MAPS Geometry Simulation

30th March 2006, MAPS meeting at RAL

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Introduction

- We tested Si sensitive thickness modification.
  - Default: 0.500 mm, MAPS: 0.015 mm (3.0%)
  - Ecal02.cc (driver of TESLA simulation) was modified.
  - Secal01.cc (super driver of Ecal02.cc) wasn't modified. (see slides page 3,4)
  - We implemented Non-sensitive Si volume. (0.485 mm thickness)
  - We studied Energy deposit distribution for single electron to make comparison.

Default Software

- Ecal02.cc (default in Mokka-05-05)
  - Si Sensitive thickness is input value from steering file.
  - Si Physical thickness is equal with Sensitive thickness.
  - Alveolus is defined with 2 PCB + 1 Si Sensitive.
  - PCB thickness is defined in super driver SEcal01.cc as (alveolus_thickness - si_thickness) / 2.
  - Default values: alveolus_ thickness= 2.1 mm,
    si_ thickness= 0.5 mm,
    pcb_thickness is not input value.

MAPS Software Modification

- Ecal02.cc (MAPS)

  - Si Physical thickness is input from steering file.

  - Si Sensitive thickness is fixed as 0.015 mm in code.

  - Si Non-sensitive volume was implemented with (Physical_thickness - 0.015 mm) in code.

  - Secal01.cc (super driver of Ecal02.cc) wasn't modified because still the PCB thickness definition is valid. pcb_thickness = (alveolus_thickness - si_thickness) / 2.
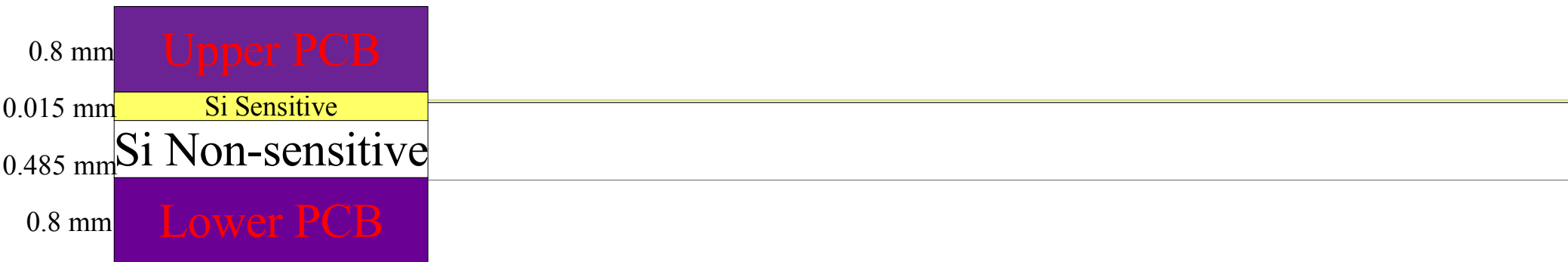
Physical thickness

Geometry Comparison

Default

0.8 mm	Upper PCB
0.5 mm	Si Sensitive
0.8 mm	Lower PCB

MAPS

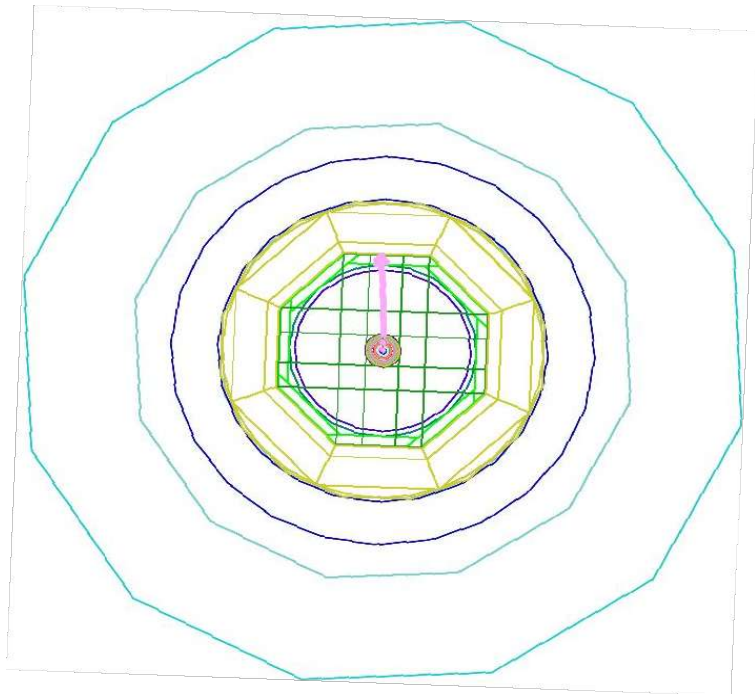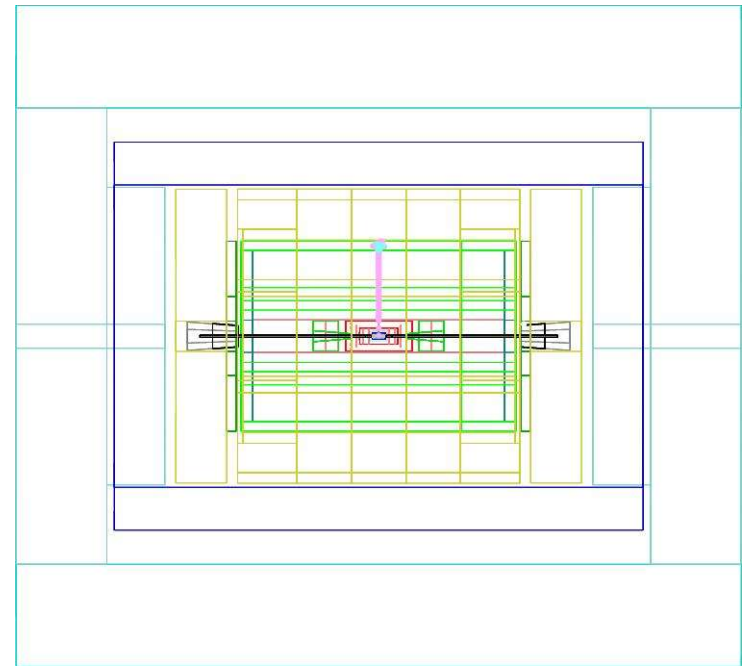|	
0.8 mm	Upper PCB
0.015 mm	Si Sensitive
0.485 mm	Si Non-sensitive
0.8 mm	Lower PCB

