DCH:
Background studies

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[Presenting slides from R. Cenci, D. Lindemann, D. Swersky]

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BKG parallel session
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Production configuration

- Modified geometry from previous studies:
  - Additional Dch endplate to simulate electronics
  - Dirc and Bwd Cal added
- 5 configurations for Radiative Bhabha:
  - Default (DeltaE 10%), 200k evts
  - Unshielded, 200k evts
  - Lower DeltaE: 1%, 200k evts
  - Lower DeltaE: 0.2%, 200k evts
  - High precision neutron tracking, 100k evts (not so interesting for us)
- Note: Delta E is the minimum energy variation of the radiating particle

Background study details

- Dch structure
  - Minimum radius 24 cm (chamber starts at 23cm)
  - Cells 1.3x1.3 cm
  - Only Axial, Babar, SuperB layers structure
- Still no cut on cells accumulated energy
- Important issue
  - for this production the Geant step size has not been limited in DCH volumes
  - A single step can go across two cells or more, under-estimation of rate
  - But average step is small 2.6cm, with few cases of 1m step and more
  - Results should be corrected, more later

NOT REALISTIC: CAN CAUSE PROBLEMS

ONLY edep>0 IS APPLIED

DCH configurations

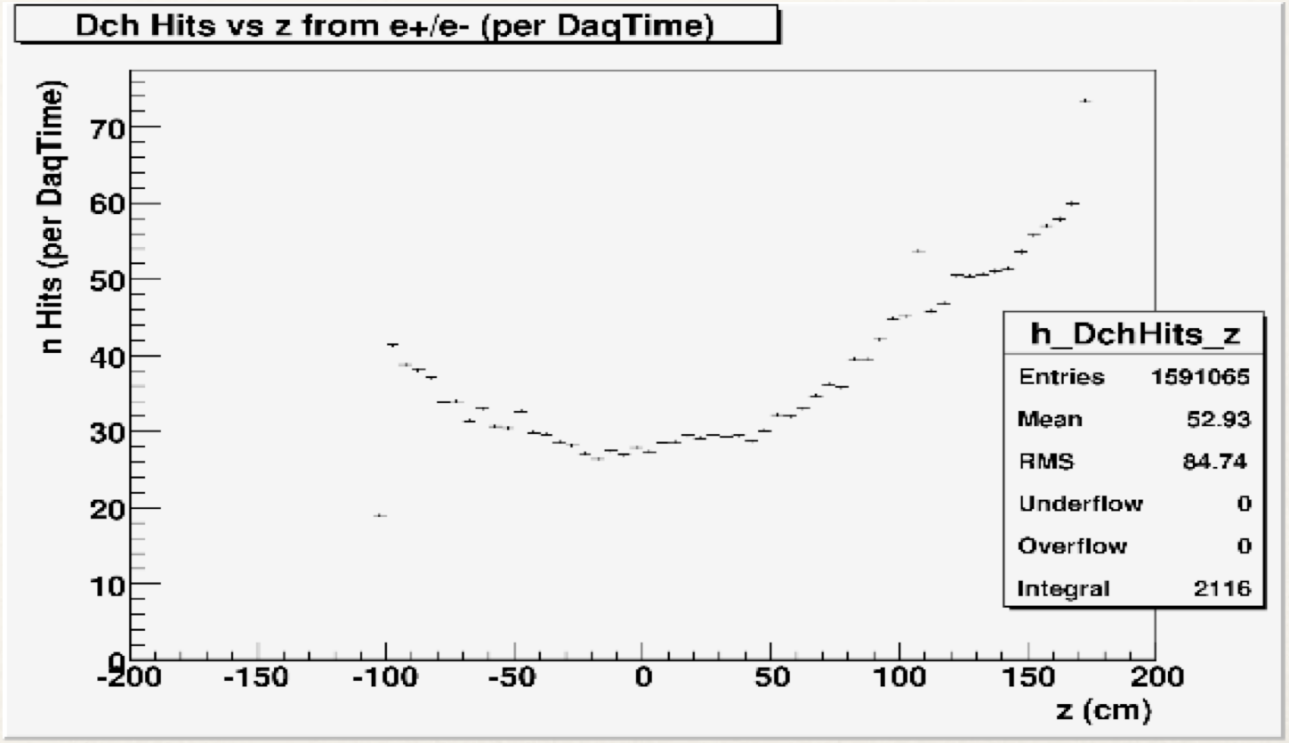
- **Dch cell configuration**:
  - Inner radius: **24 cm**, Outer radius: **80.5cm**
  - 1.3 (r) x 1.3 (phi) cm, cell size
  - Superlayer made by 4 layers
  - 10 superlayers (spaced 0.5 cm), **~10k cells**
  - Cells are not staggered
- **Superlayer configuration**
  - **Axial only** version
    - AAA AAA AAA A
  - **Babar** version
    - AUV AUV AUV A
  - **SuperB** version
    - A UV UV UV UV A
- Stereo angles like Babar

