Status of MAPS intrinsic response simulation

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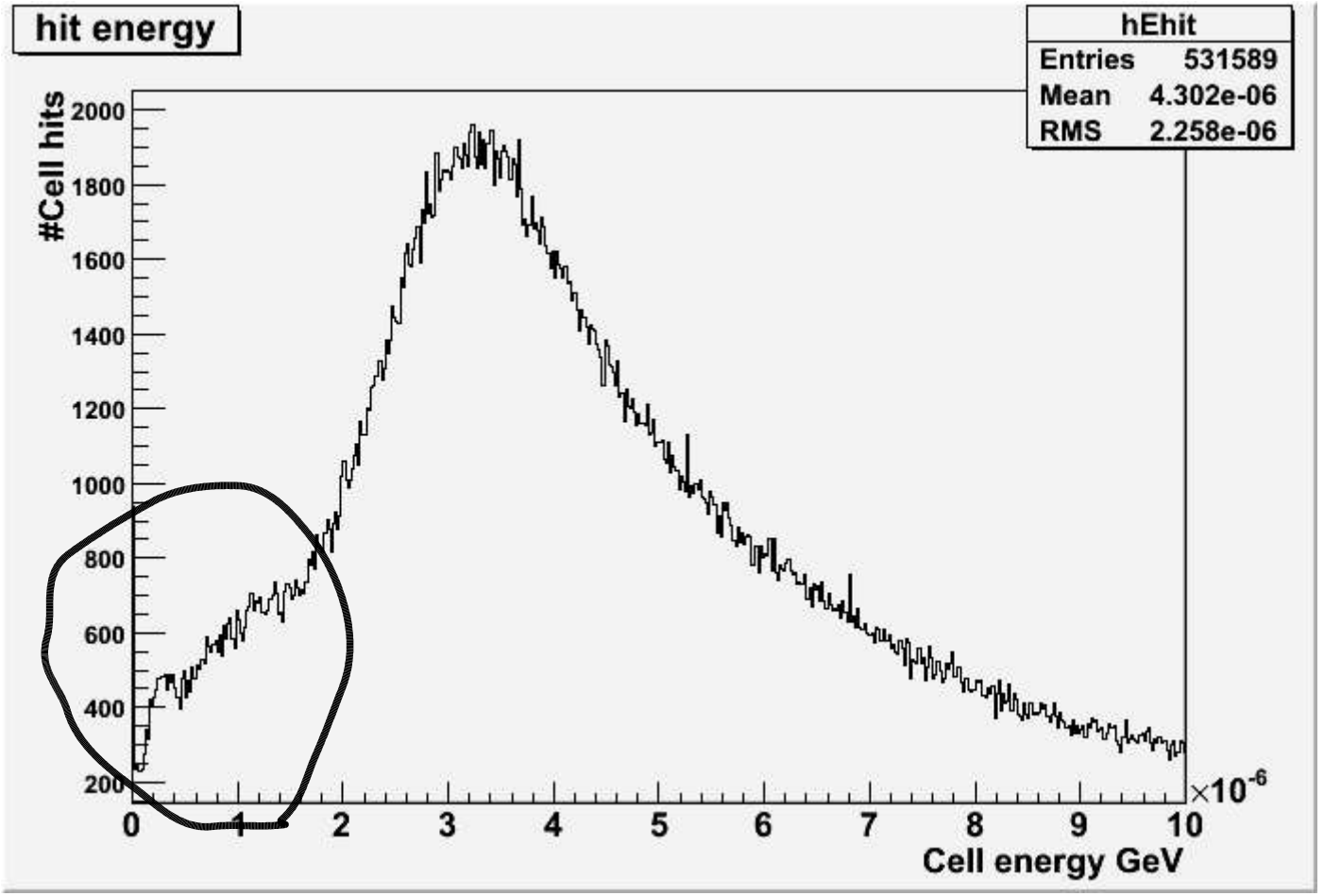
Cell hit energy distributions (1GeV photon)

