide generator for Bruno)
- Transfer events to FullSim by converting StdHepAsciiDump output to Bruno input
- Use guinea generator in Bruno
- For speed, removed EMC, DIRC, and IFR from gdml
- Compared shielded and unshielded final-focus
- Create 2000 event tuples with e+e- at 2-178, 5-175, 10-170, and 15-165 degrees in the CM frame.
- Use ROOT to estimate occupancy. Events normalized to $\mathscr{L} = 10^{36}$ cm^2/s.

Tracking Algorithm

- Bruno only provides deposited energy (hit) information within a chamber that's void of wires.
- Using the TrackID of time-ordered hits, I define a track and extrapolate the number of wires the track would cross.
  - All wires are assumed to be axial and uniformly spaced.
- Tracks starting near inner radius are drawn with 2 straight lines: from first hit to hit with max radius, then to final hit and beyond.



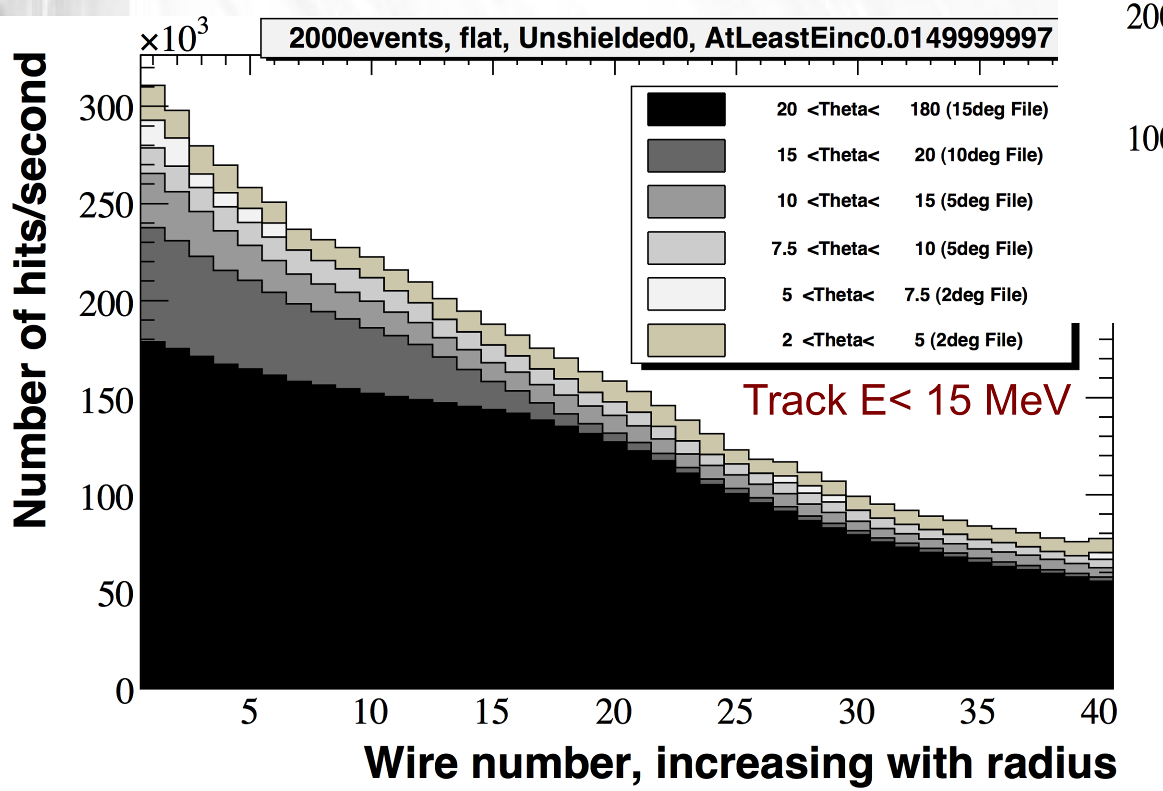
- Tracks starting within DCH (ie. 96% have E < 1.5 MeV) are drawn with one straight line: from first hit to final hit.
- Multiple straight lines used for bouncing protons.

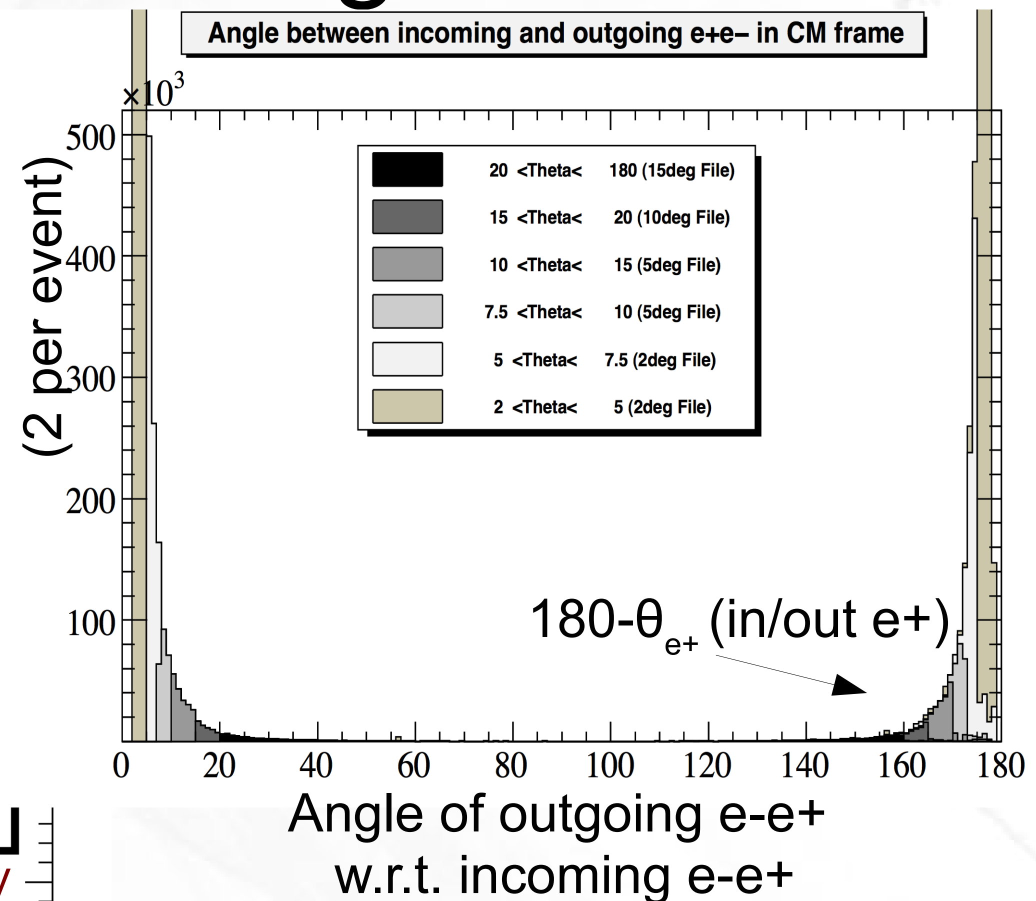
Combining tuples for higher stats

Cross-sections from Bhwide:

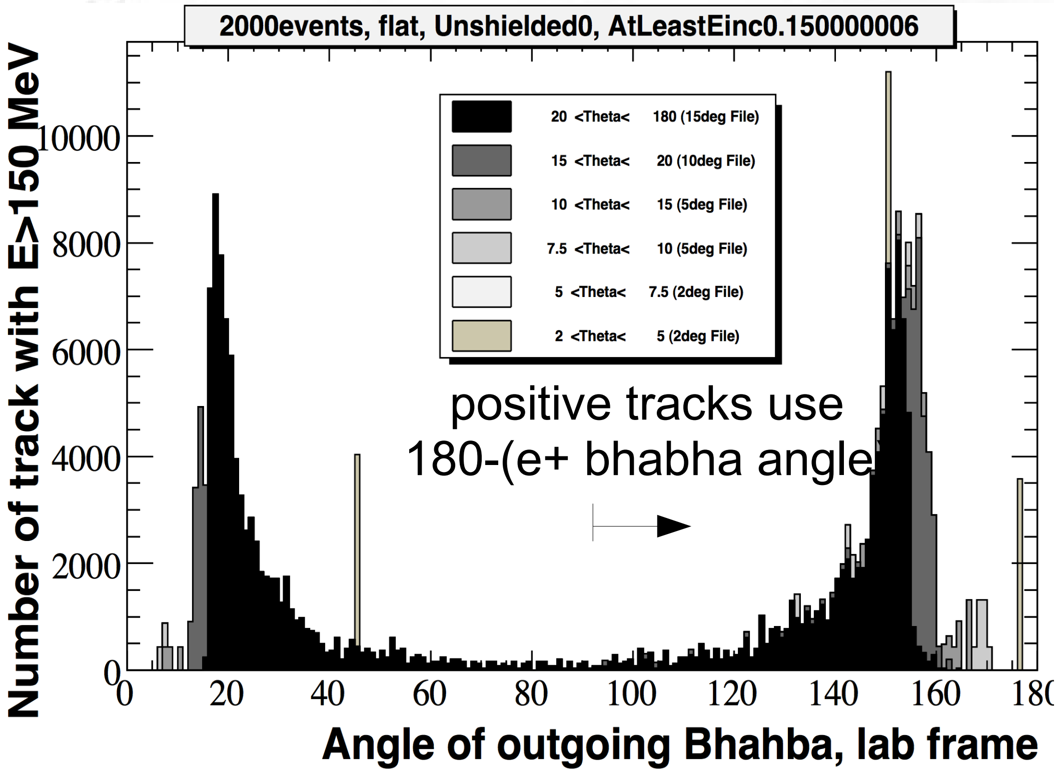
$(\theta_{max} = 180-\theta_{min})$

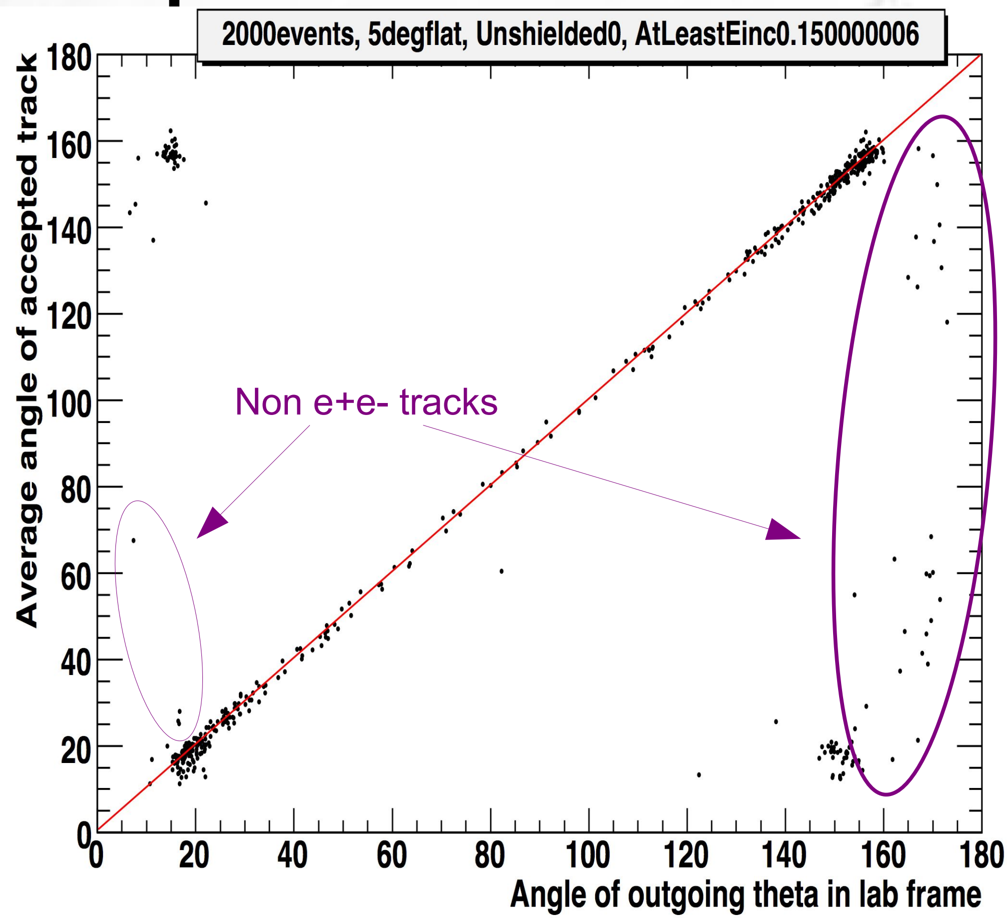
σ (nb)	θ_{min} (deg)
7171.7	2
876.3	5
201.2	10
81.68	15