BaBar NIM paper

SL	# of Cells	Radius (mm)	Width (mm)	Angle (mrad)
1	96	260.4	17.0-19.4	0
2	112	312.4	17.5-19.5	45-50
3	128	363.4	17.8-19.6	-(52-57)
4	144	422.7	18.4-20.0	0
5	176	476.6	16.9-18.2	56-60
6	192	526.1	17.2-18.3	-(63-57)
7	208	585.4	17.7-18.8	0
8	224	636.7	17.8-18.8	65-69
9	240	688.0	18.0-18.9	-(72-76)
10	256	747.2	18.3-19.2	0

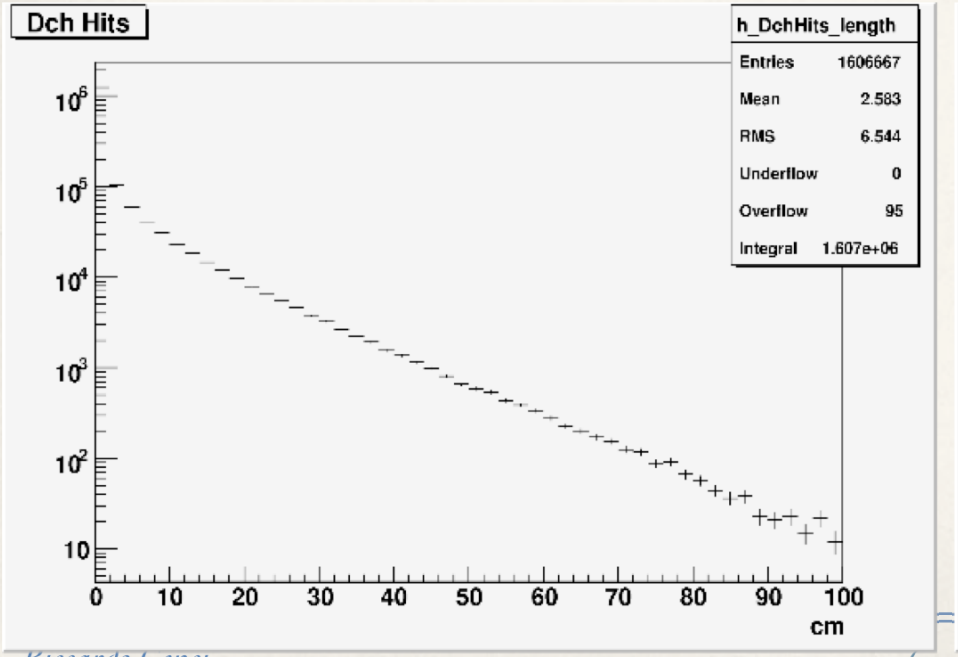
Hits distribution (z coordinate)

