

MAPS Geometry Simulation

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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.
- 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 $2 \text{ PCB} + 1 \text{ Si Sensitive}$.
 - PCB thickness is defined in super driver SEcal01.cc as $(\text{alveolus_thickness} - \text{si_thickness}) / 2$.
 - Default values: alveolus_thickness= 2.1 mm,
si_thickness= 0.5 mm,
pcb_thickness is not input value.

MAPS Software Modification

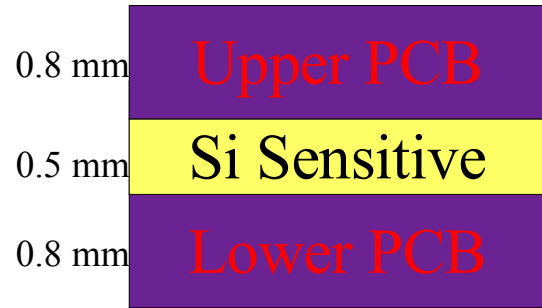
- Ecal02.cc (MAPS)
 - Si Physical thickness is input from steering file.
 - Si Sensitive thickness is fixed as 0.015 mm in code.
 - Si Non-sensitive volume was implemented with (Physical_thickness - 0.015 mm) in code.
 - Secal01.cc (super driver of Ecal02.cc) wasn't modified because still the PCB thickness definition is valid.
$$\text{pcb_thickness} = (\text{alveolus_thickness} - \text{si_thickness}) / 2.$$