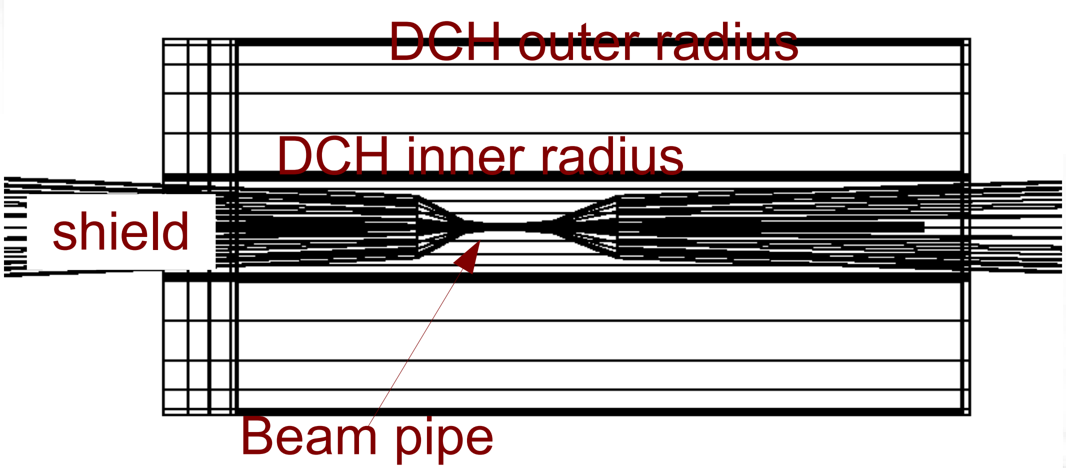




Shielded Acceptance

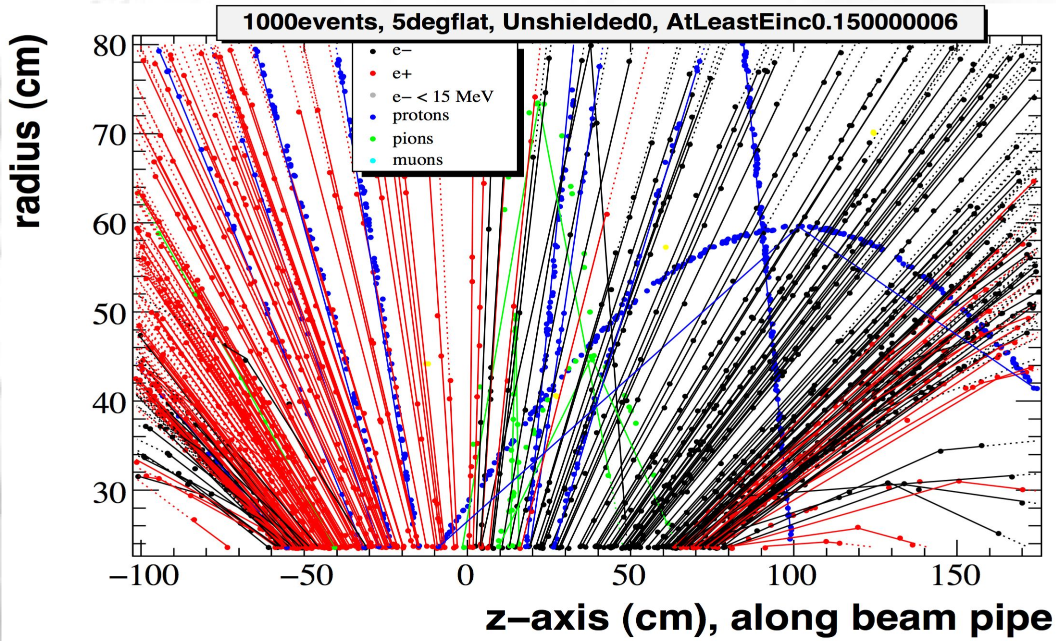


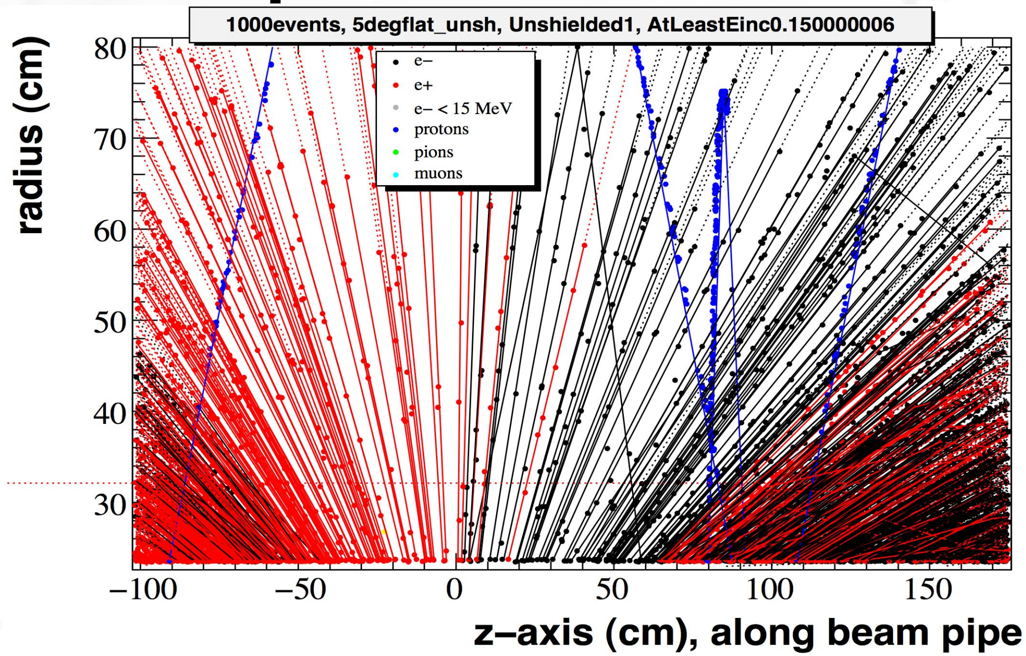




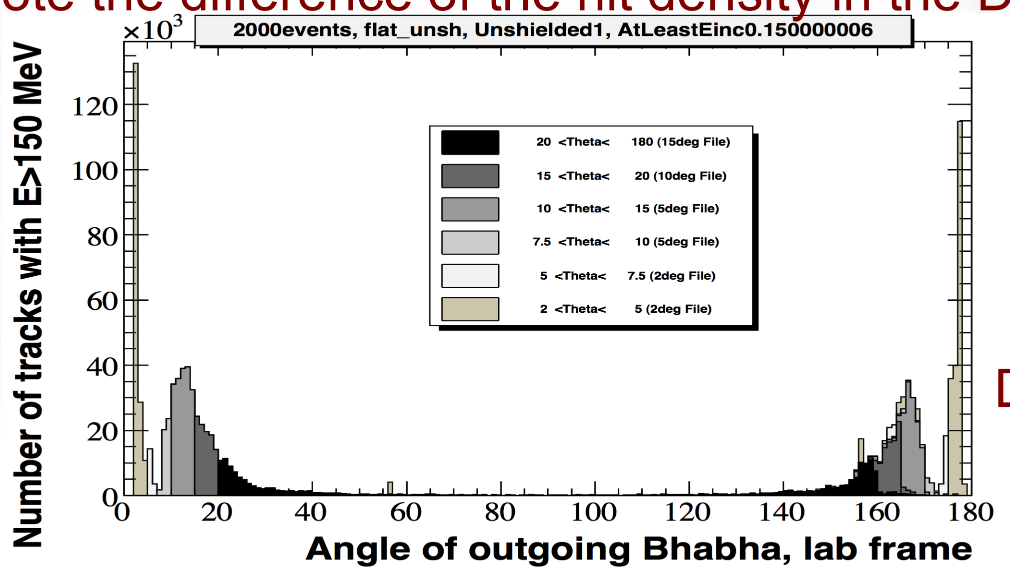
Radius=13.5cm at z = -33cm, 42.5cm;
Shield cuts bhabhas <17.6 and >157.7 °

Unshielded Acceptance





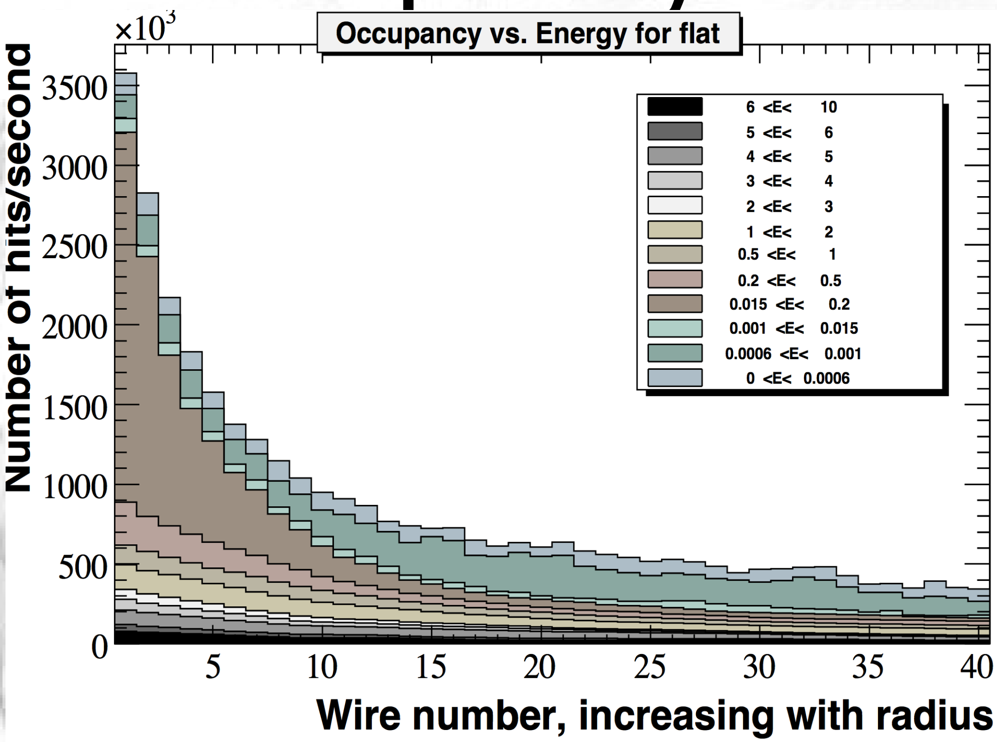
Note the difference of the hit density in the DCH corners for shielded vs. unshielded



DCH r = 23.7 - 80cm, z = -100 - 175cm;