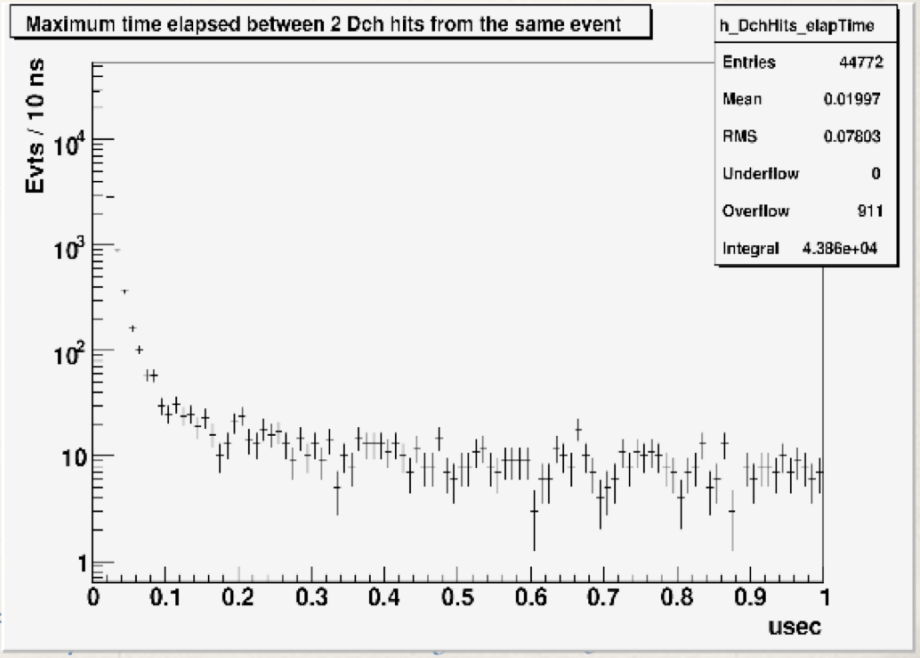
- Note: those are Geant4 hits
- Z distribution confirms that most part of the hits is coming from the endplates



Hits distribution (step length, elap time)

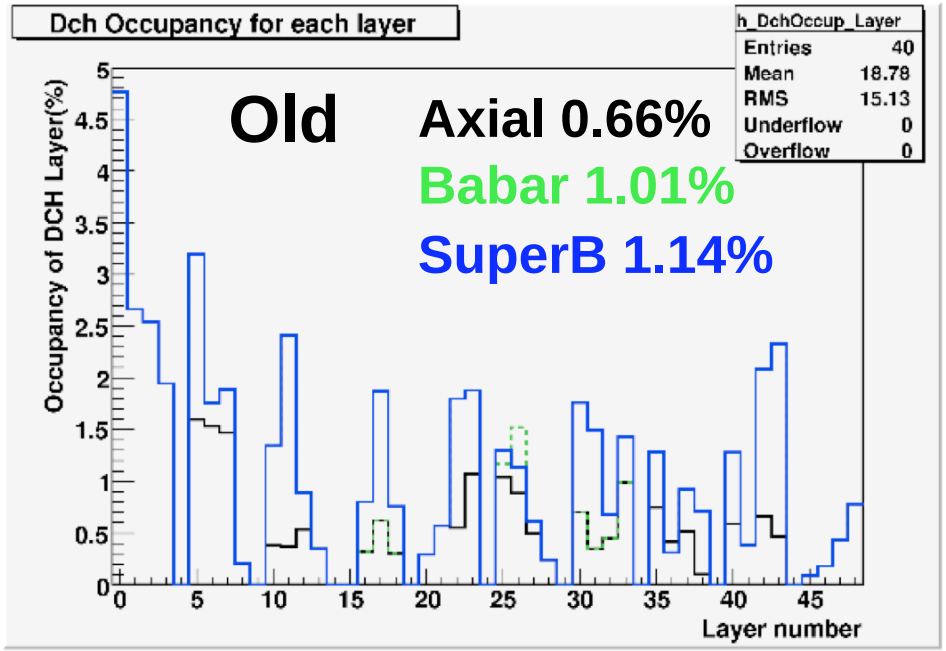
- 80% of the hits has a step length of less than 2cm, mean value is 2.6cm
- ElapTime = The max time between two dch hits in the same evt is less than 50ns for 95% of evts
- Effects from hits from other bunch-crossings in the same daq time are negligible