Geant4 Adaptive GUI (GAG) output distributions looks fine.

Test Simulation Event

- We used following parameters for test simulation.

  - /gun/energy   20 GeV
  - /gun/particle   e-
  - /gun/position   0   0   0
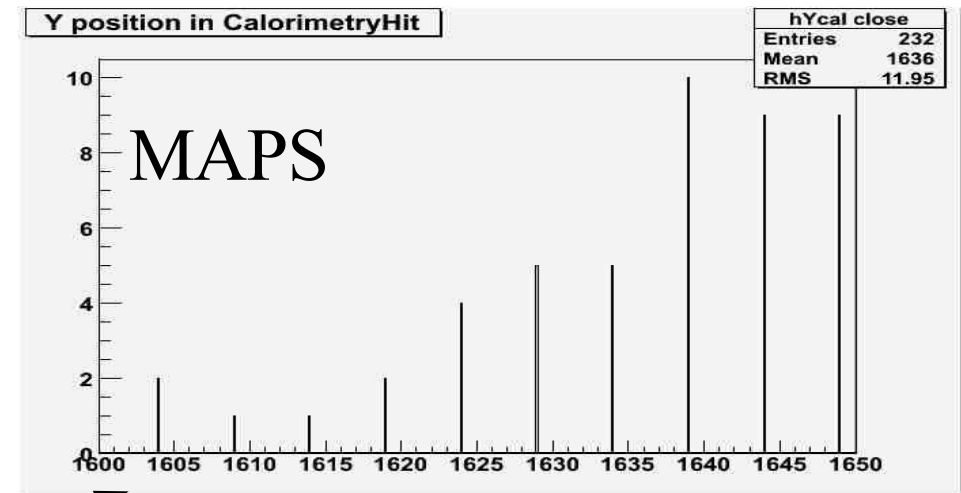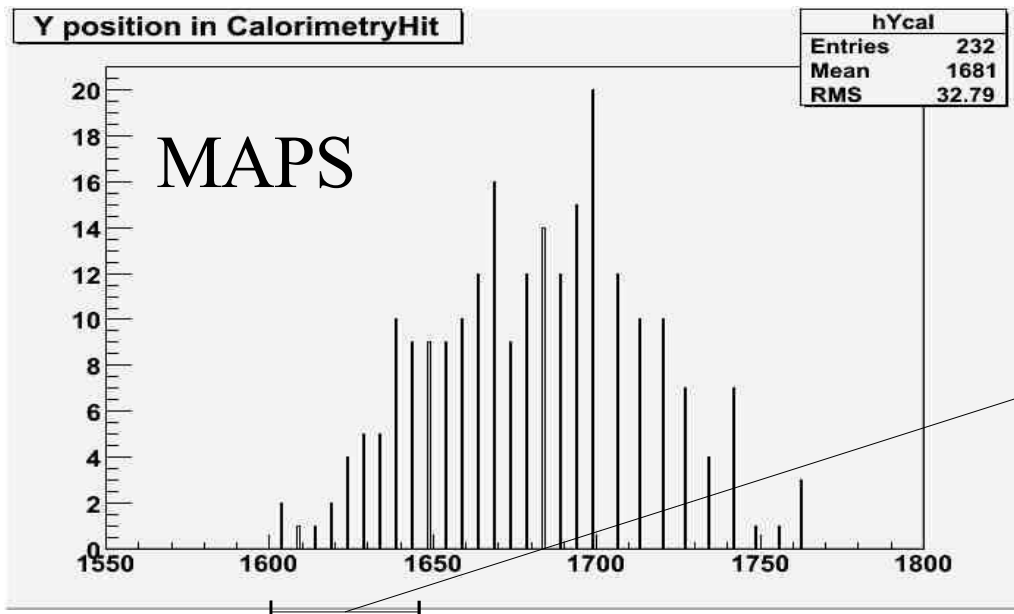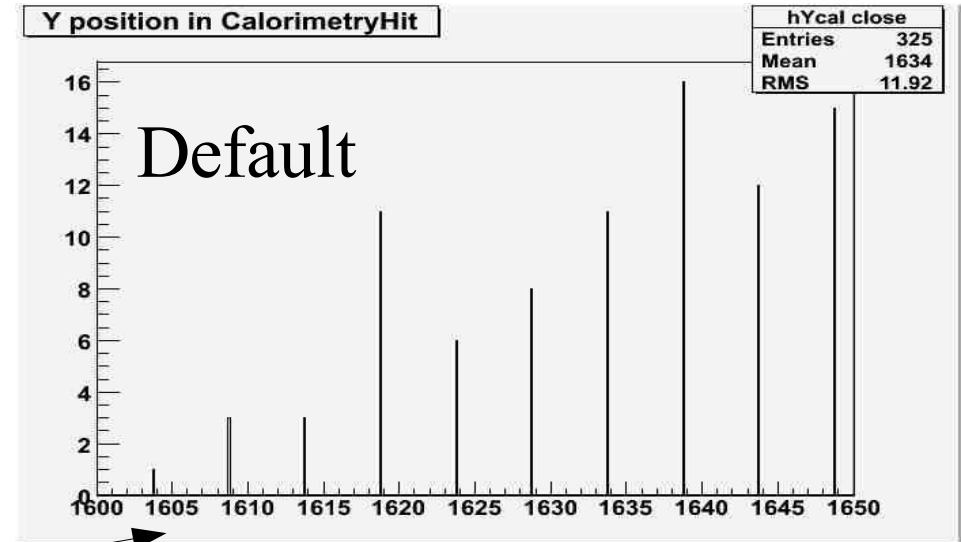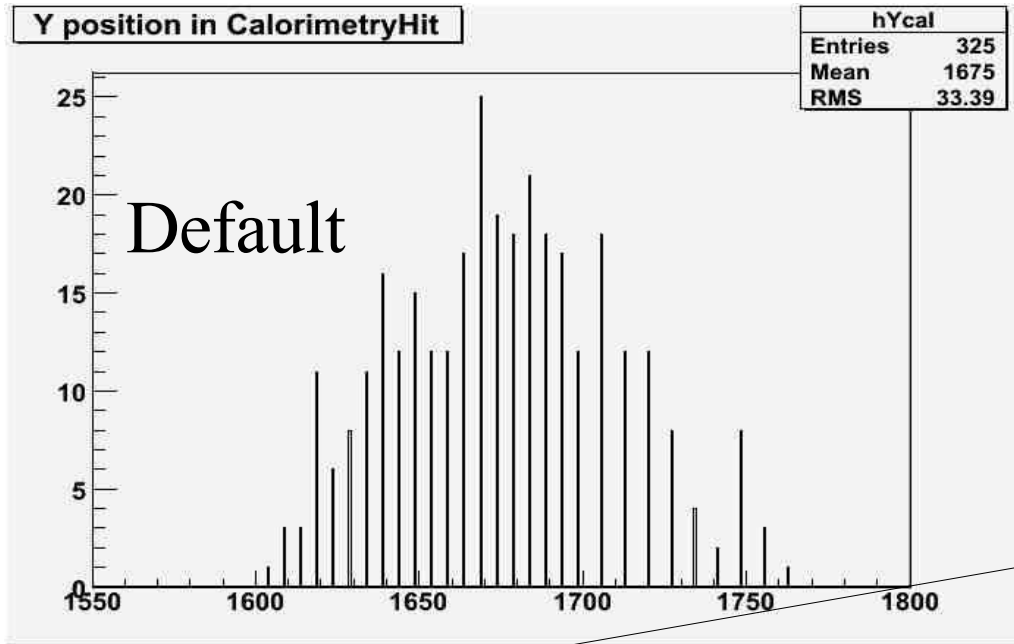 - /gun/direction   0.   1.   0.