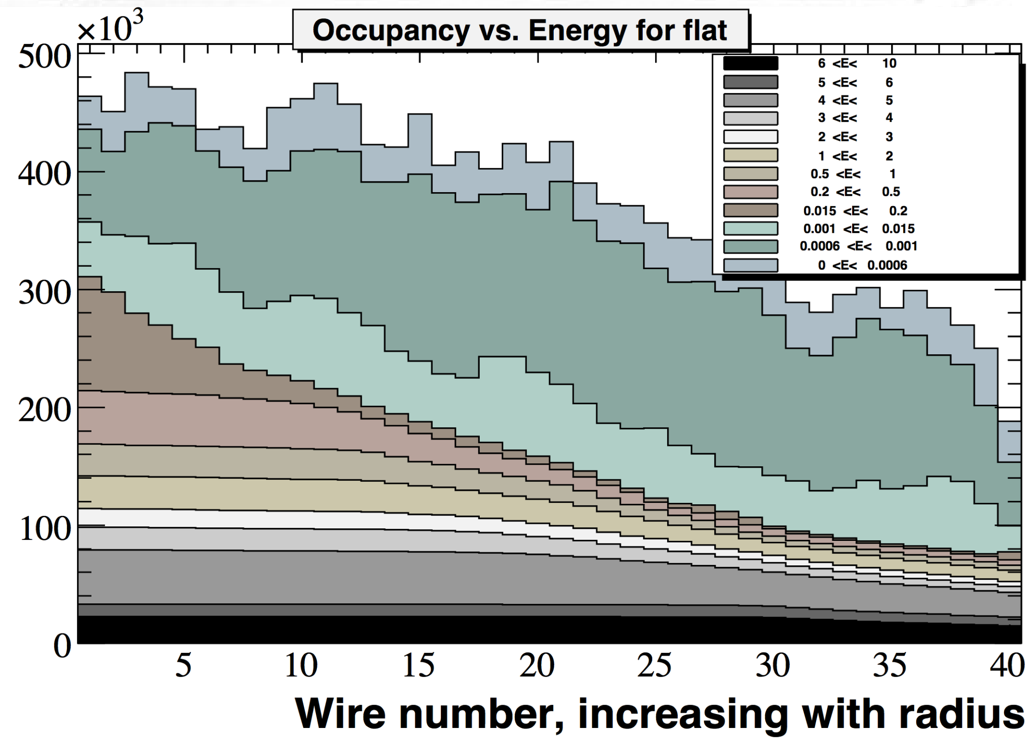
DCH accepts bhabhas >7.7 and <166.7 ◦

Occupancy: Shielded vs. Unshielded

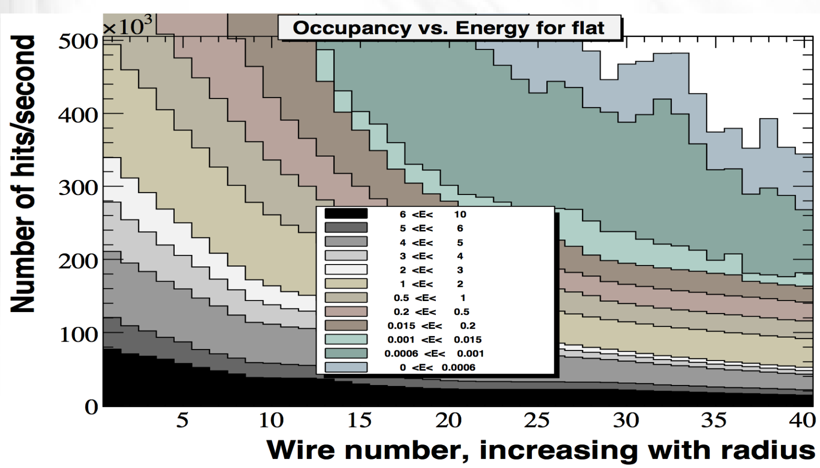


Unshielded

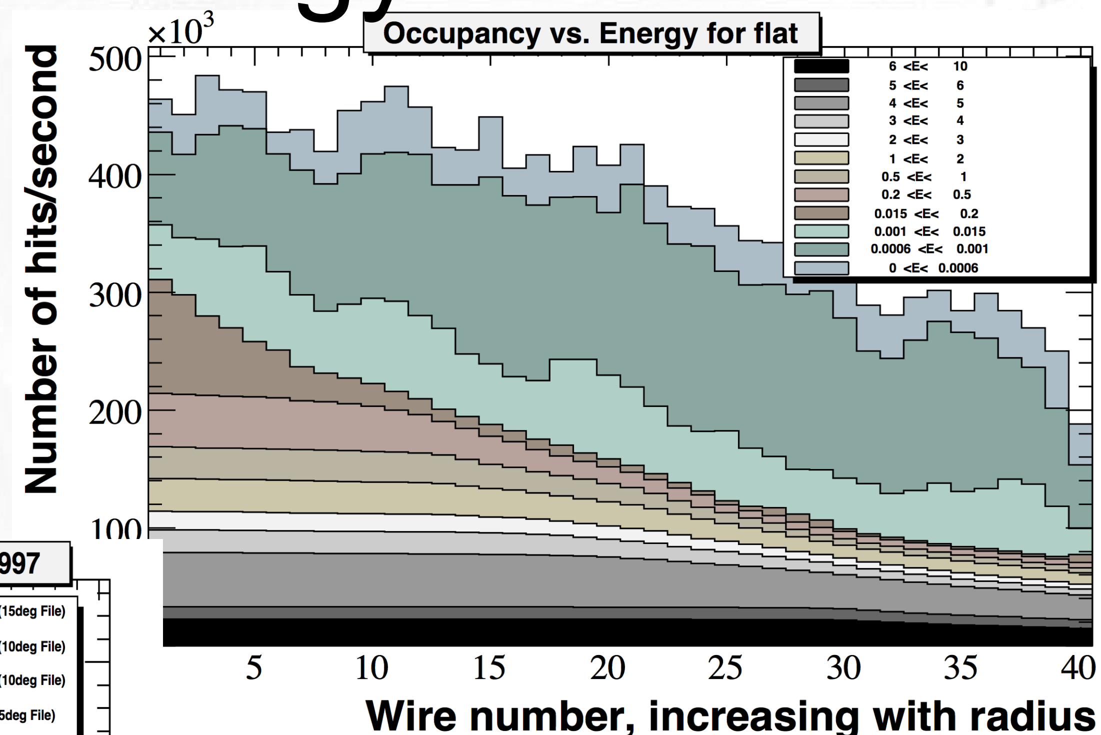
(zoomed in below for comparison)

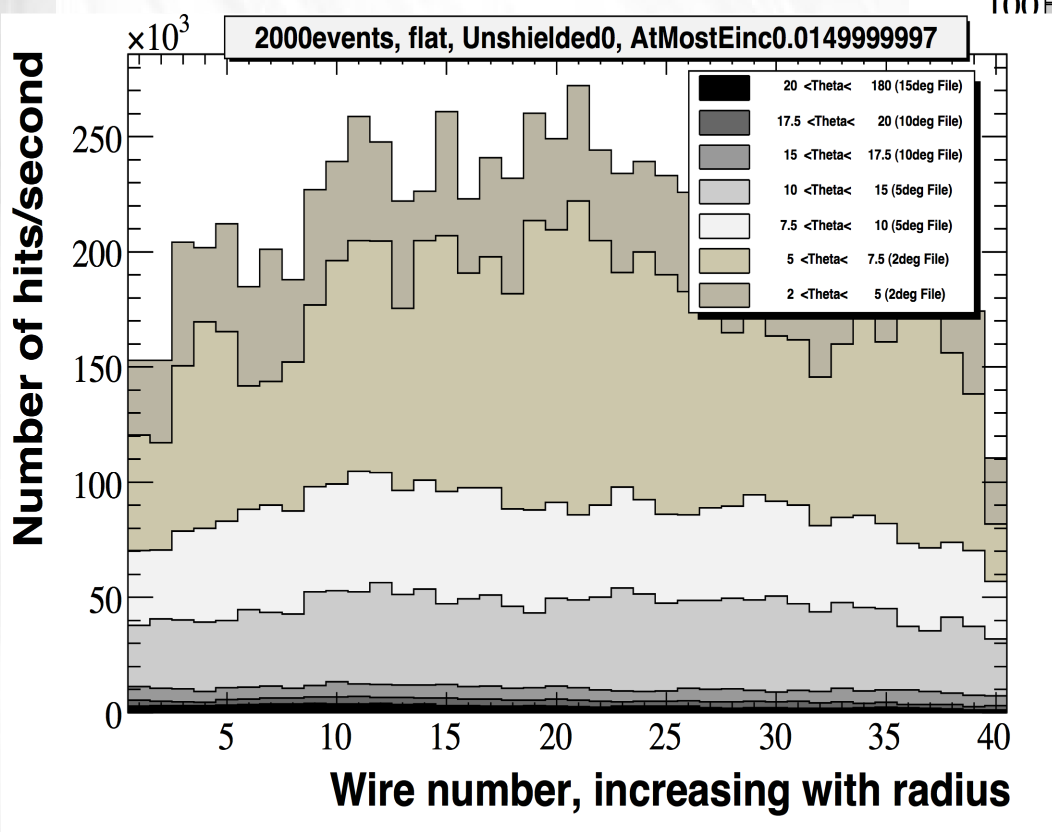


Shielded



Occupancy vs Energy: Shielded

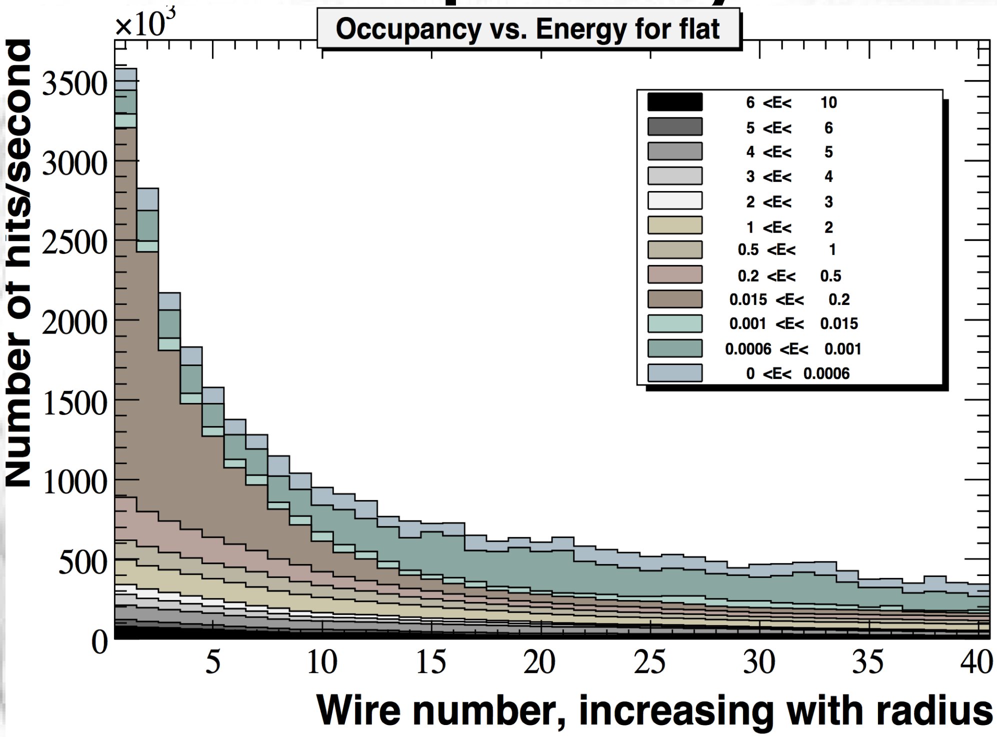




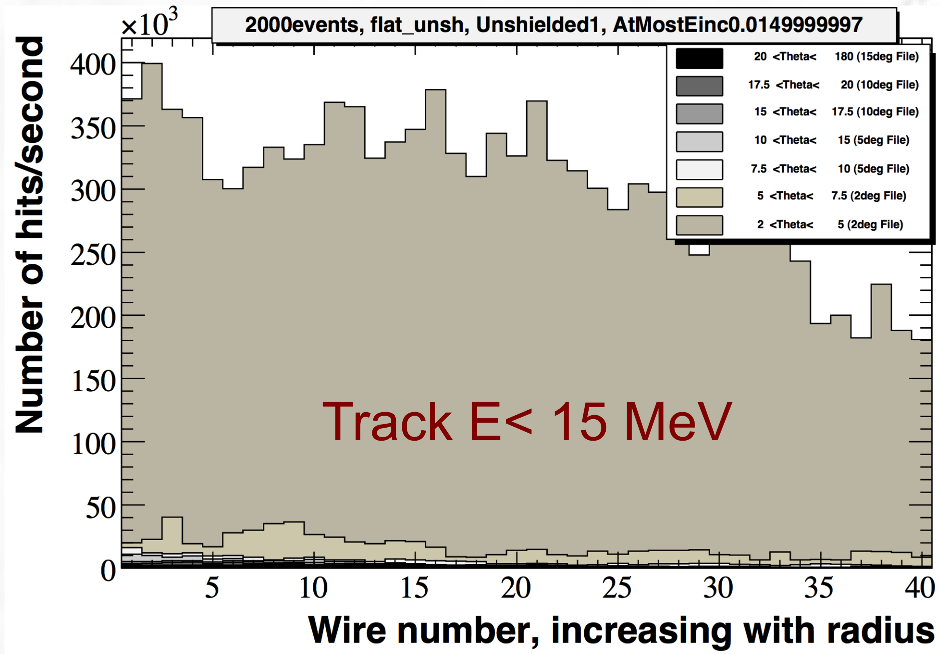
Shielded

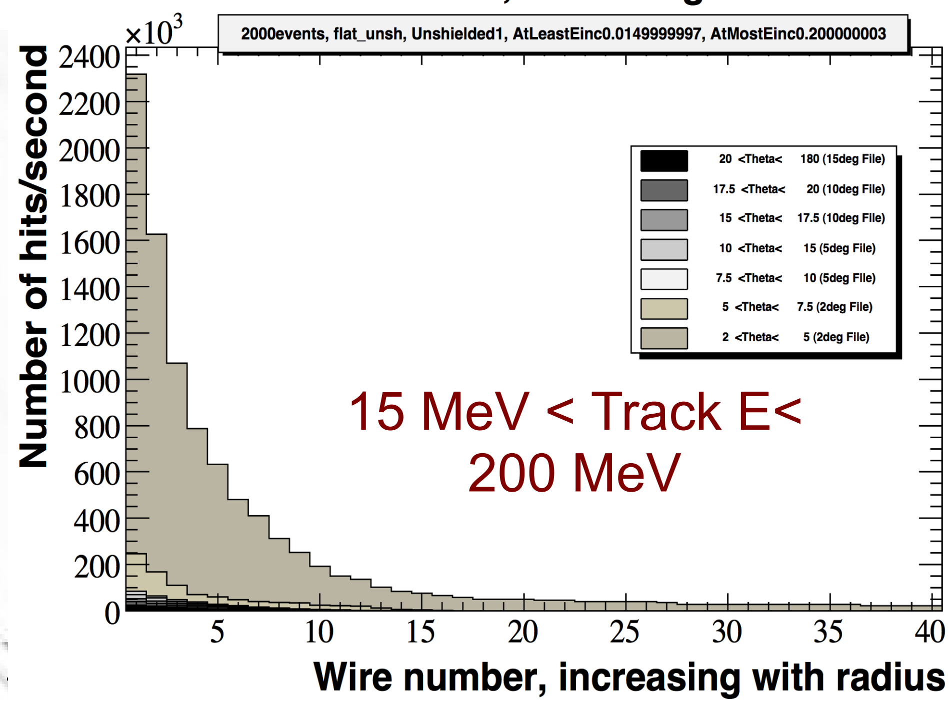
Low energy (<1.5 MeV) tracks come from angles that go through the shielding (<17.6 deg)