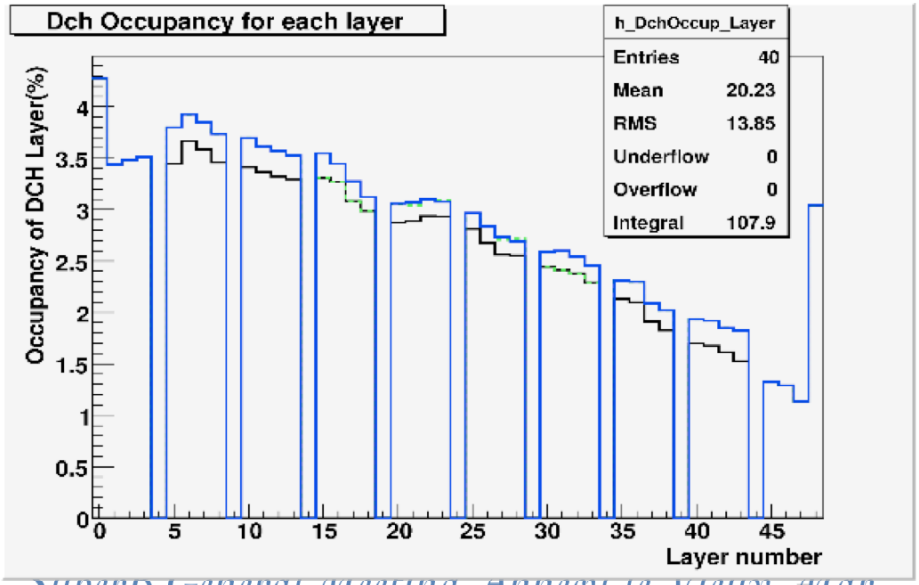


Occupancy

- Higher stat, total occupancy: **2.5%** with RMS ~0.6%
- New results not exactly compatible with old ones
- Again stereo layers does not make so much difference for bkg, less than 0.5%
  - Maybe related to step size issue