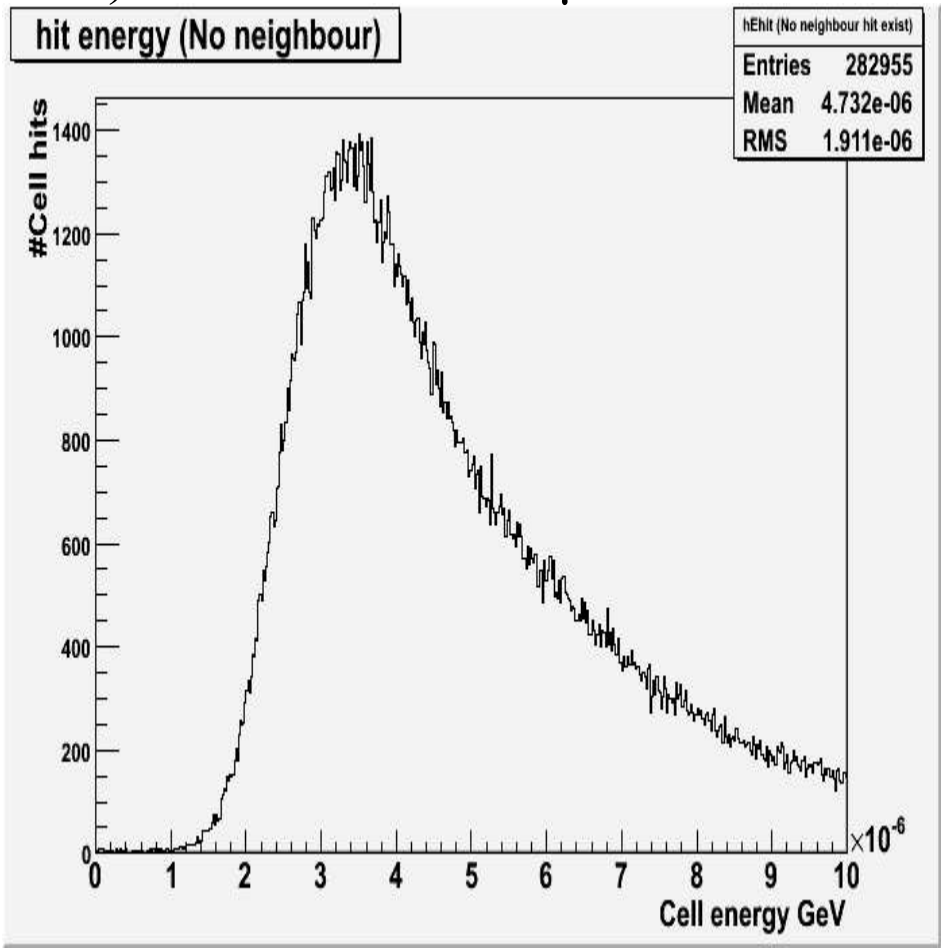
50μmX50μmX15μm



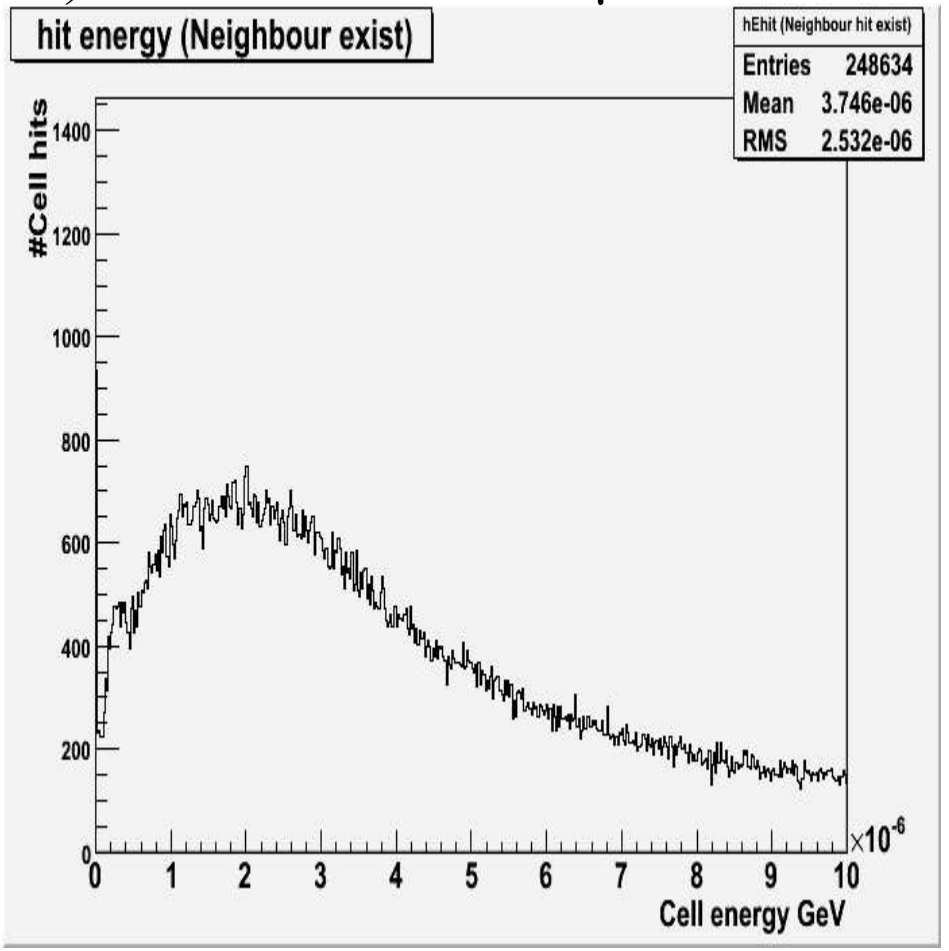
Please see next two slides

Cell hit energy distributions (1GeV photon)

1) No hit within 80μm distance



2) Hit exists within 80μm distance



The ~2keV lower energy bump was due to MIPs crossing cell boundary.