Occupancy vs. Energy: Unshielded



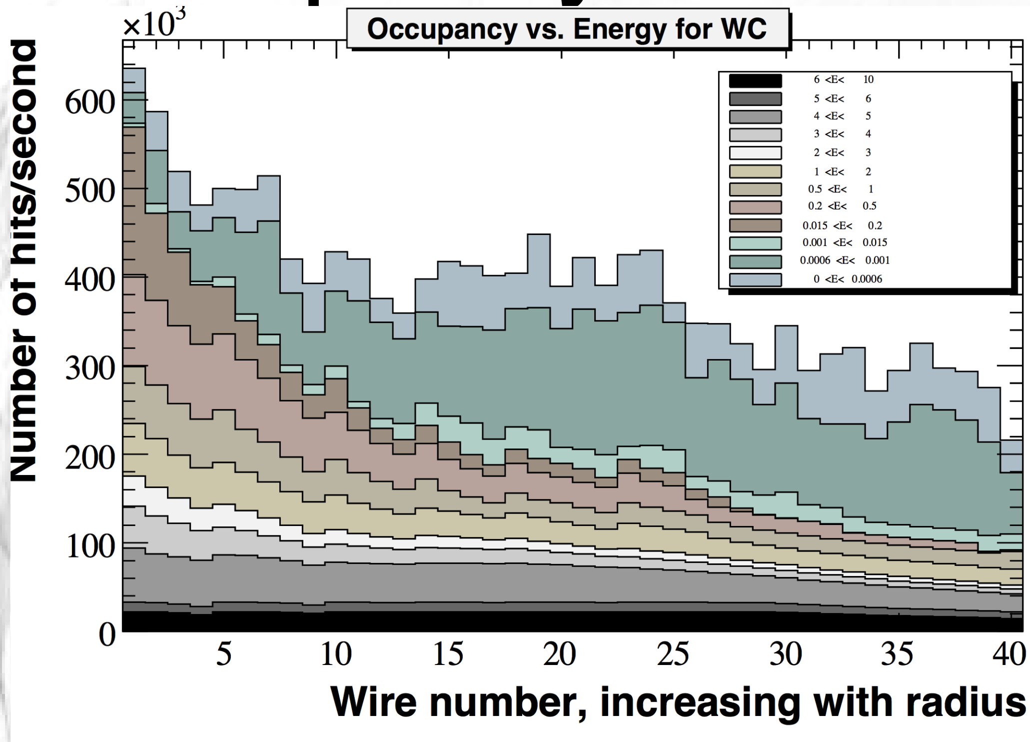
Unshielded



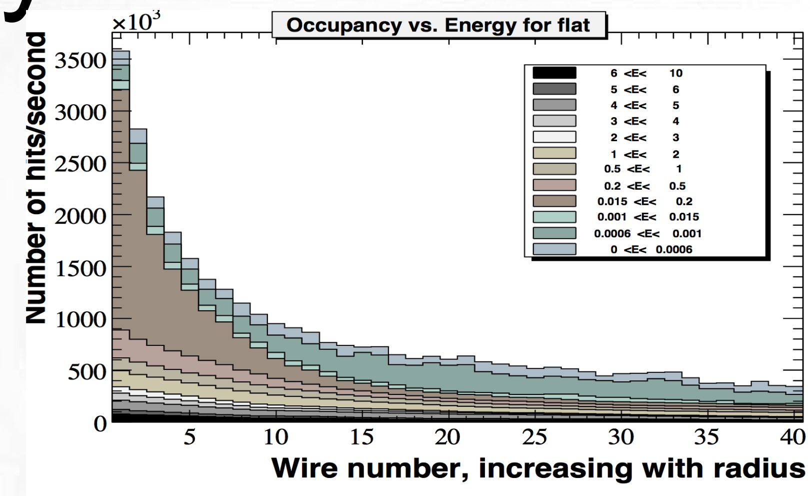


Without shielding, low E hits mainly coming from <5 degree Bhabhas

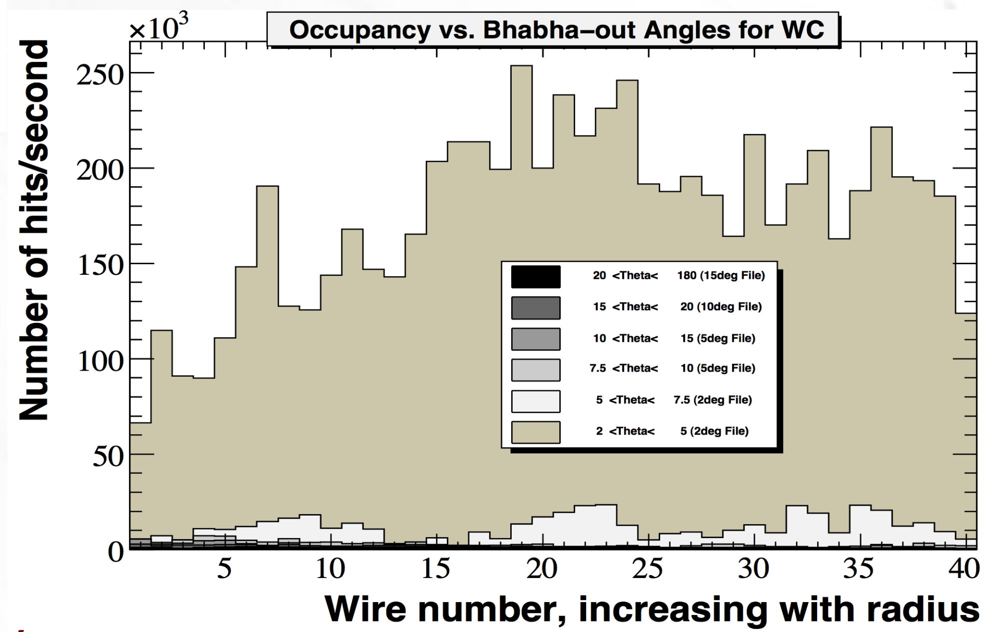
Occupancy vs. Energy: Unshielded WC



Unshielded Wedding Cake



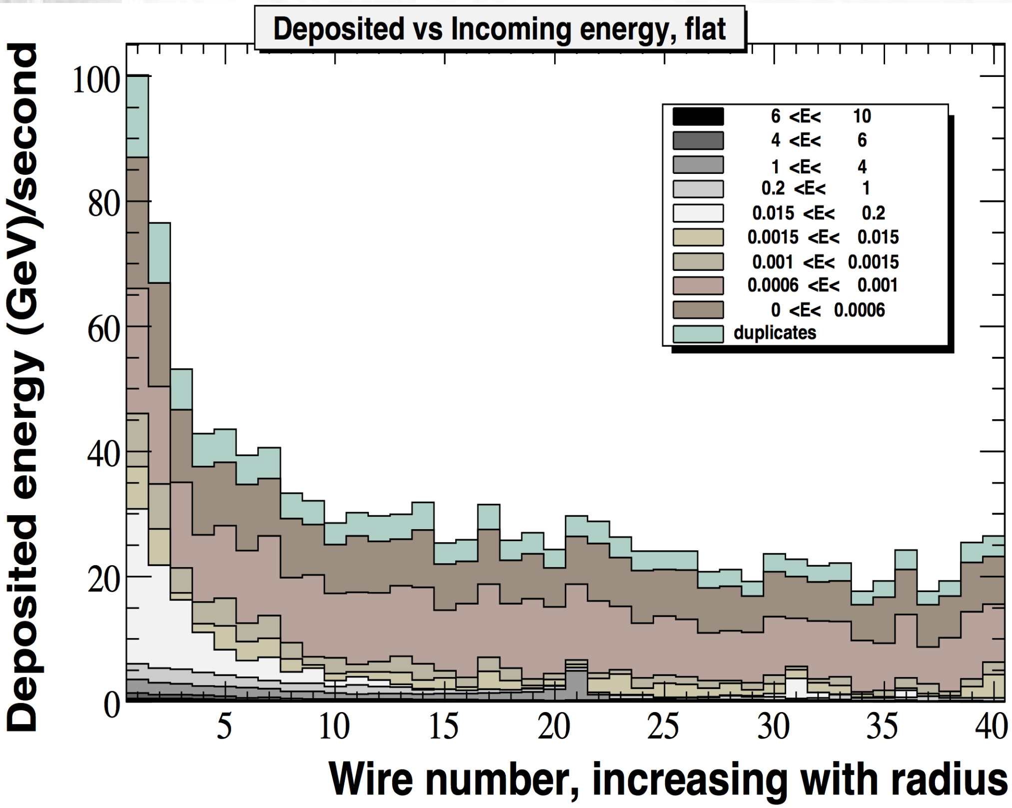
Unshielded Flat geometry, for comparison



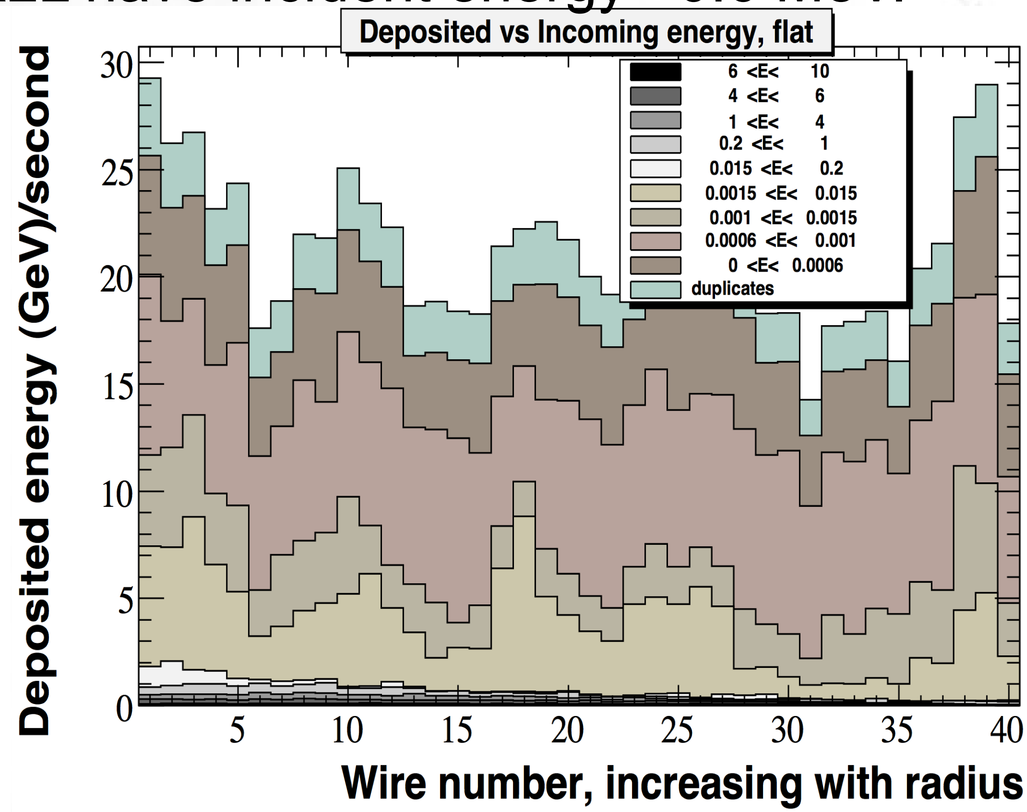
Track E< 15 MeV

Raw Occupany

- Instead of forming tracks, I calculate the raw occupany on each wire by summing the deposited energy of all hits that lie closest to that wire.
- From the low amount of deposited energy from high energy tracks, I conclude that many low energy hits are actually spin-offs from high energy tracks.
- "Duplicates" refer to single e- hits with the exact position (to μm³) as another hit from an actual track. These hits ALL have incident energy <0.6 MeV.