Physical thickness

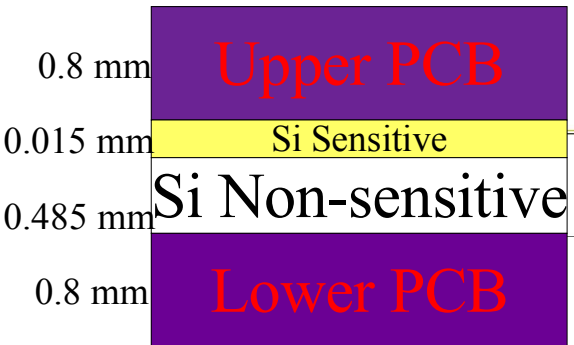


Geometry Comparison

Default

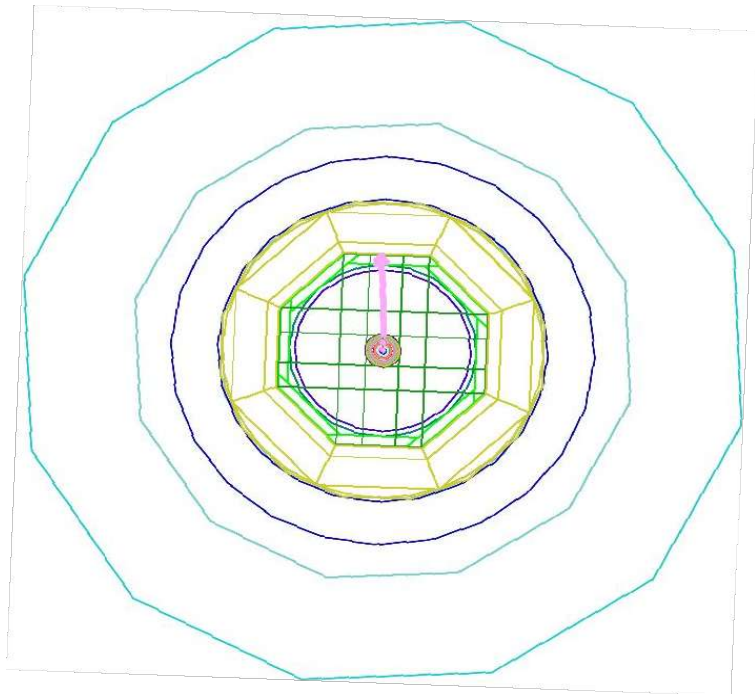


MAPS

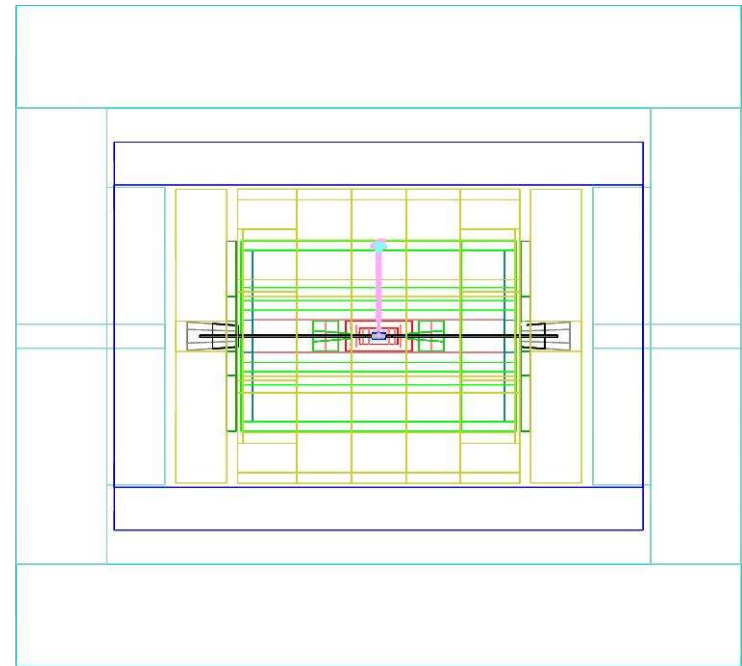


Test Simulation

- We used following parameters for test simulation.
 - /gun/particle e-
 - /gun/energy 20 GeV
 - /gun/position 0 0 0
 - /gun/direction 0. 1. 0.