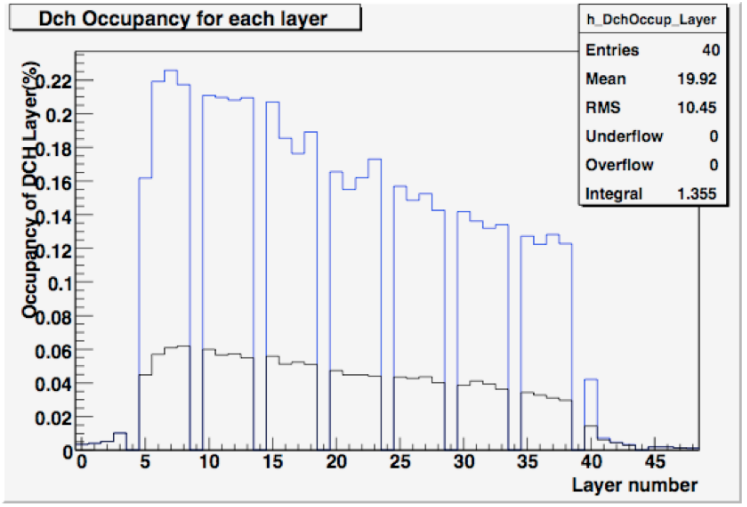
Axial 2.48%
Babar 2.60%
SuperB 2.64%



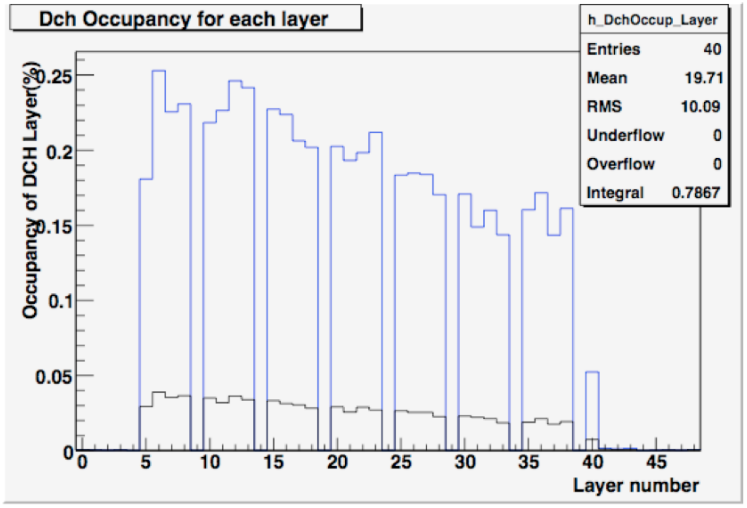
Additional test on stereo algorythm

- Single electron along z through the whole chamber

- Step limit matters here:
  - No G4 step limit, stereo layers increase occupancy a factor 3/3.5x (Babar/SuperB config)
  - Step limit at 0.5cm, increase factor 5.4x / 7.1x, better agreement with Giuseppe rough estimation (9x)