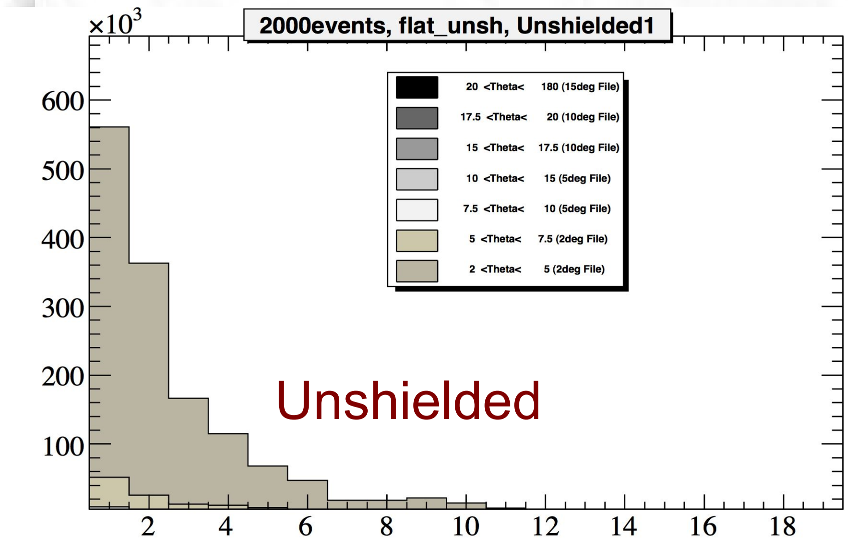
Unshielded

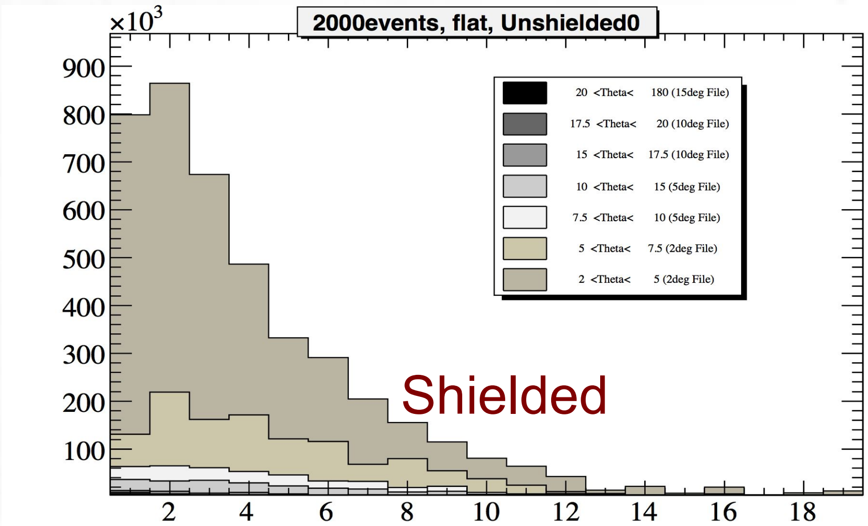


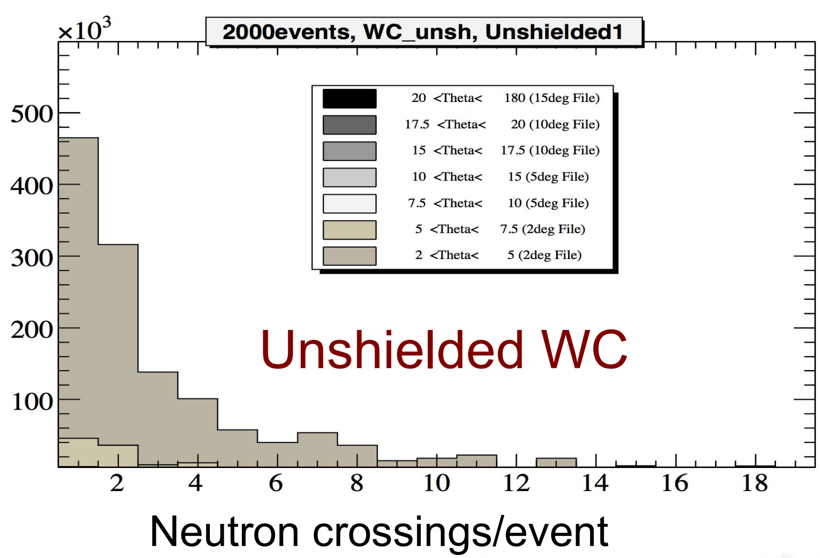
Shielded

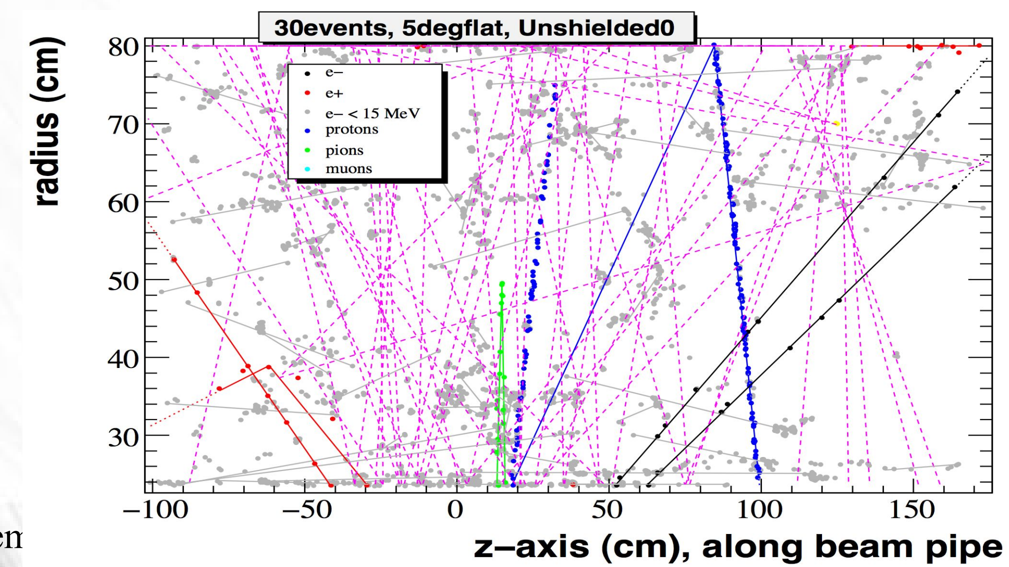
Presence of Neutrons

- This is the number of neutron crossings/event; each may cross several times.
- There is no correlation between the amount of low energy hits or deposited energy and the number of neutrons in any ONE given event.



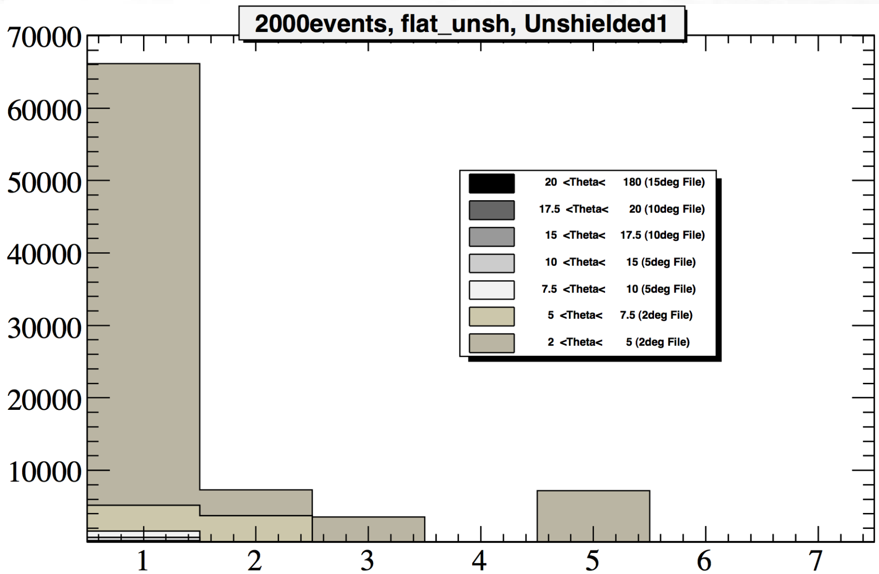


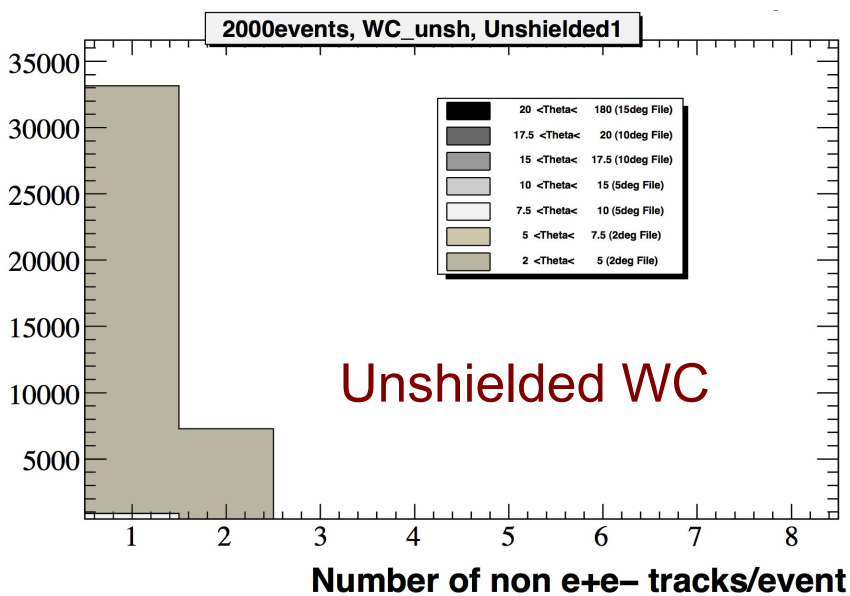




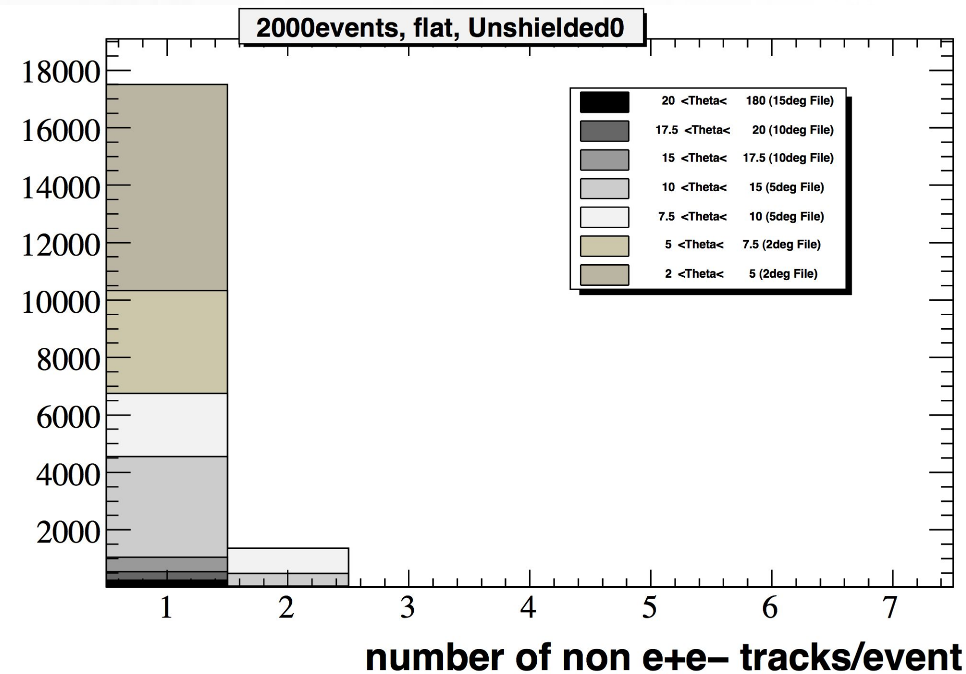
Presence of non e+e- tracks

Unshielded





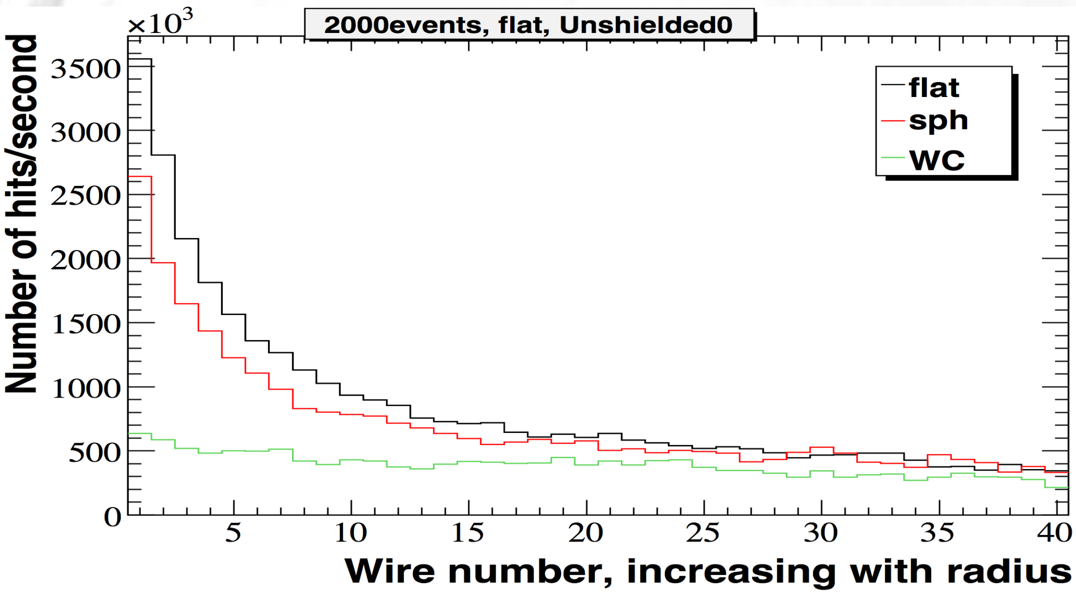
Shielded



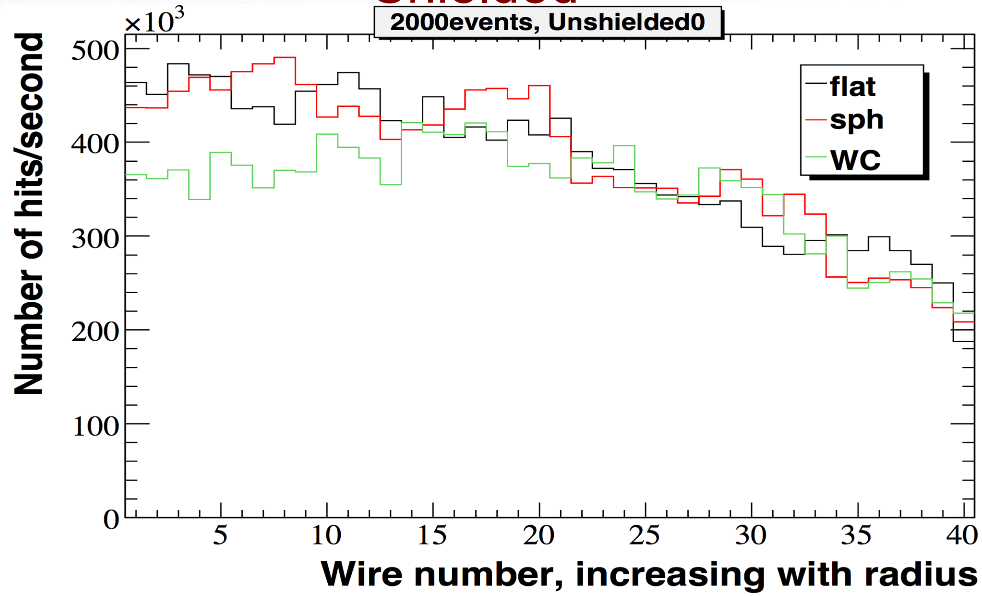
- The ratios of the angles here for are similar to the ratios of angle for <1.5 MeV hits, though there is not other evidence of correlation.