y

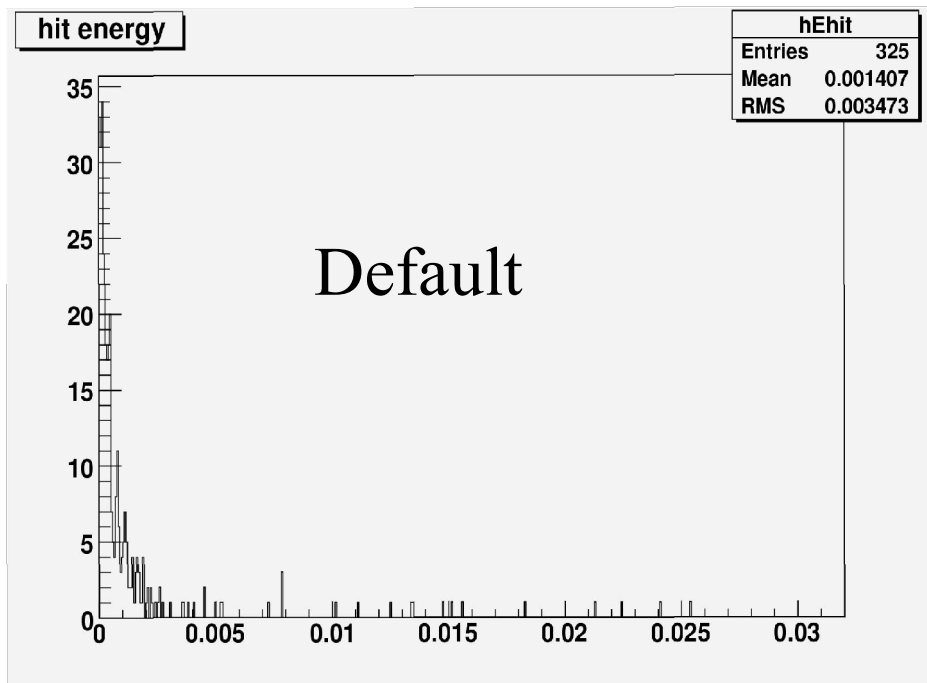Only barrel top sector has hits.
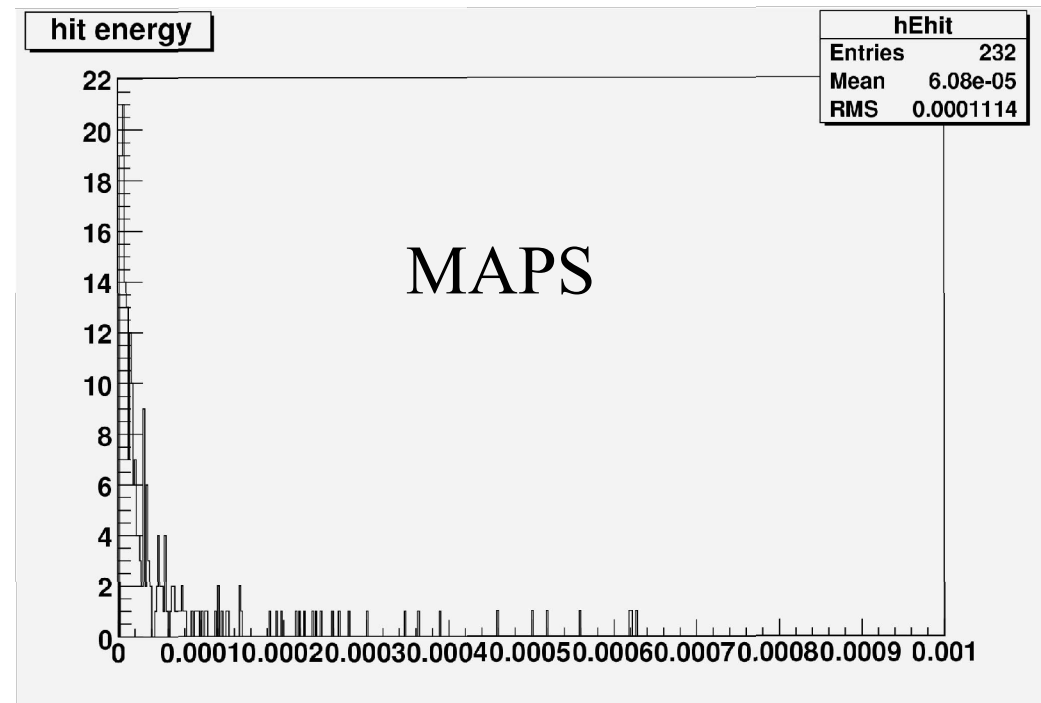
Barrel y position distribution

The same interval and only 0.2425 mm shifted.

Energy Deposit Comparison

Energy deposit (Single Event)