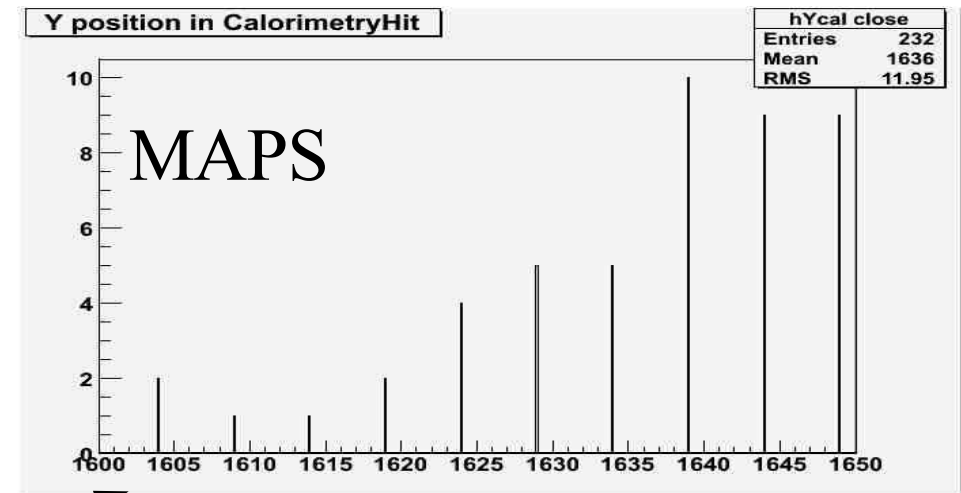
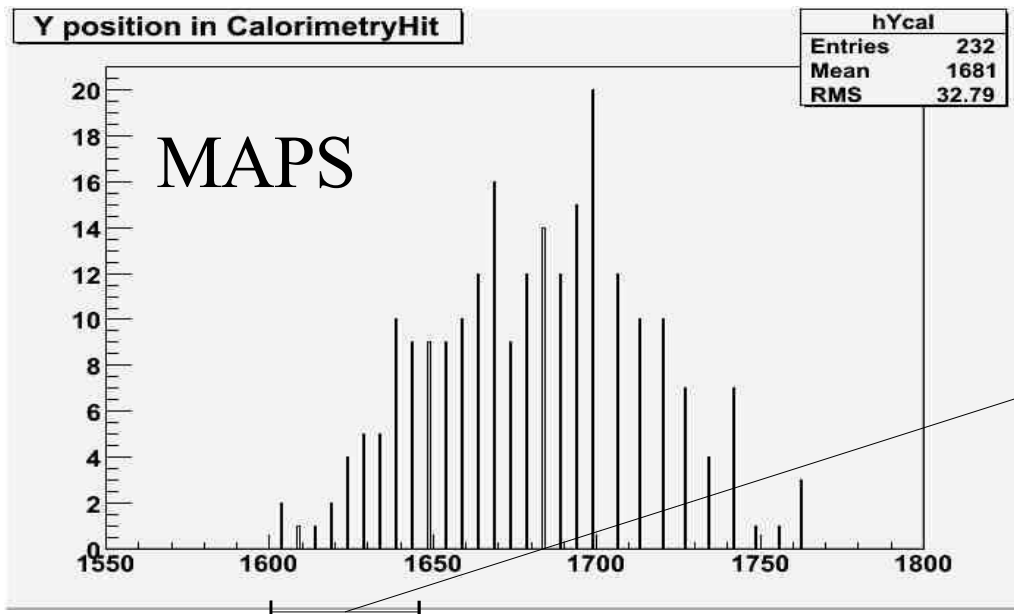