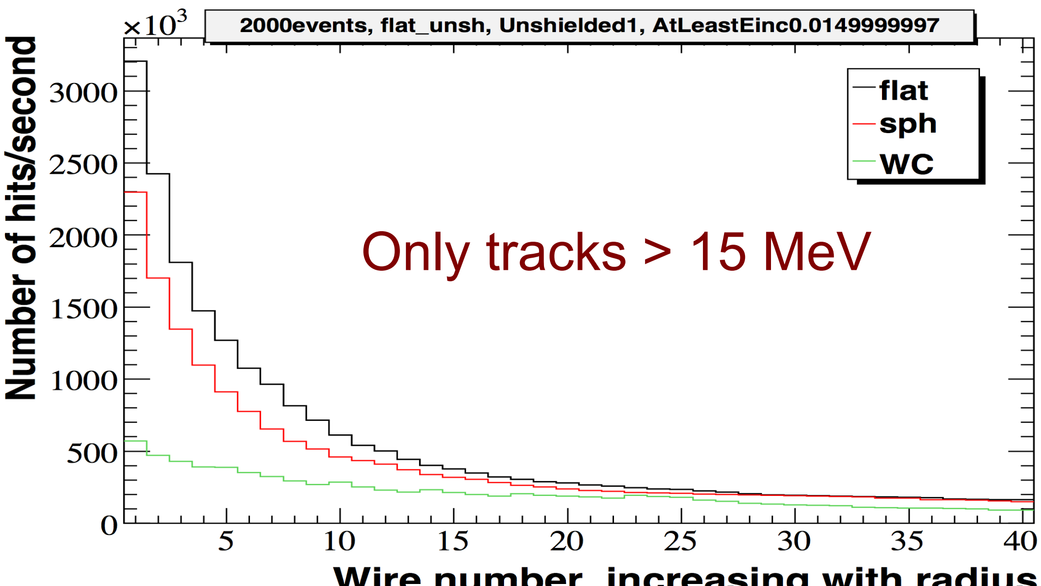
Geometries: Shielded vs. Unshielded

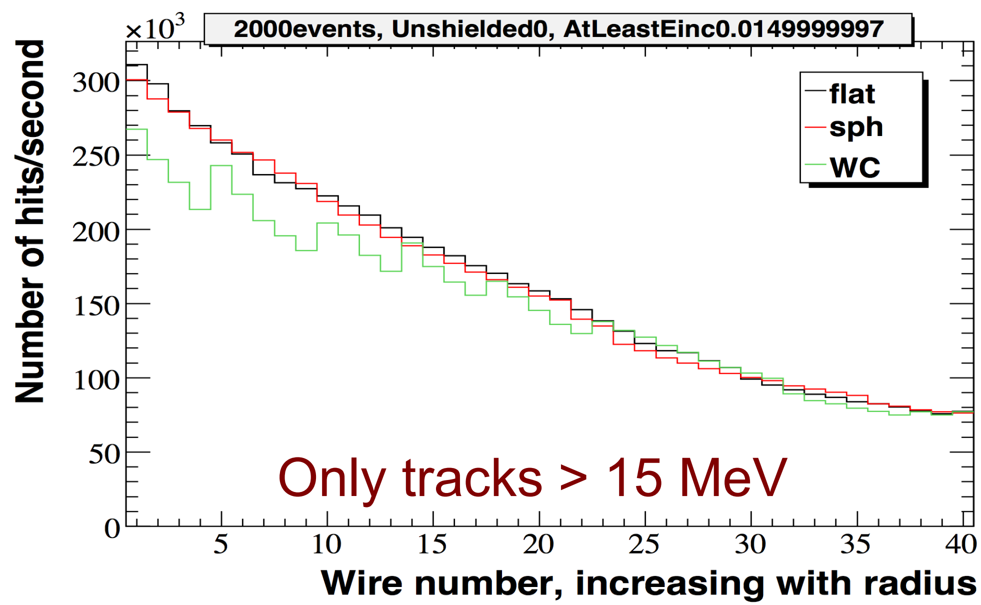
Unshielded



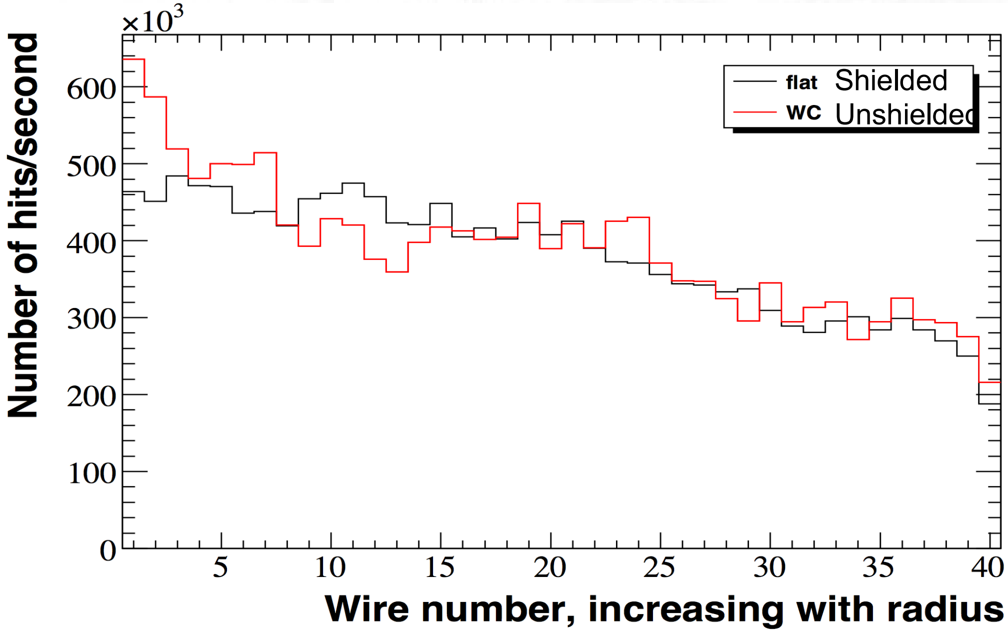
Shielded



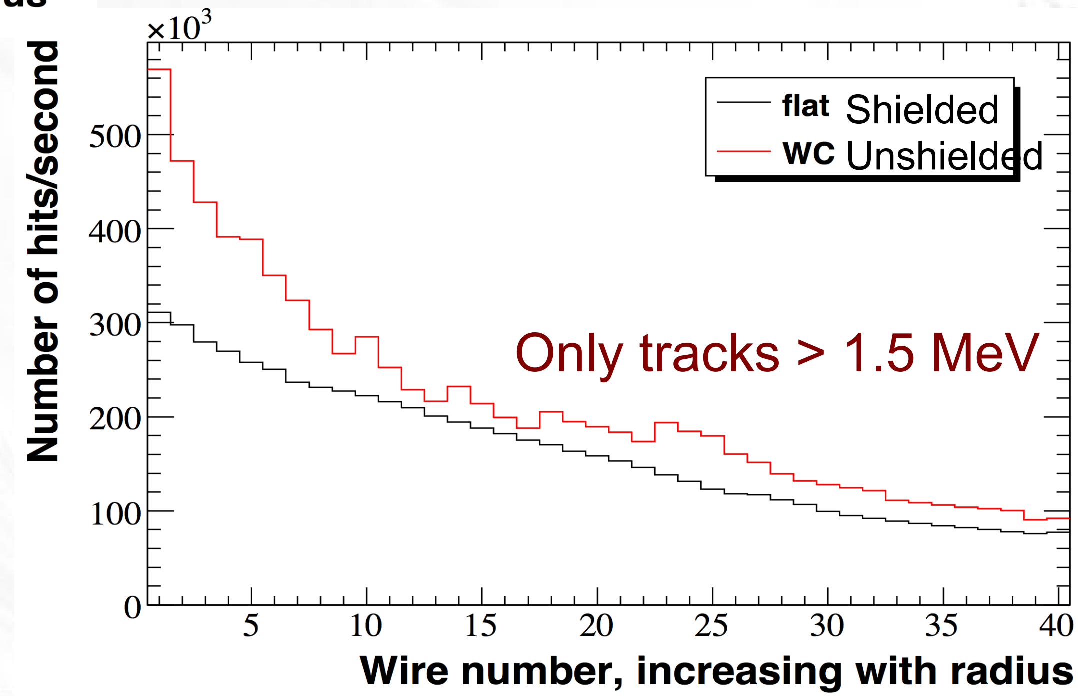




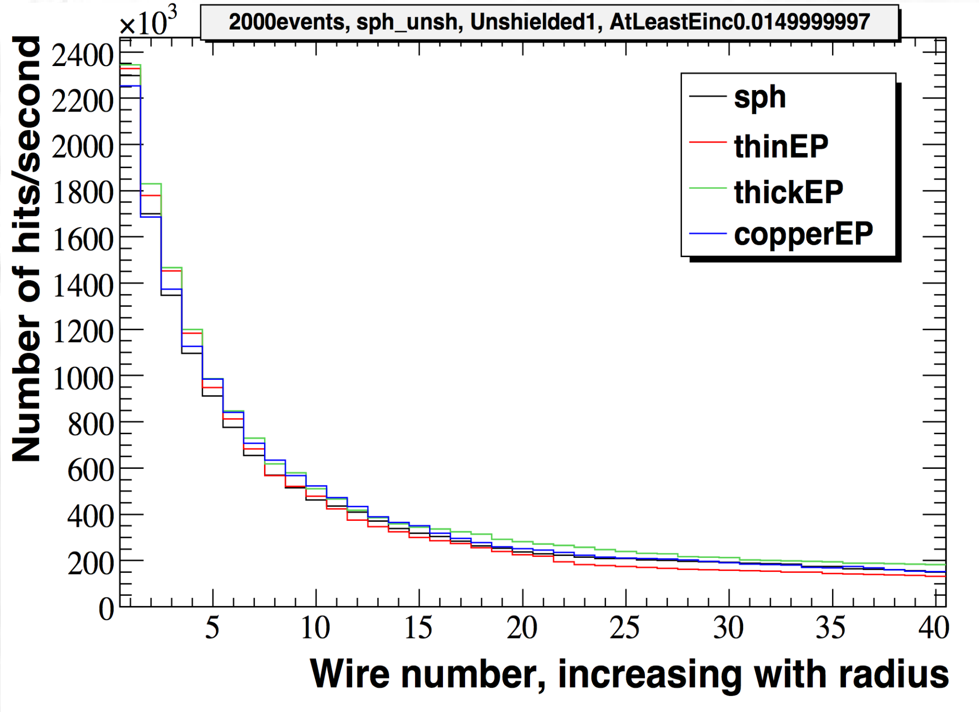
Geometries: WC vs. Shielded

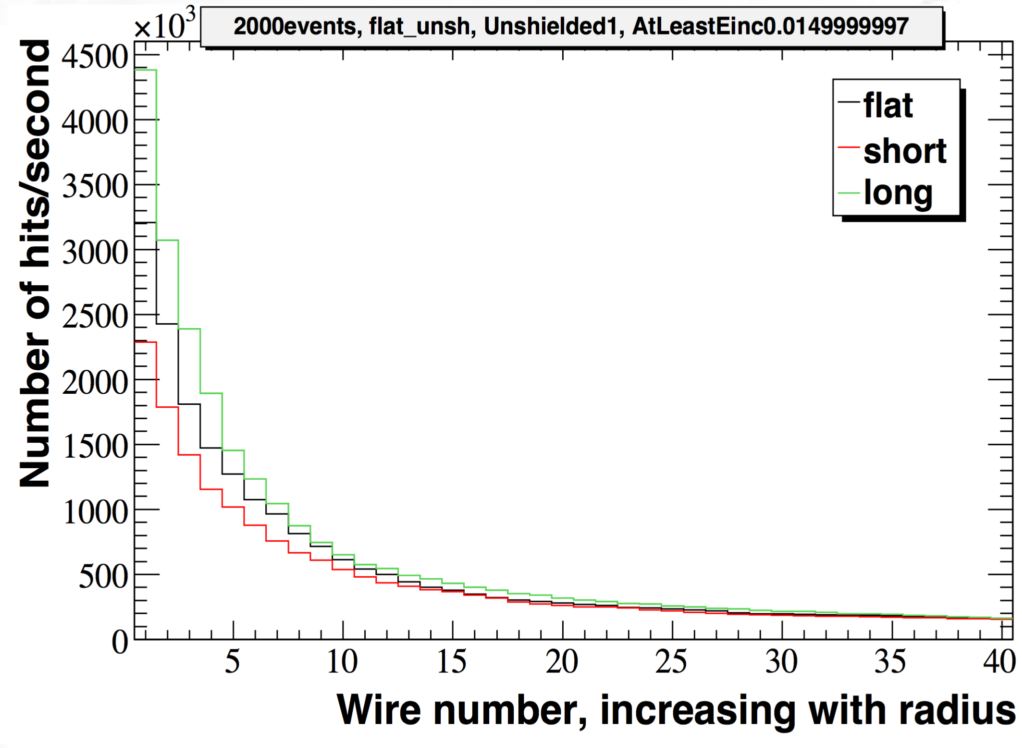


Note:
WC chamber currently cuts angles < 19.4-22 from vertex.
Shield cuts angles <17.6 and >157.7