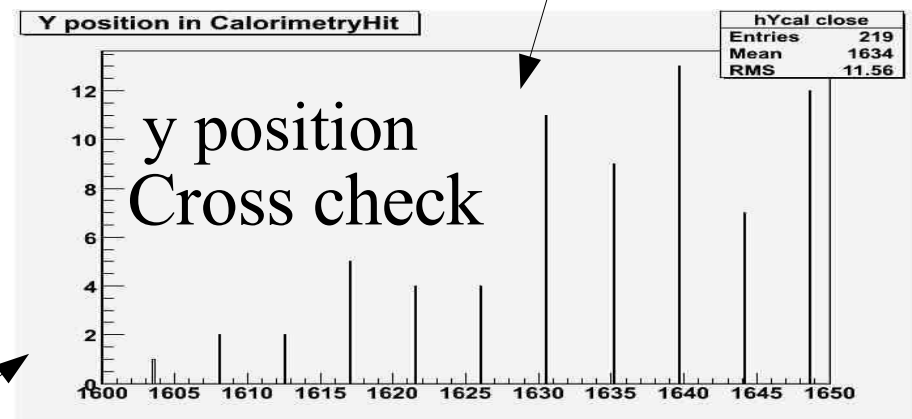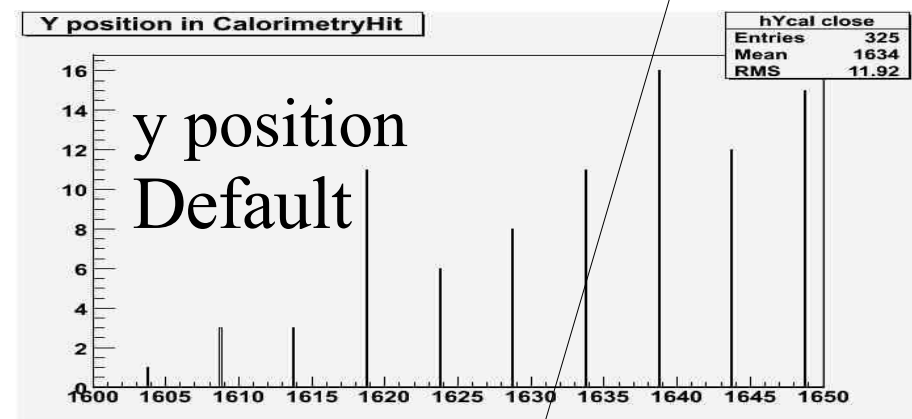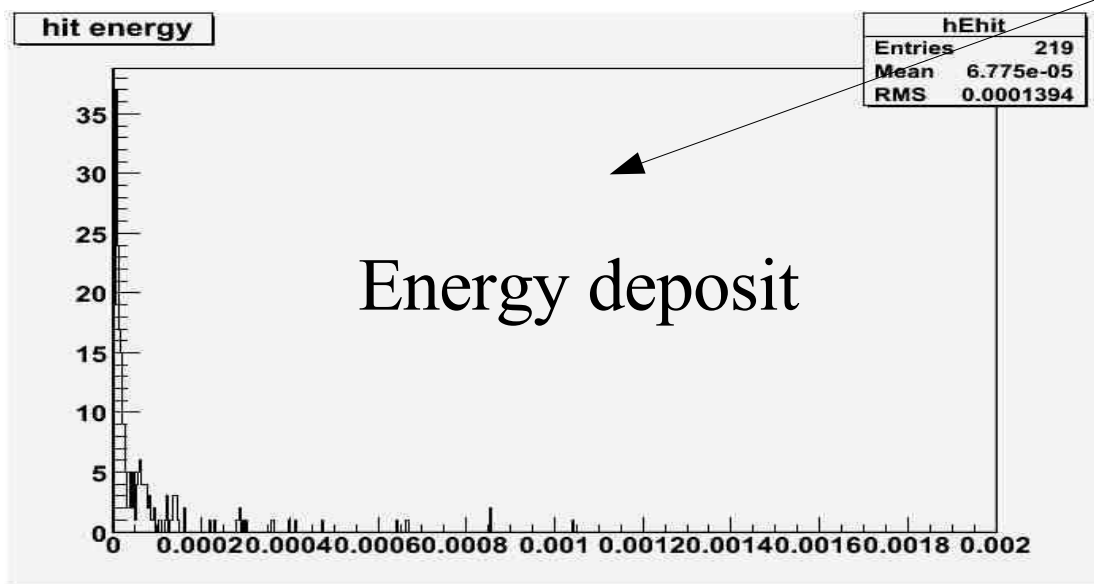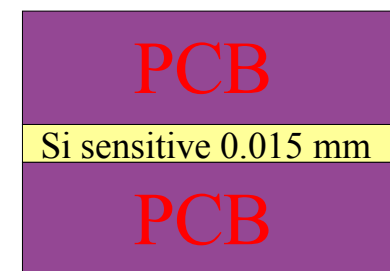Energy Deposit (Single Event)

Number of hits: 325

Number of hits: 232

Mean   :1.407 MeV

Mean   : 60.8 KeV

Mean ratio for MAPS/Default = (4.32 +/- 0.38)%

Consistency check (1)

PCB

Si sensitive 0.015 mm

PCB

– We tested 0.015 mm Si sensitive without any Non-sensitive Si volume.

hit energy

hEhit

Entries	219
Mean	6.775e-05
RMS	0.0001394

Energy deposit

Number of hits : 219

Mean : 67.8 KeV

Similar with MAPS modification.

Y position in CalorimetryHit

hYcal close

Entries	325
Mean	1634
RMS	11.92

y position
Default

Y position in CalorimetryHit

hYcal close

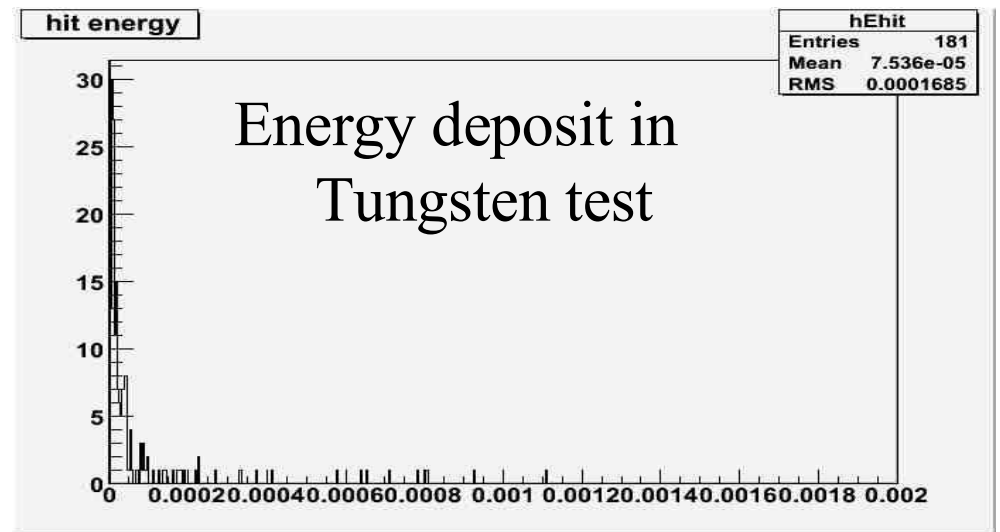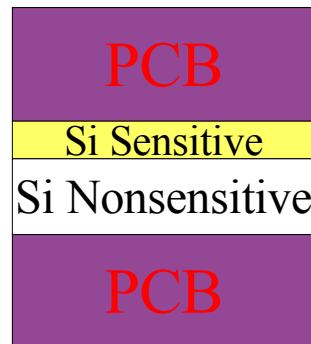|	
Entries	219
Mean	1634
RMS	11.56

y position
Cross check

Interval is 0.485 mm smaller than default.