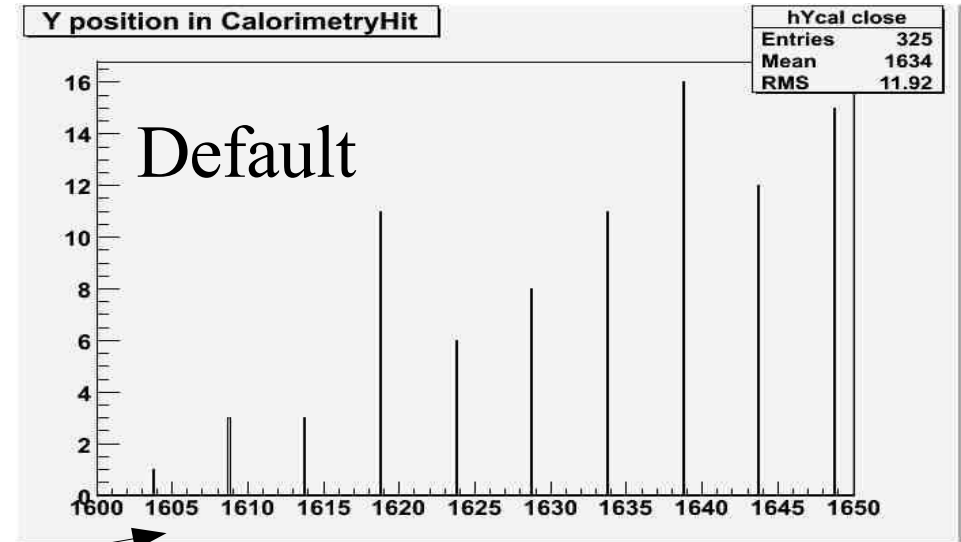
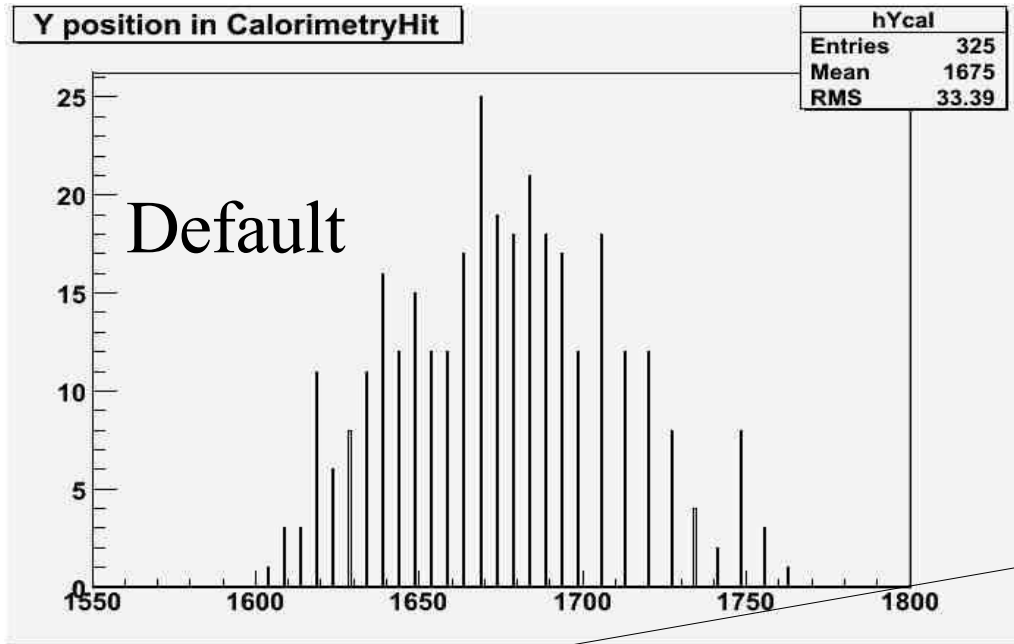