More Geometries





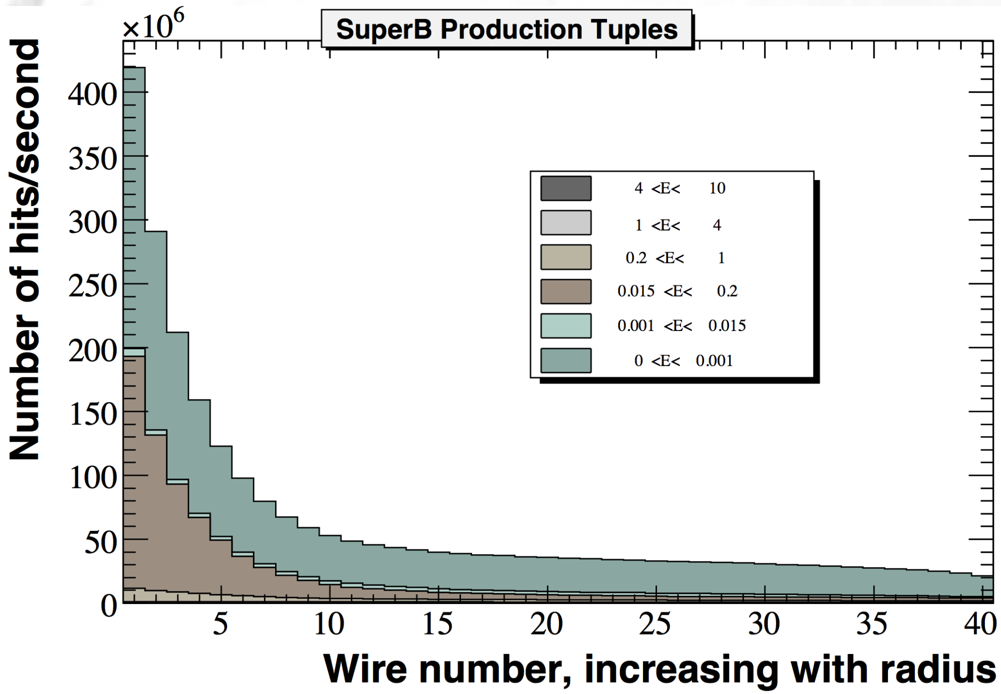
Unshielded, E>15MeV, Spherical EndPlate
sph:10 mm aluminum EP
thinEP: 5 mm
thickEP: 20 mm
copperEP: 10 mm copper EP

Unshielded, E>15MeV, Flat EndPlate
flat: Forward EP 175 cm from vertex
short: Forward EP 160 cm from vertex
long: Forward EP 190 cm from vertex

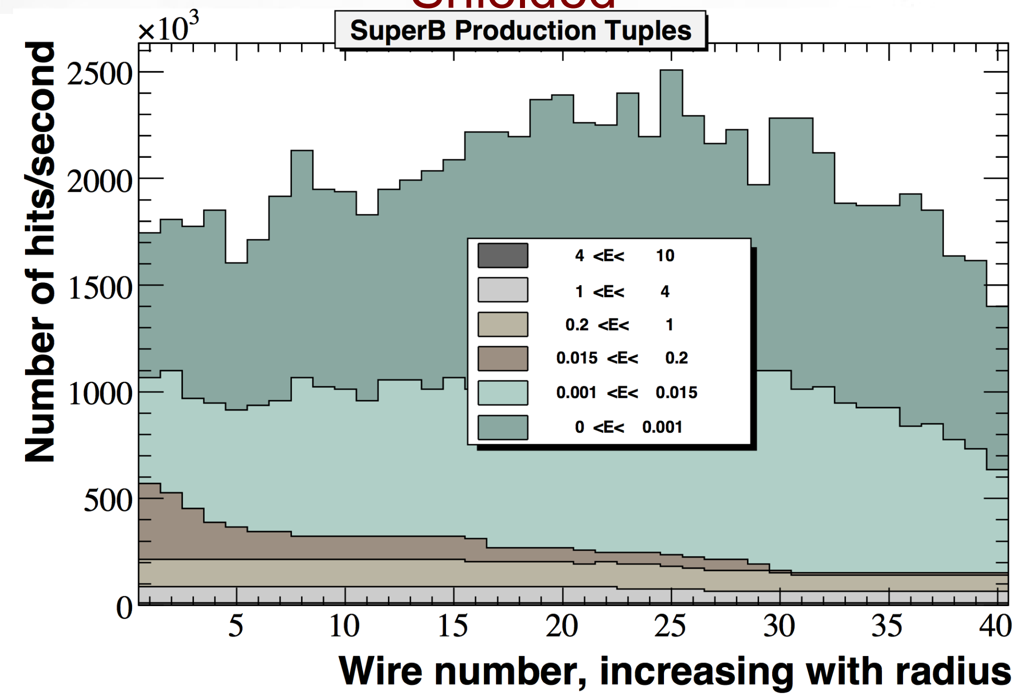
SuperB nTuple production - Bbbrem

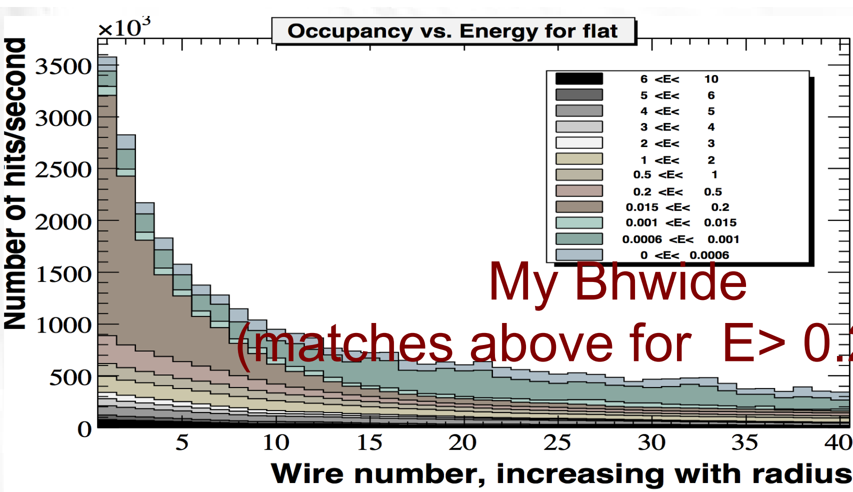
Using 20000 events

Unshielded

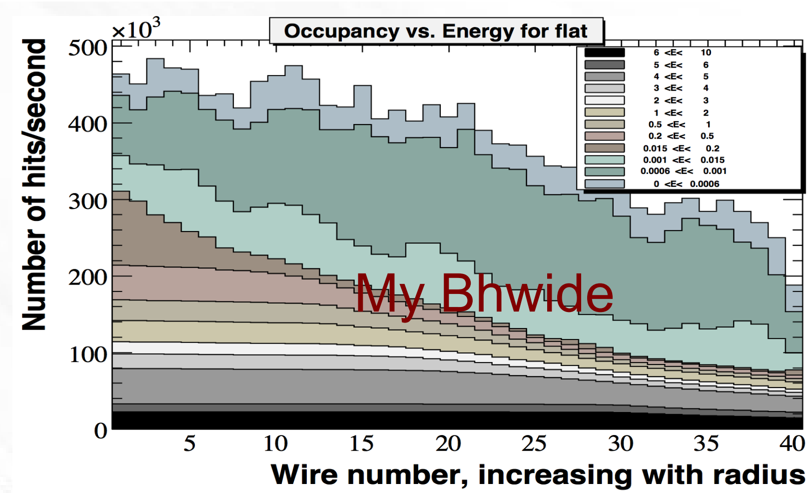


Shielded



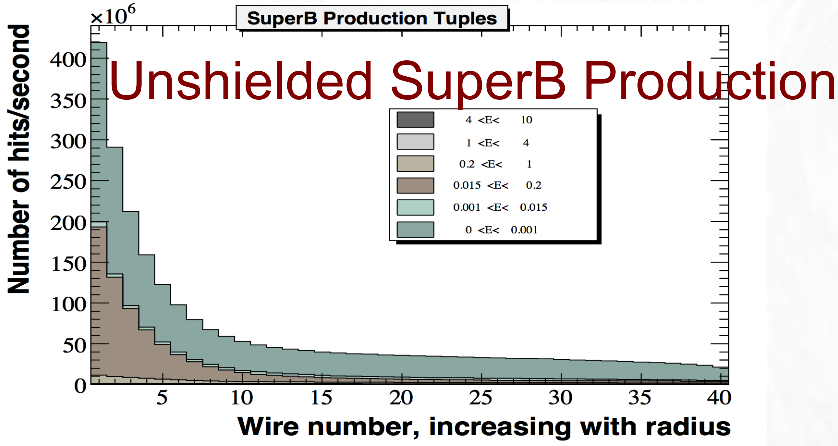


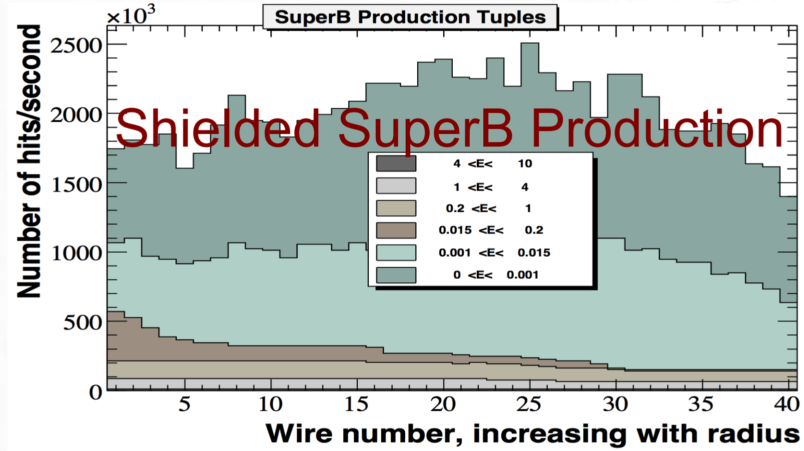
My Bhwide
(matches above for E> 0.2 GeV)