Consistency Check (2)

– We tested implement of Tungsten instead of Silicon-Non-Sensitive volume for cross check.

MAPS Energy deposit

hEhit	
Entries	232
Mean	6.08e-05
RMS	0.0001114

Energy deposit in Tungsten test

hEhit	
Entries	181
Mean	7.536e-05
RMS	0.0001685
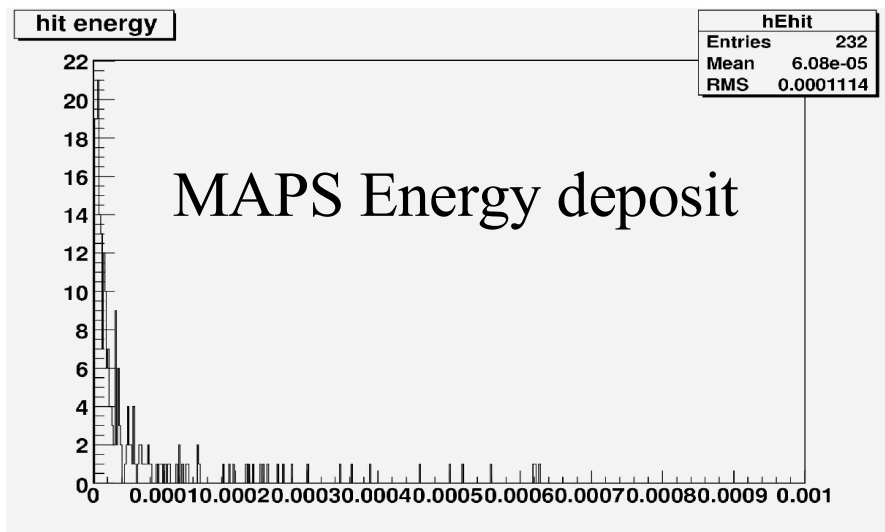
Number of Hits: 232
Mean of Hits: 60.8 KeV

PCB
Si Sensitive
Si Nonsensitive
PCB

Number of Hits: 181
Mean of Hits:75.4 KeV

PCB
Si Sensitive
Tungsten
PCB
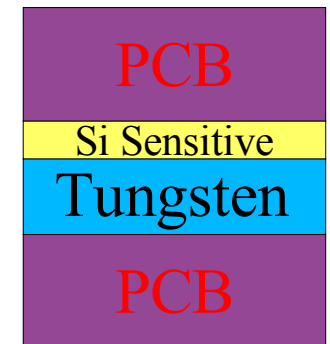
Energy Dependence for Number of Hits

- Single electron event
- Si Sensitive thickness is 0.015 mm
- Si Non-sensitive thickness is 0.485 mm
- Cell size is still 1 cm times 1 cm