noStep limit



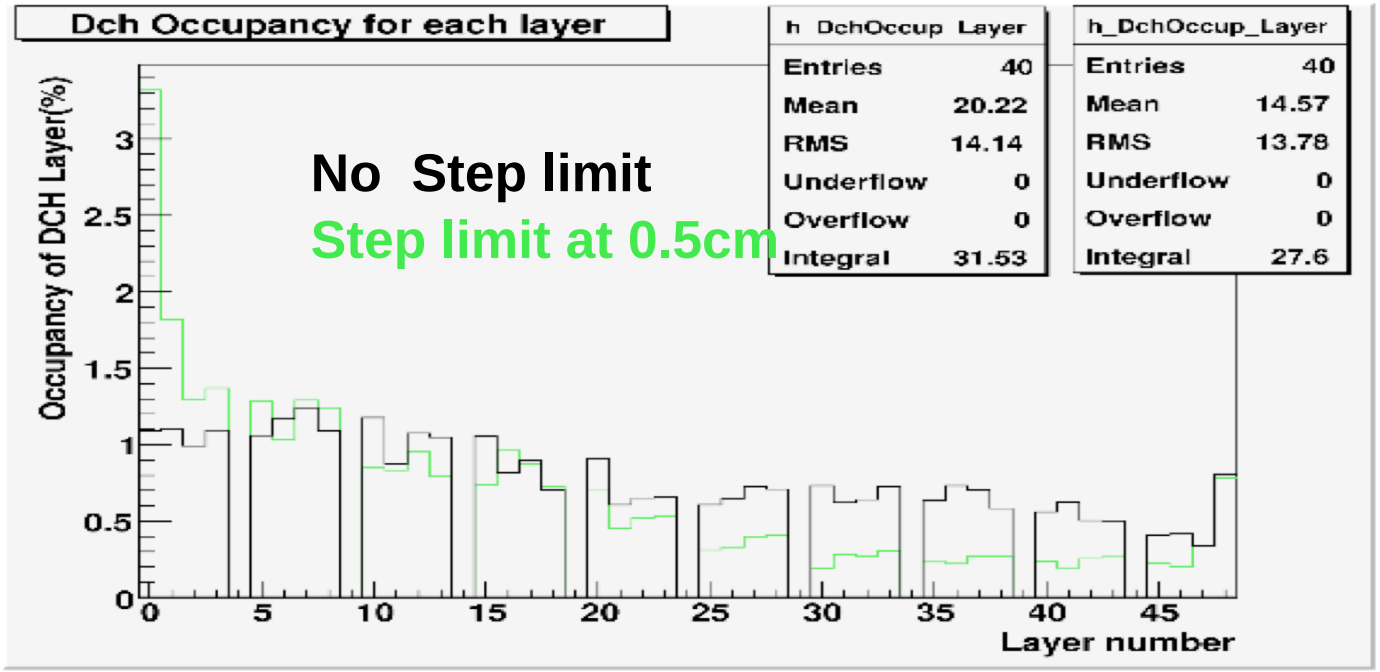
Step limit 0.5cm

Other configurations

- Unshielded (more a test than a real option)
  - Occupancy up to 31.4±1.4%, really not feasible
- Lower DeltaE minimum
  - DeltaE >5%, Occup 2.48% -> 2.54%
  - DeltaE >0.2%, Occup 2.48% -> 2.82%
  - Small differences
- High precision for neutrons
  - Negligible differences, Occup 2.48% -> 2.50%

2photons (aka Pairs) bkg

- I simulate again with the new geometry the 2photons bkg (40k evts)
- I tried to understand any difference using different step size