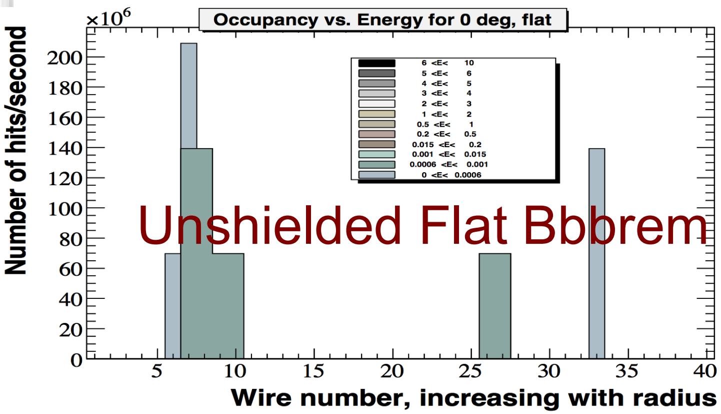


My Bhwide

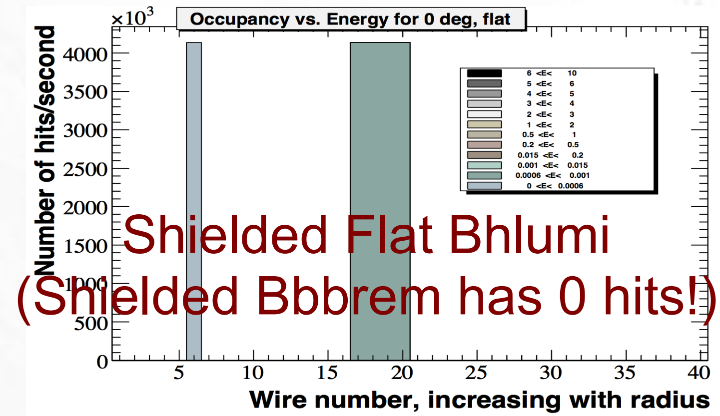
Bbbrem and Bhlumi

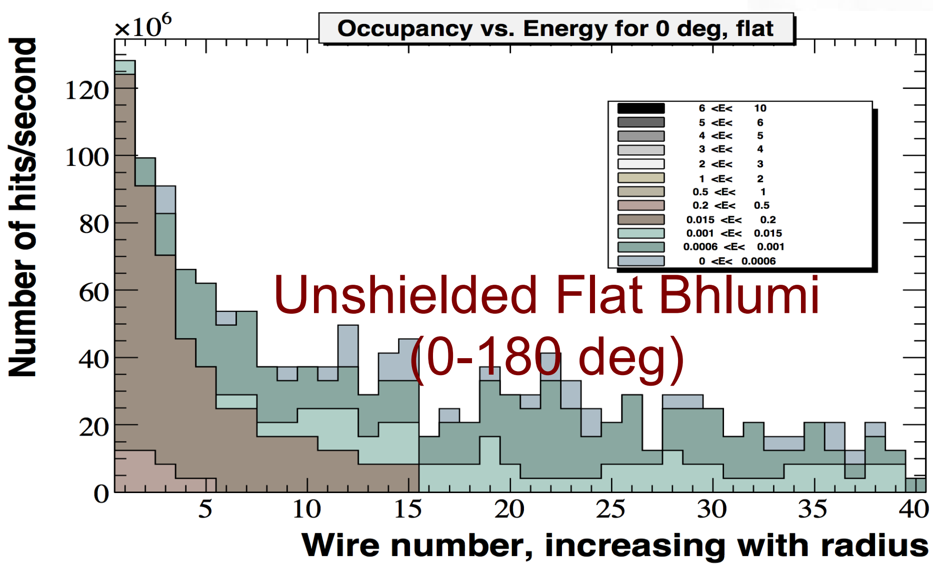


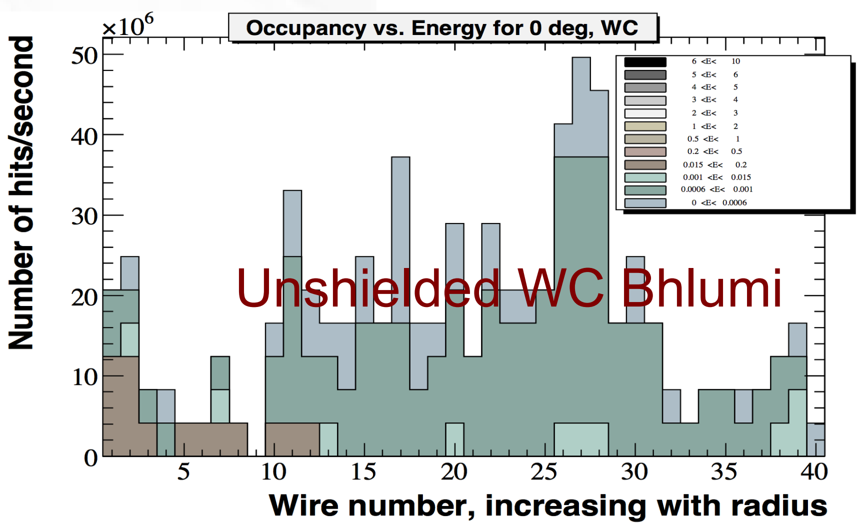




Using 10000 events





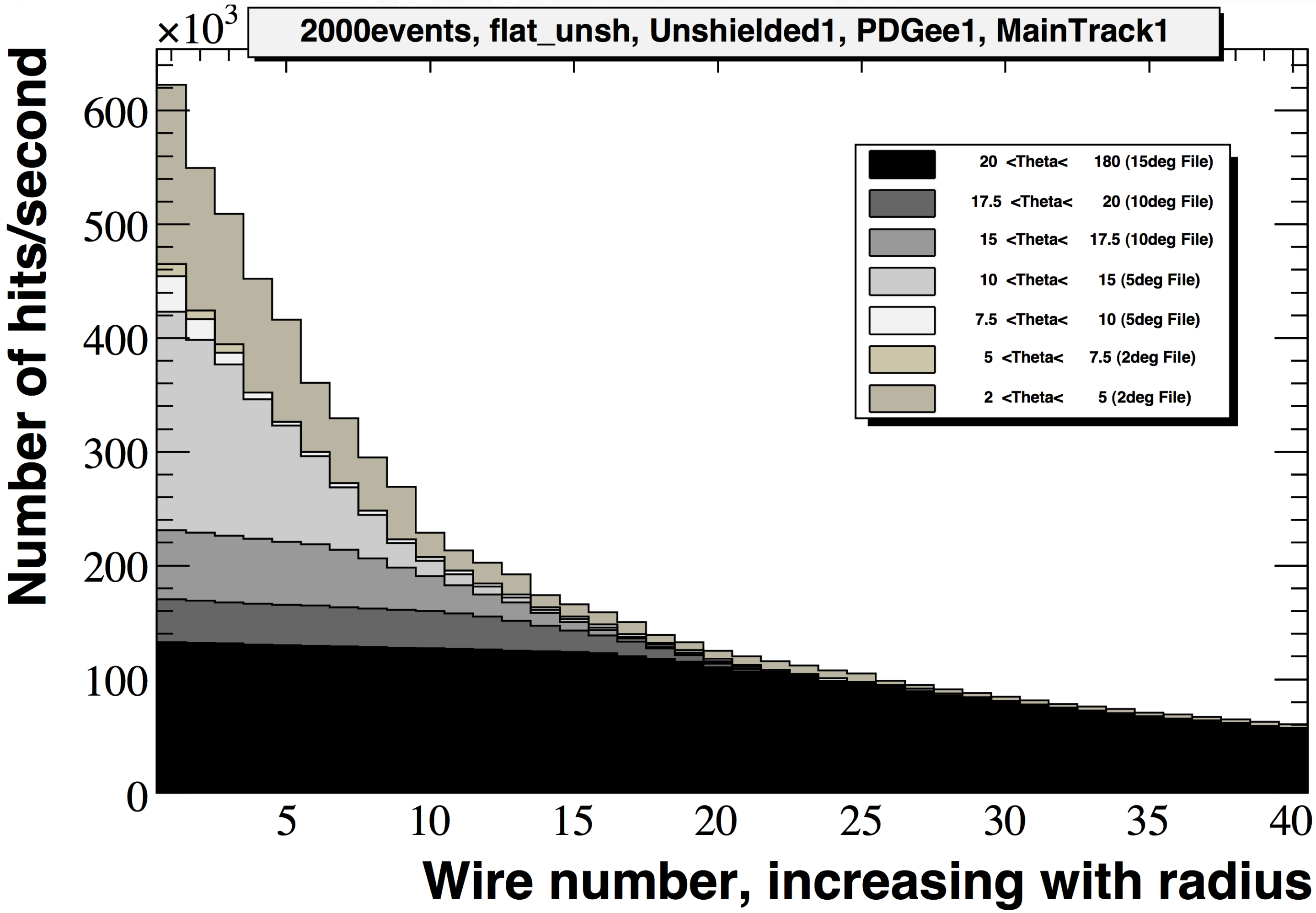


Conclusions

- The shield provides an effective reduction for low angle BhaBhas. Therefore, a WC chamber is not as necessary with a shield.
- The shield seems to be the cause of the low energy hits from unknown origin, contributing to an almost uniform increase in occupany, as well as the presence of neutrons.
- Bhwide, SuperB production tuples, and preliminary Bhlumi studies all agree that low-angle bhabhas produce the highest occupancies

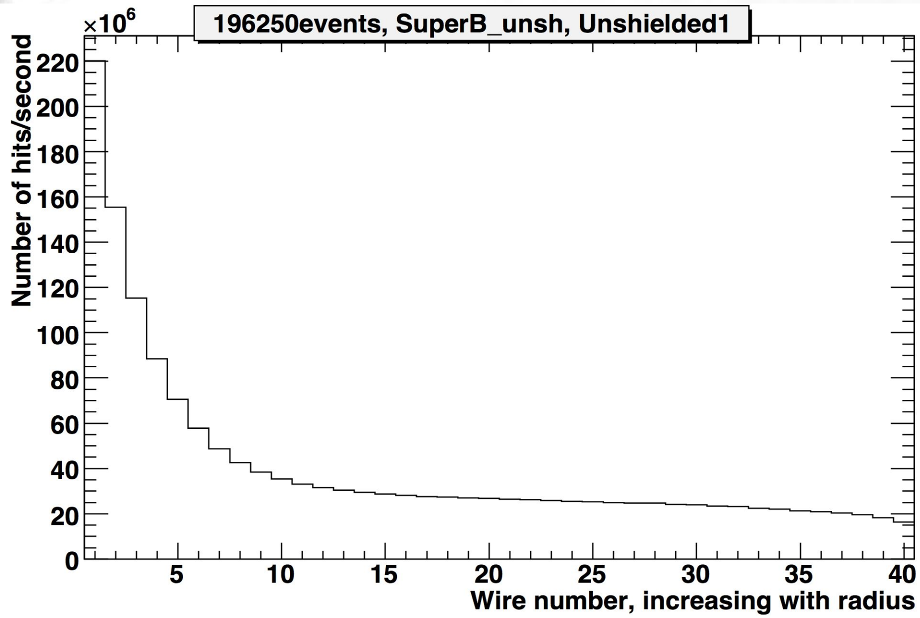
Backup Slides

Using outgoing e+e- BhaBhas only

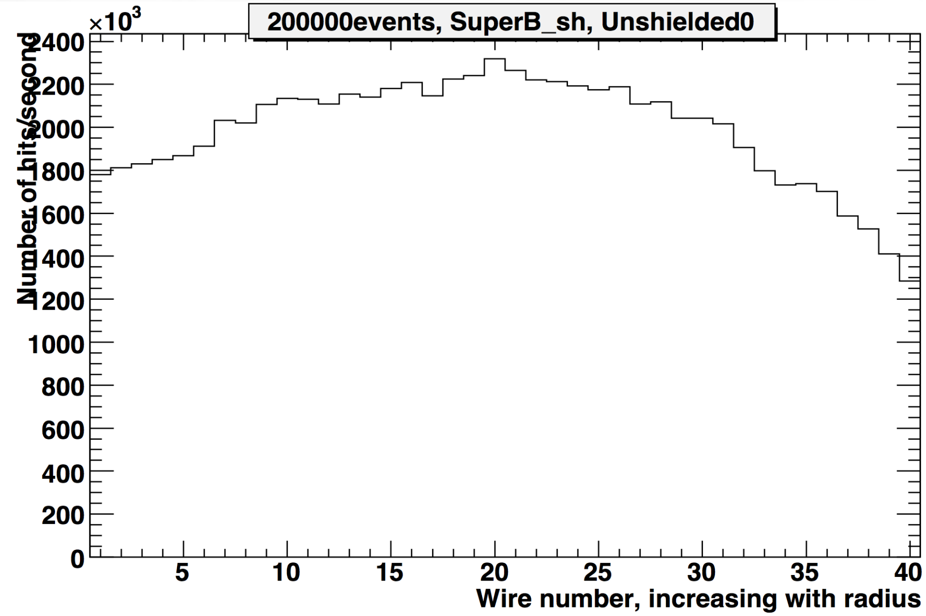


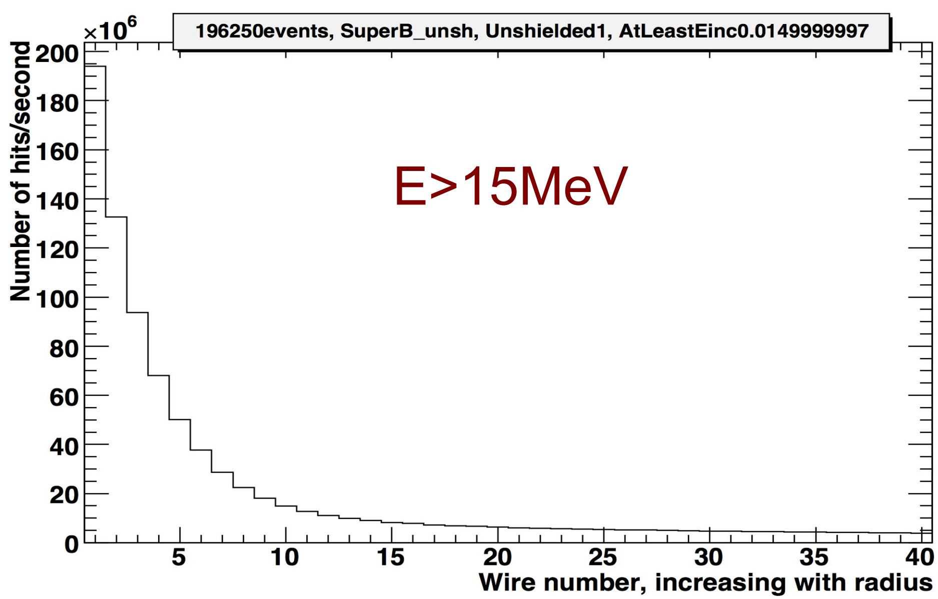
SuperB FULL production sample

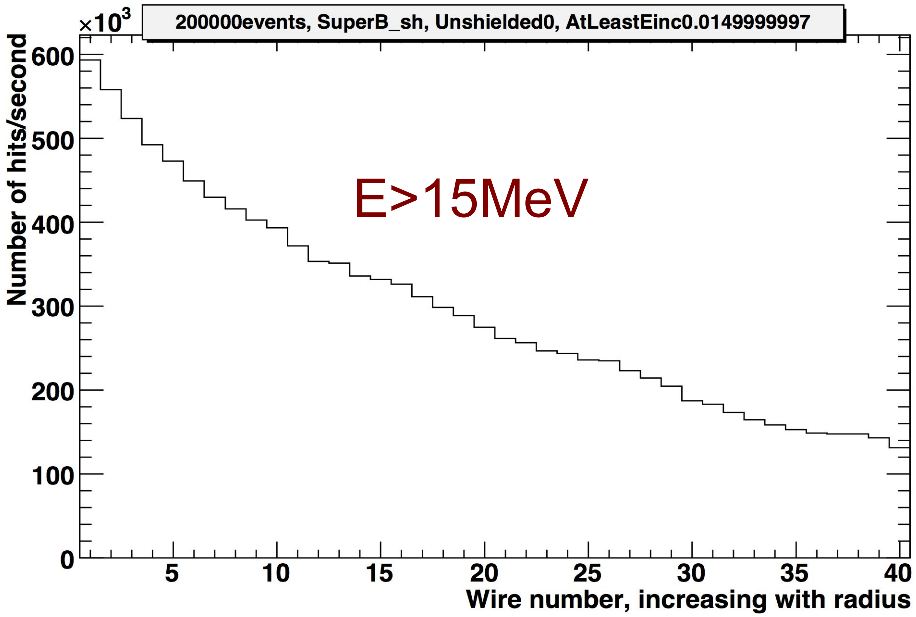
Unshielded



Shielded







Occupany vs. Angle