y
↑



Only top barrel has hits.

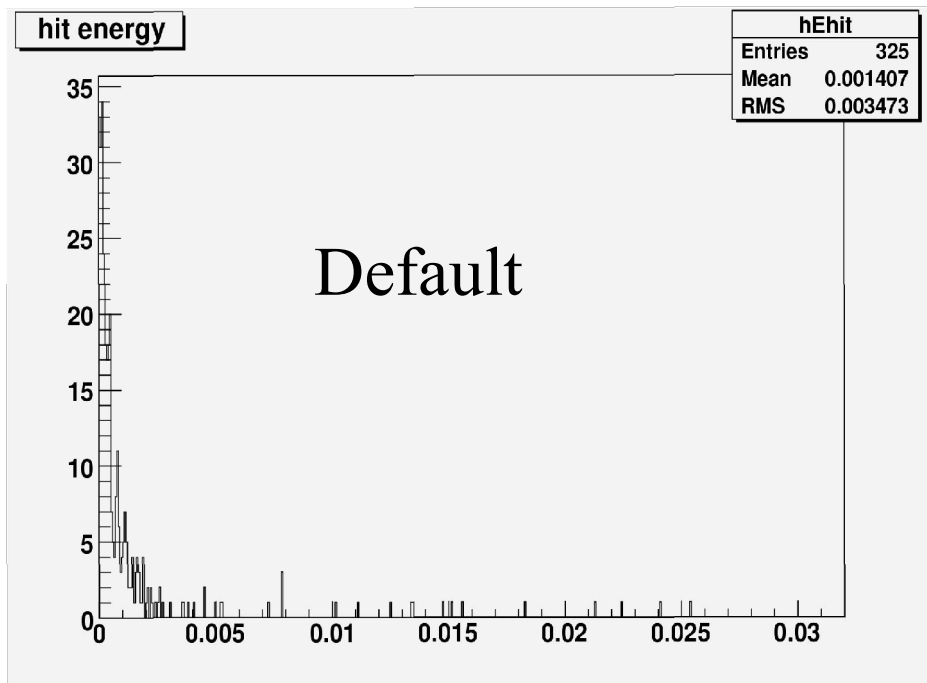
Barrel y position distribution



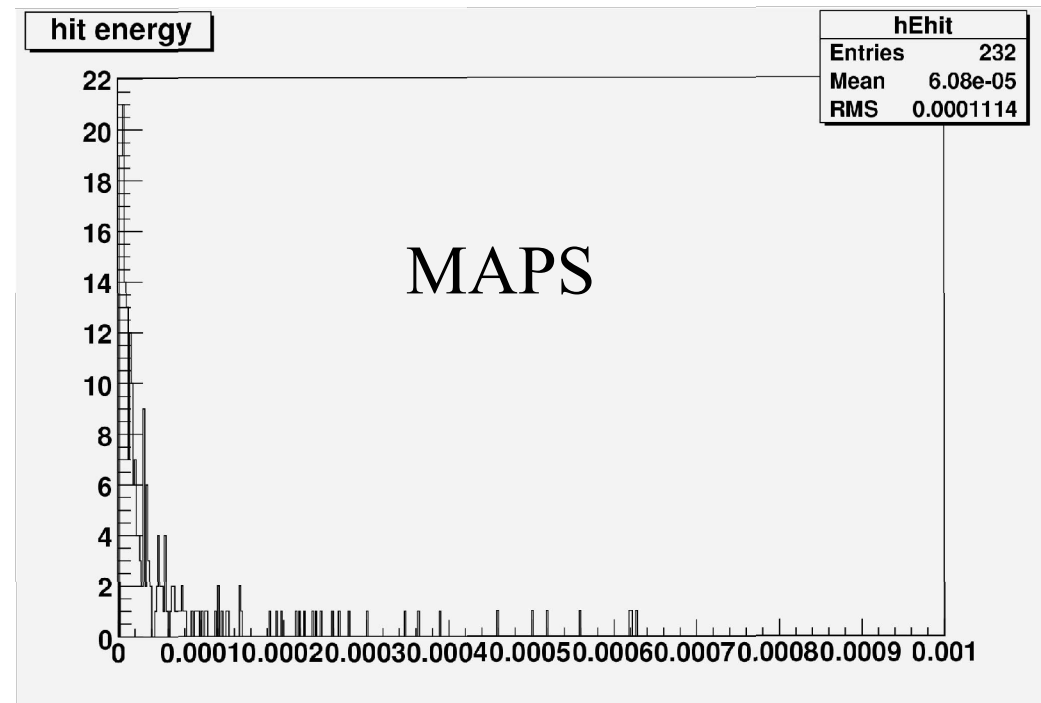
The same interval and only 0.2425 mm shifted.

Energy Deposit Comparison

Energy deposit (Single Event)



Energy Deposit (Single Event)