Number of hits with energy dependence
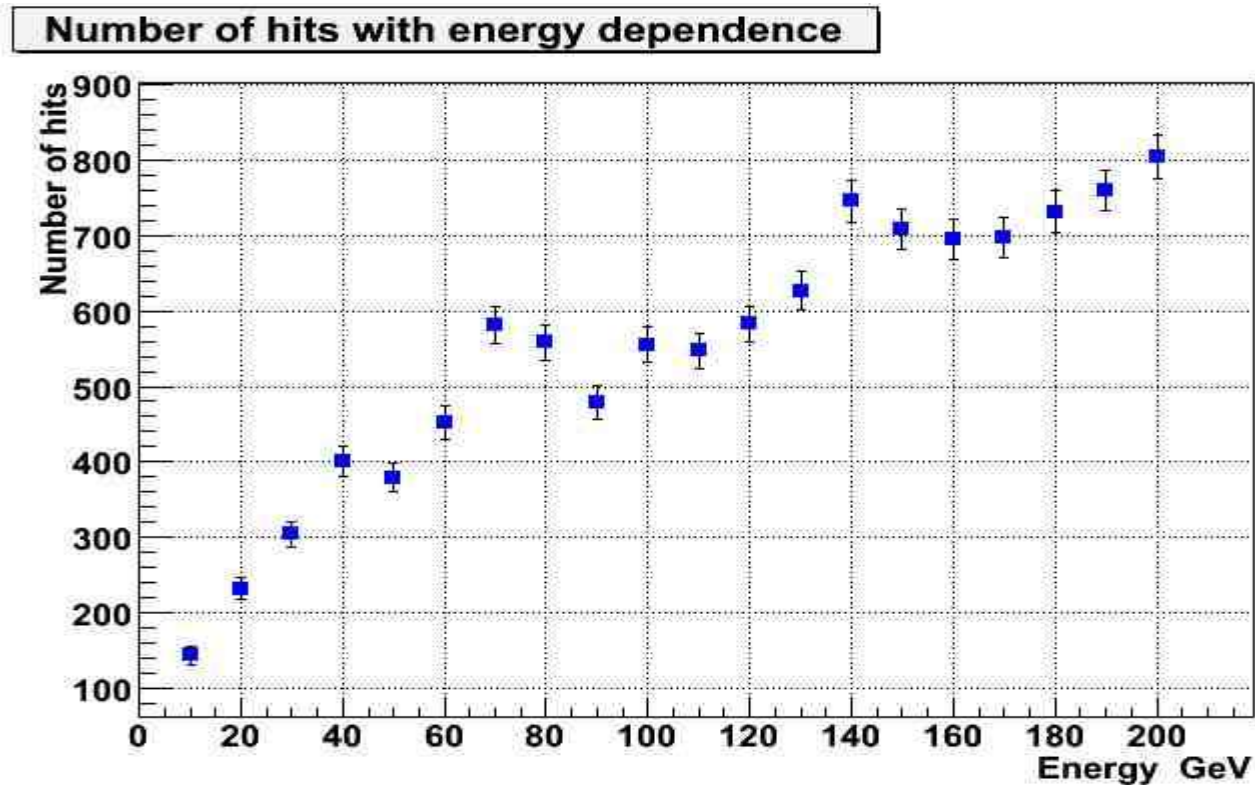
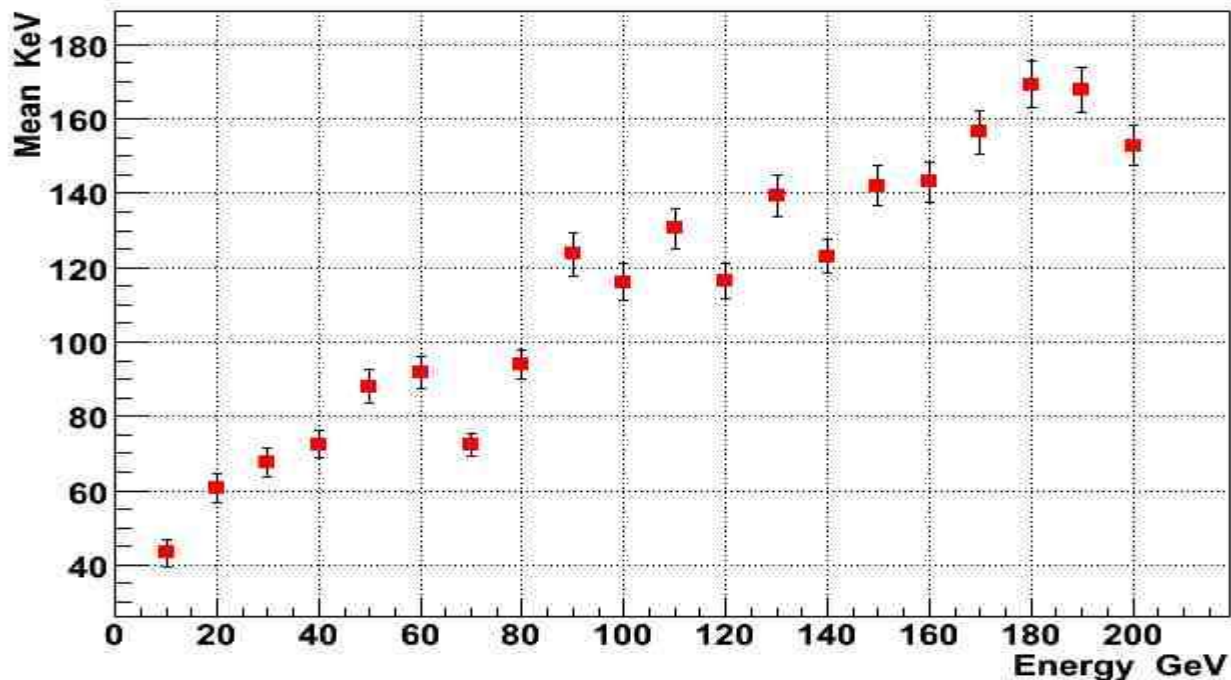# Mean of Hits Energy with Energy Dependence

- Single electron event

- Si Sensitive thickness is 0.015 mm

- Si Non-sensitive thickness is 0.485 mm

- Cell size is still 1cm times 1cm