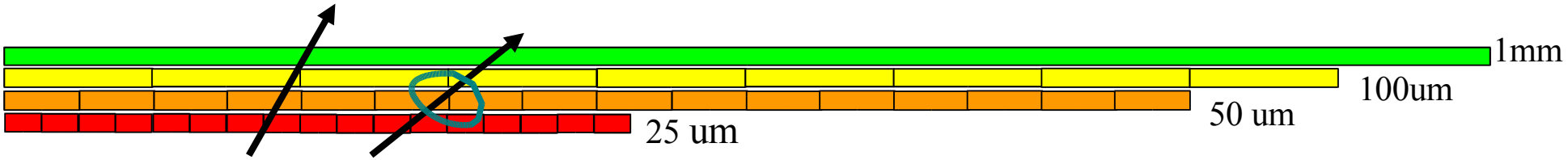
Lower energy bump components

1) Cell boundary physical effect

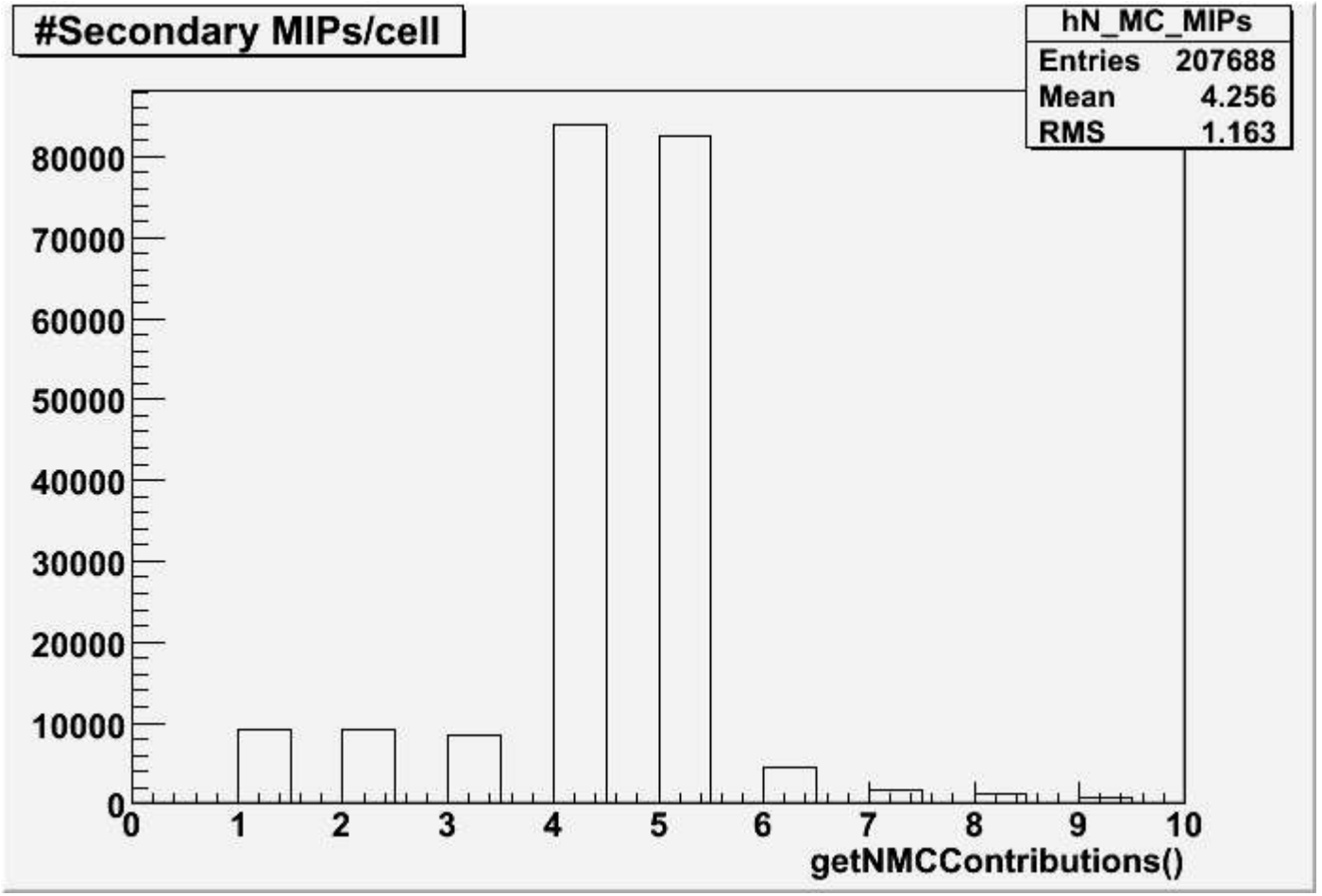
2) Geant4 effect in small cell like 5μmX5μm

1) When a MIP pass through cell boundary with angle effect, the pass length are shared by two (or more) cells. Although total pass length of one MIP is longer than a less angle case, the pass length in one cell is shorter. It has lower peak in energy deposit.

2) Geant4 has a bug or a limit in smaller cell size like 5μmx5μm. (Probably it is related in cell boundary.)