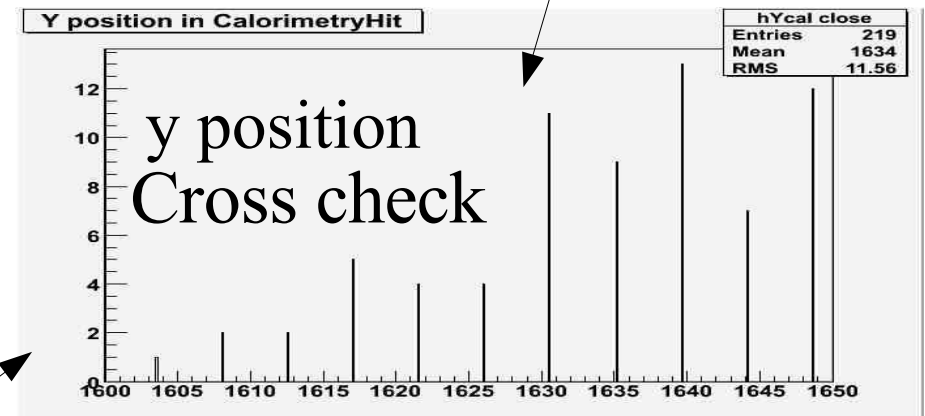
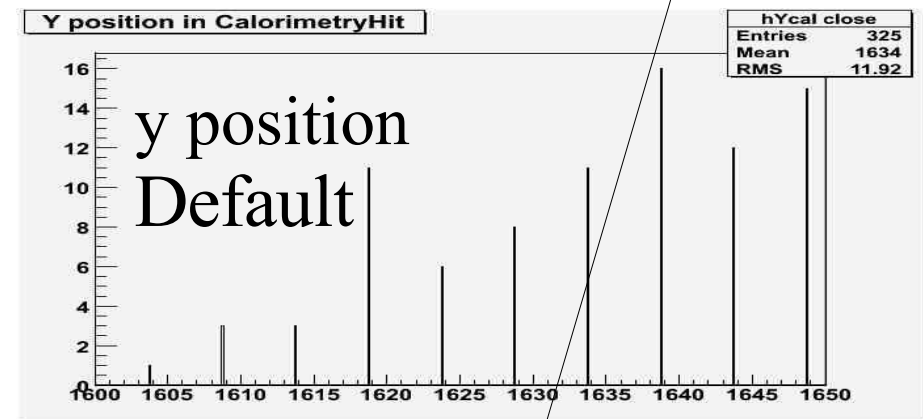
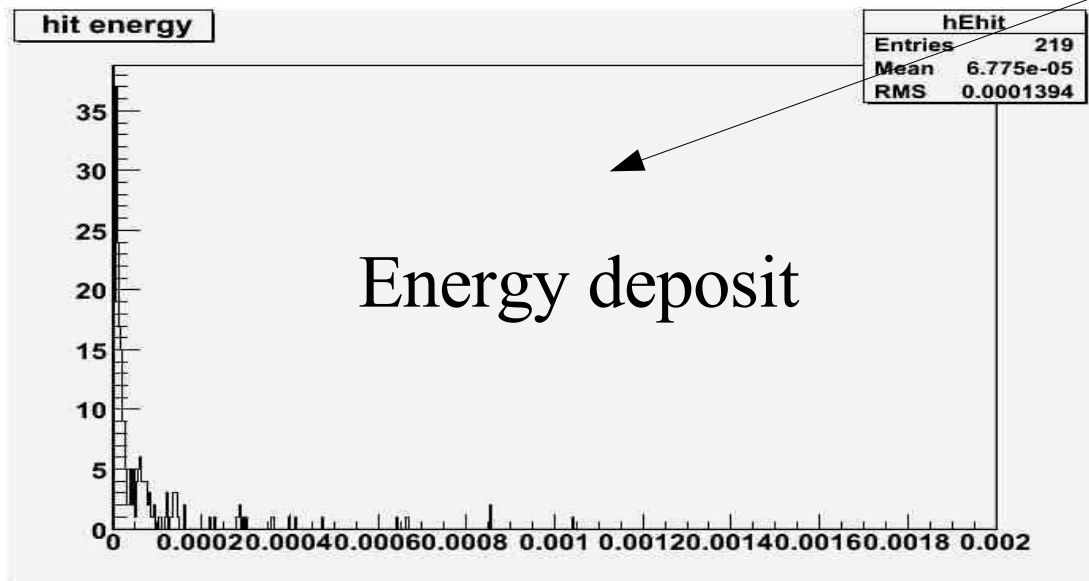
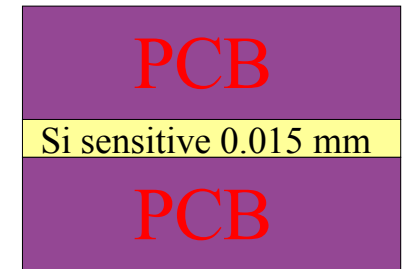
Number of hits: 325
Mean : 1.407 MeV

Number of hits: 232
Mean : 60.8 KeV

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

Consistency check (1)