Number of Hits with Si Sensitive Thickness dependence

– 20 GeV single electron event

– Si Physical thickness is 0.500 mm

– Cell size is still 1cm times 1cm

Mean of Hits with Si Sensitive Thickness Dependence
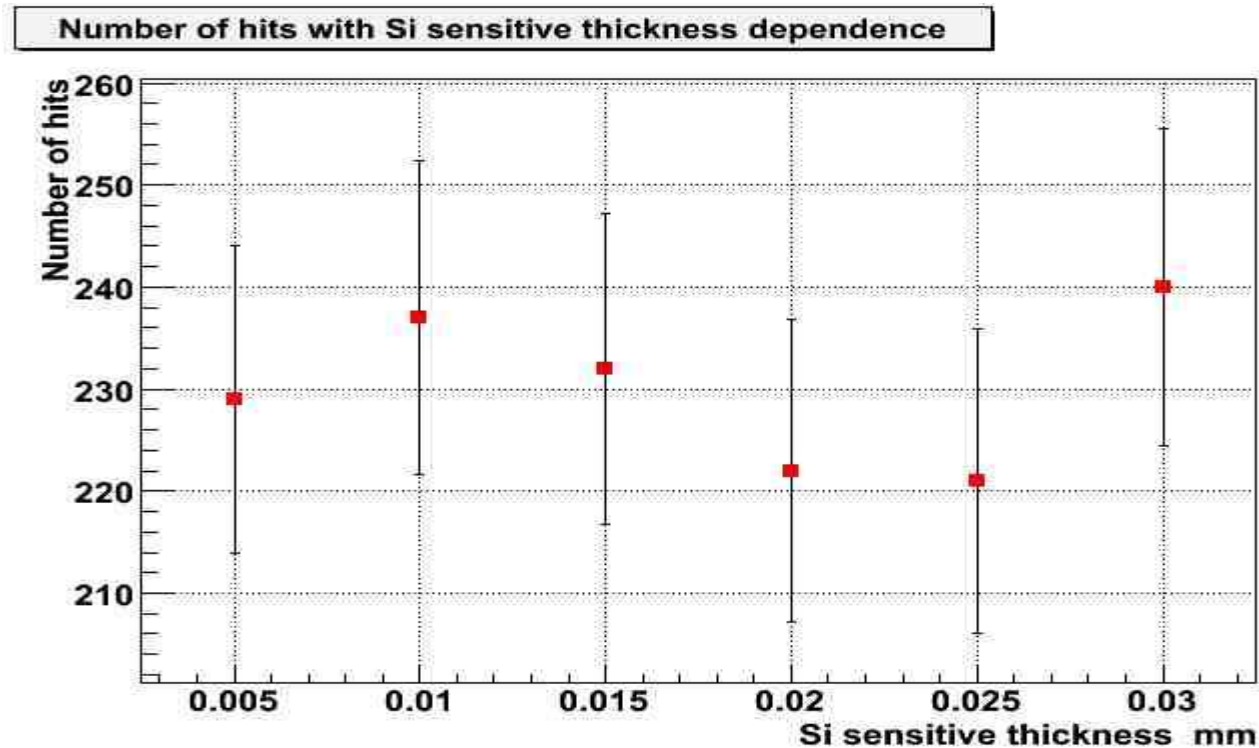
- 20 GeV single electron event