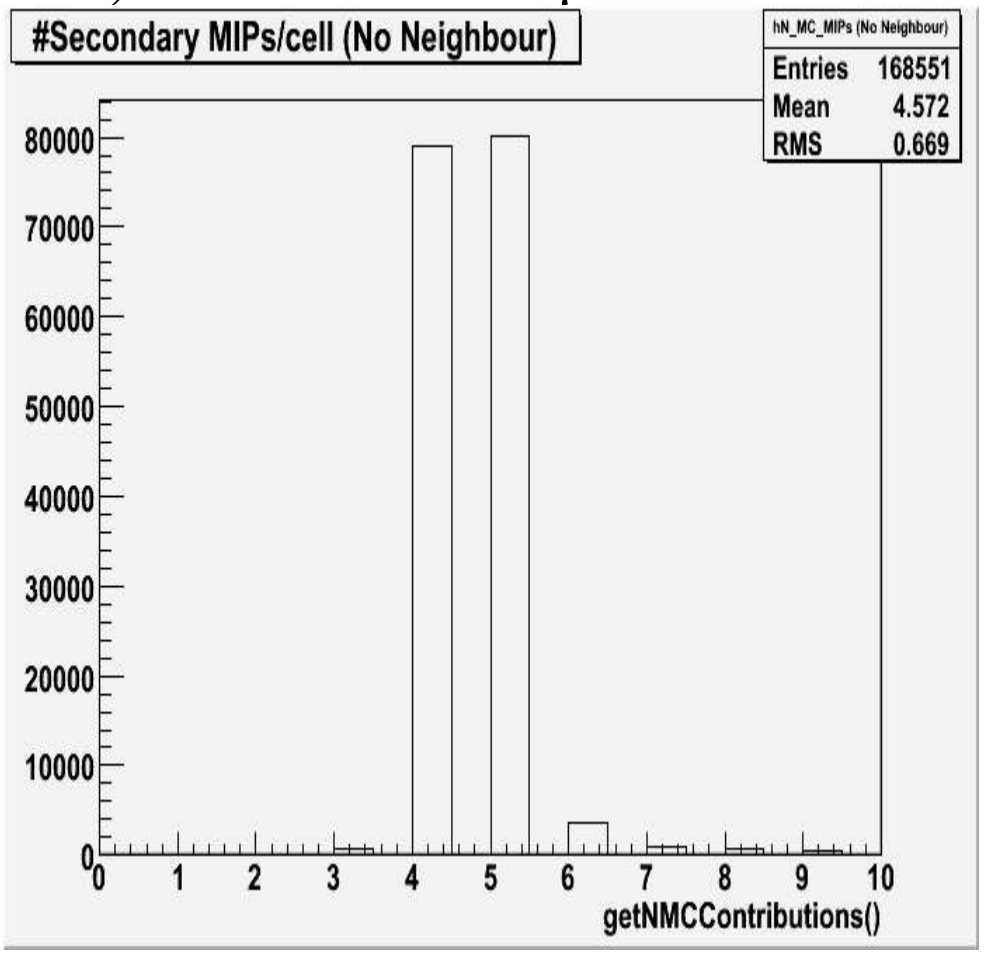


"getNMCContributions()" output (20GeV muon)