- Weird difference, total occupancy is similar anyway
- Excess on first layers is understood: w/o step limit you have hits with long step starting on chamber wall not assigned to right cells



Conclusions

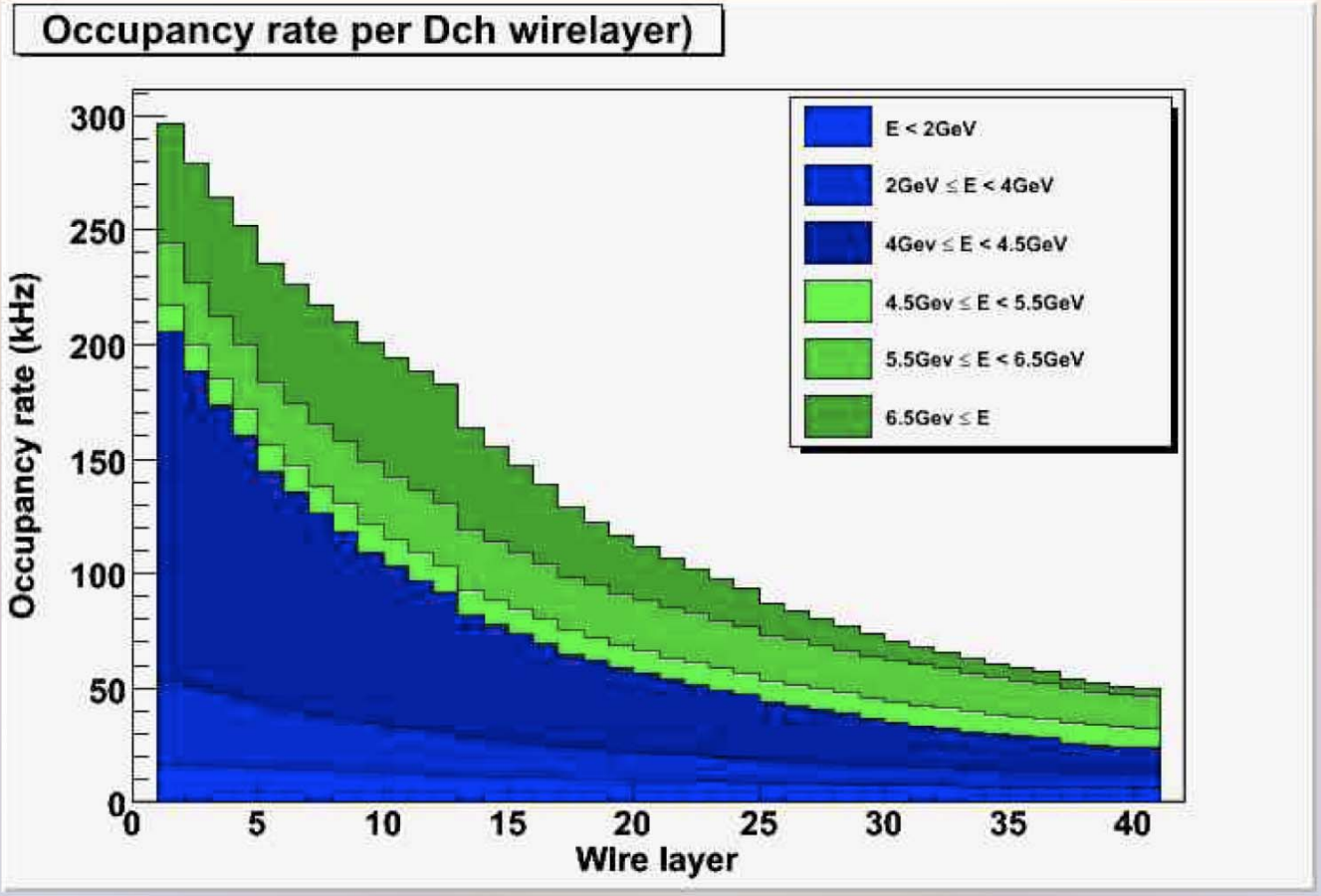
- Production allows us to have statistically significant plots for RadBhaBha bkg [WRT PREVIOUS ESTIMATES]
- Significant increase in occupancy, still not yet understood
- Step size issue, need to be fixed. Better add more information on Dch hits, than limiting the step size (cpu time consuming)