- Si Physical thickness is 0.500 mm

- Cell size is still 1cm times 1cm

Mean of hits with Si sensitive thickness dependence
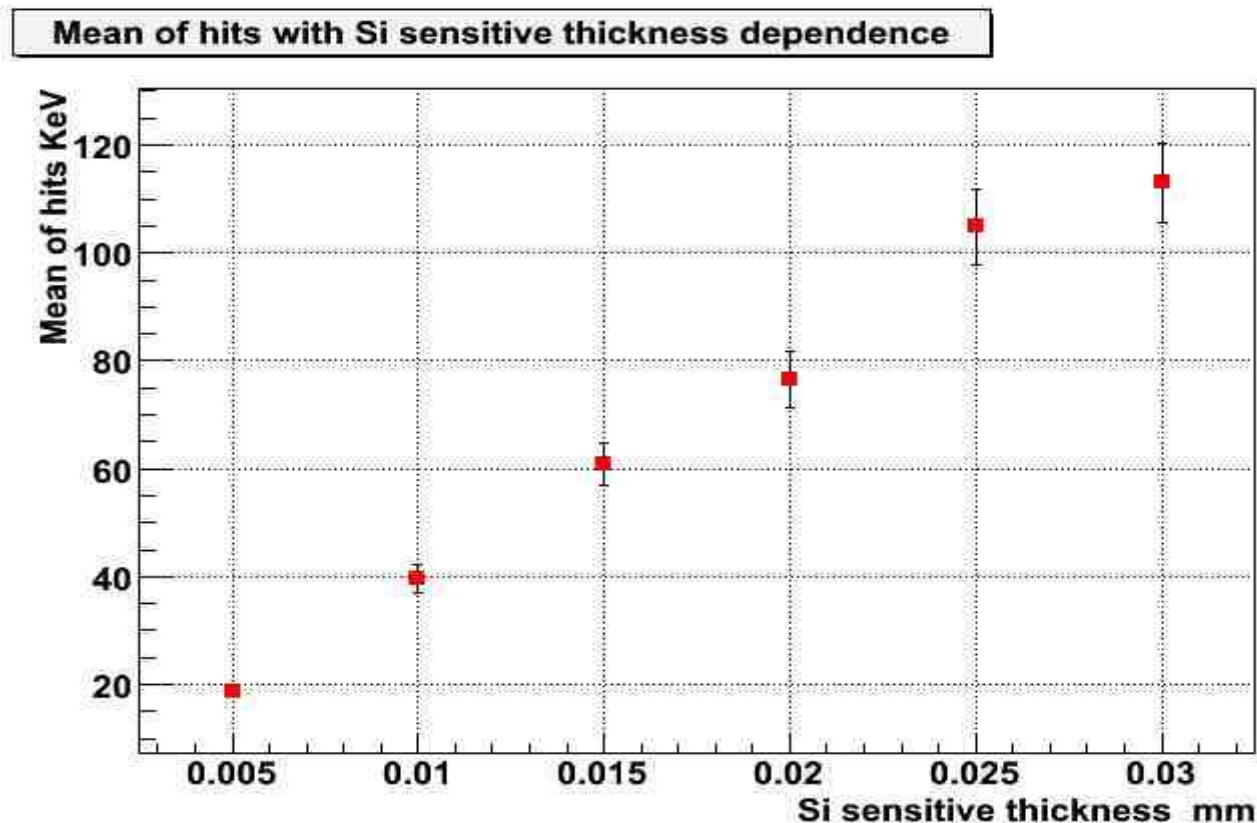
Summary and Next Steps

- Summary
  - We studied Si thickness modification. (Mokka-05-05 Geant4-8 and LCIO-v01-06 are used.)
  - The modification looks working well.

- Next steps
  - More statistics
  - Cell size changes
  - Digitization for position
  - Energy/angle/position resolutions
  - Systematic studies and cross checks