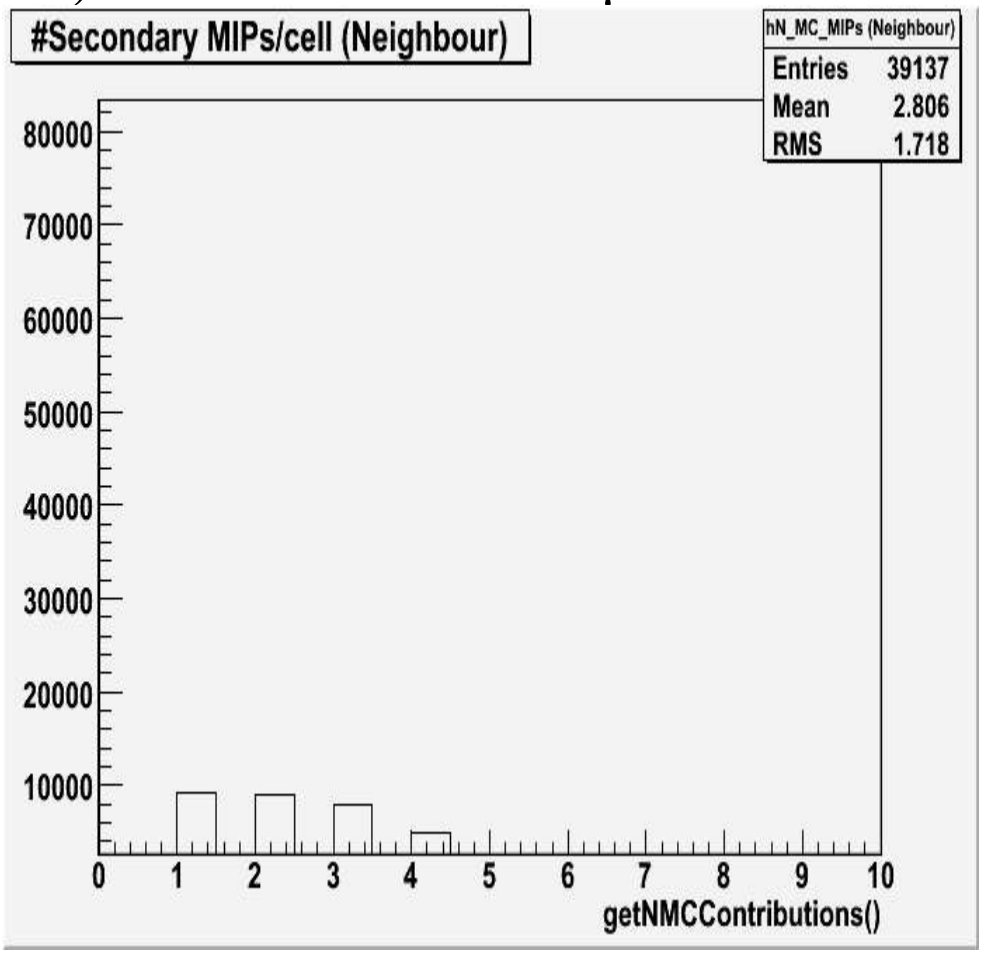


"getNMCContributions()" output (20GeV muon)

1) No hit within 80μm distance



2) Hit exists within 80μm distance



- The 4~5 peak was happening when there is no neighbour hits.
- **This 4~5 peak can be seen in muon as well. -> This is MIP response.**
- **Step size of actions is most likely to explain this.**

Sensitive Bulk options

1) Current style

i.e. MAPS vs Default Diode with different MC samples

- Merit: Already available and simple
- Demerit: Consuming CPU time, Disk space and book keepings

2) Simple bulk sensitive style

i.e. MAPS + Bulk diode in the same MC sample

- Merit: Exactly the same MC sample
- Demerits: -Need two drivers for two sensitive sensors with different cell size.

-Complicated comparison between MAPS [12μm+288μm(insensitive)] and bulk [12μm(insensitive)+288μm] in Si thickness.

3) Advanced style

i.e. MAPS + (Sum of MAPS 1cmX1cm + Bulk) diode in the same MC sample

- Merit: -Exactly the same MC sample.

  -Realistic comparison between [12μm+288μm(insensitive)] and 300μm in thickness.
- Demerit:-Need two drivers for two sensitive sensors with different cell size.

-Need correlation between MAPS (x,y) and Bulk (x,y) in global coordinate.

Note: Even the advanced style, different MIPs are running between MAPS region and bulk region -> Only statistical comparison is meaningful.
-> Physics comparison is similar with current style.

Summary

- Lower energy bump in 50µmX50µm cell is understood.
- The 4~5 hits in getNMCContribution() output is MIP response.
- Making bulk sensitive has some possible options.

Next steps

- Plot of #Secondary particle/cell

(Need to use Frank's MAPS lcio version which stores each momentum of MIP)

- Understanding Geant4 cell boundary effects in 5µmX5µm
- Making bulk sensitive simultaneously with MAPS ?

(Modifying code is possible but it will take time to confirm everything is fine.)

- Using Anne-Marie's latest digiMAPS
- Linearity and resolutions for each step and full digitization