Large angle Bhabha rate estimates (with BHLUMI)

Darren Swersky

“Large angle Bhabhas”, FastSim

Baseline Geometry: Occupancy Rates



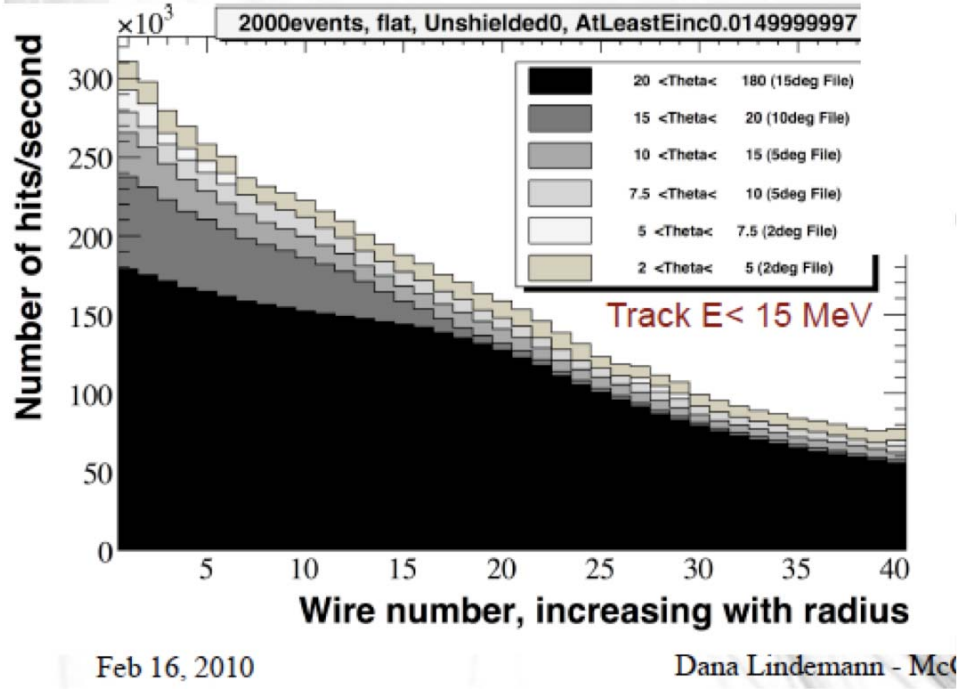
Dana Linemann

“Large angle Bhabhas”, FullSim

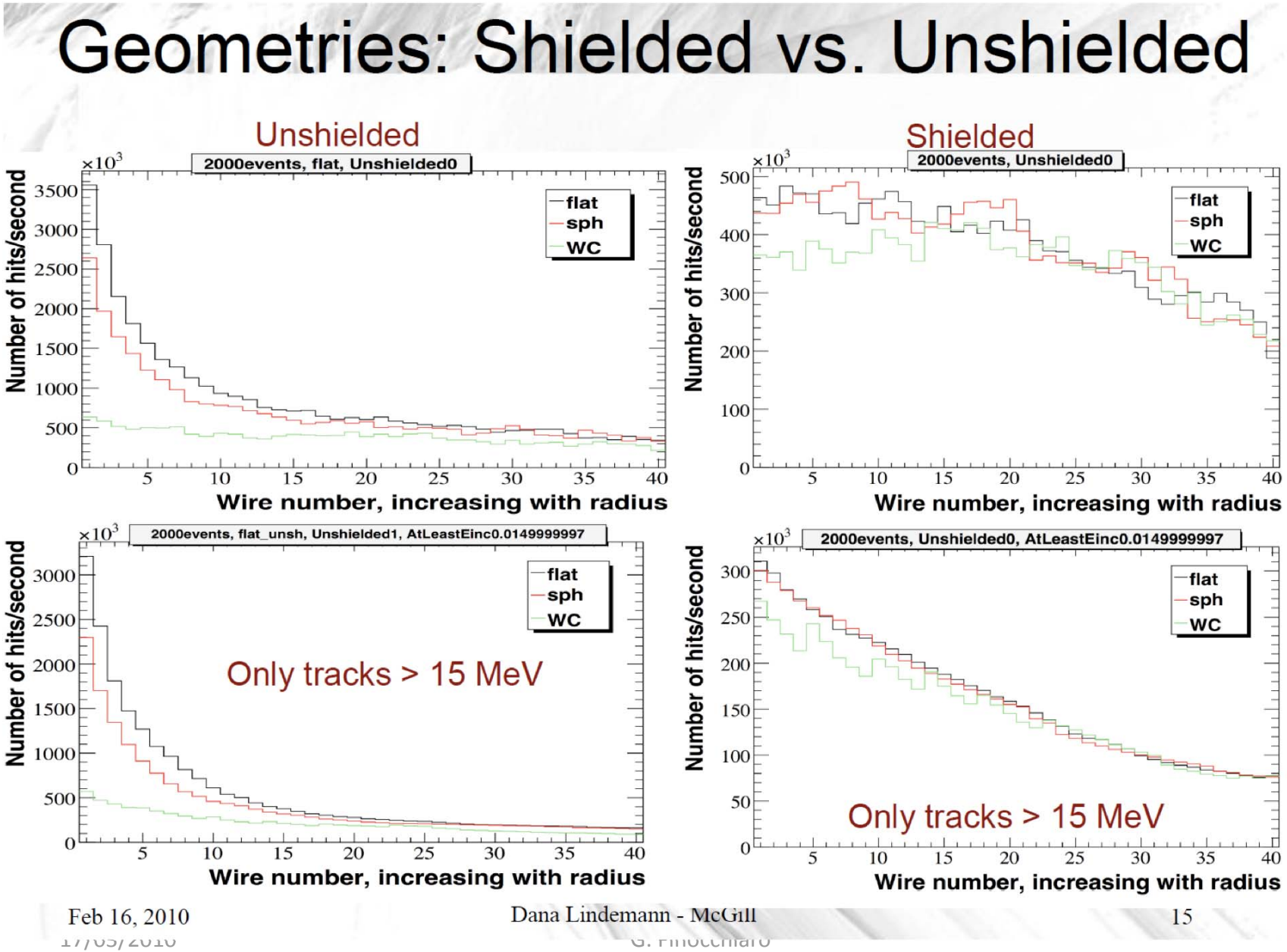
Cross-sections from Bhwide:

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

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



“Large angle Bhabhas, FullSIm



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

Summary

- No firm conclusion yet
- Some indications however:
  - Small angle bhabha's (SAB) cause larger bkg rates than LAB's
    - "2 photon" also smaller than SAB
  - The DCH (as other detectors) benefits from a well designed shield
    - crucial to make sure that no harmful background is created by the shields themselves
  - probably the shields can save us the complications of tapered endplates (to be confirmed)