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



Number of hits : 219

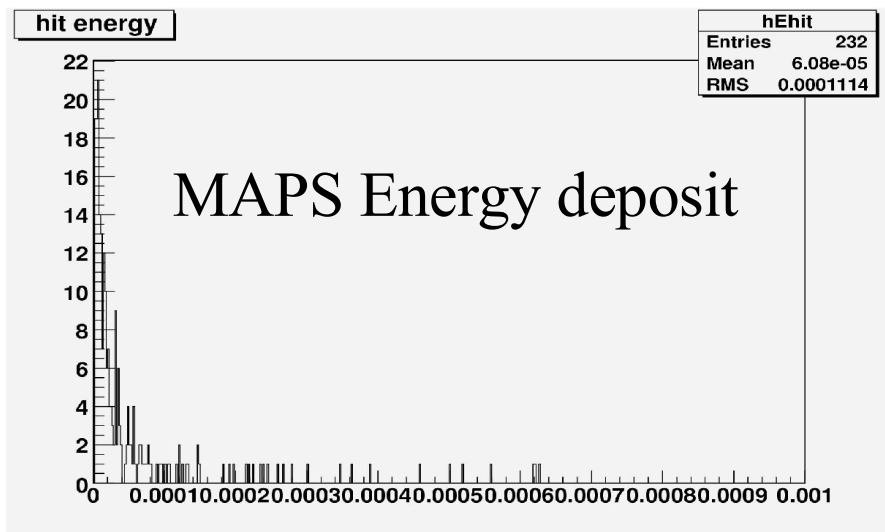
Mean : 67.8 KeV

Similar with MAPS modification.

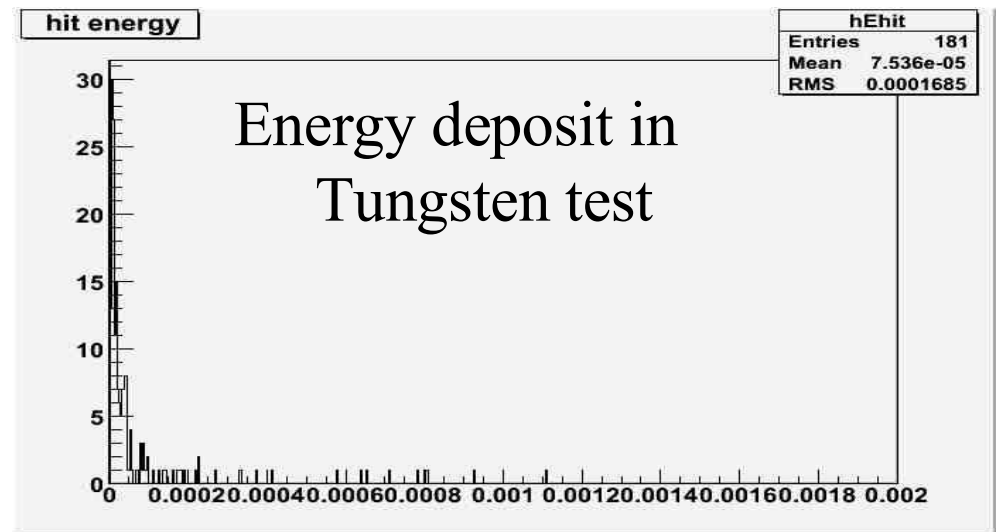
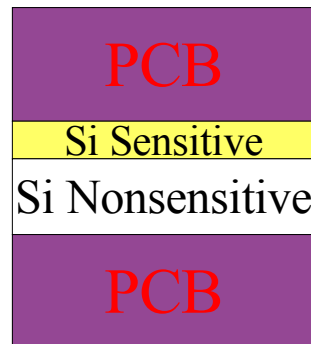
Interval is 0.485 mm smaller than default.

Consistency Check (2)

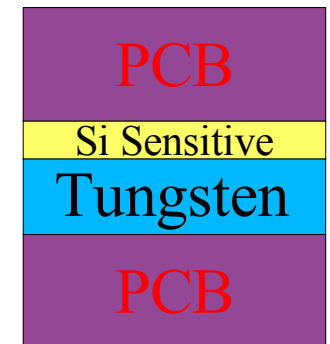
- We tested implement of Tungsten instead of Silicon-Non-Sensitive volume for cross check.



Number of Hits: 232
Mean of Hits: 60.8 KeV

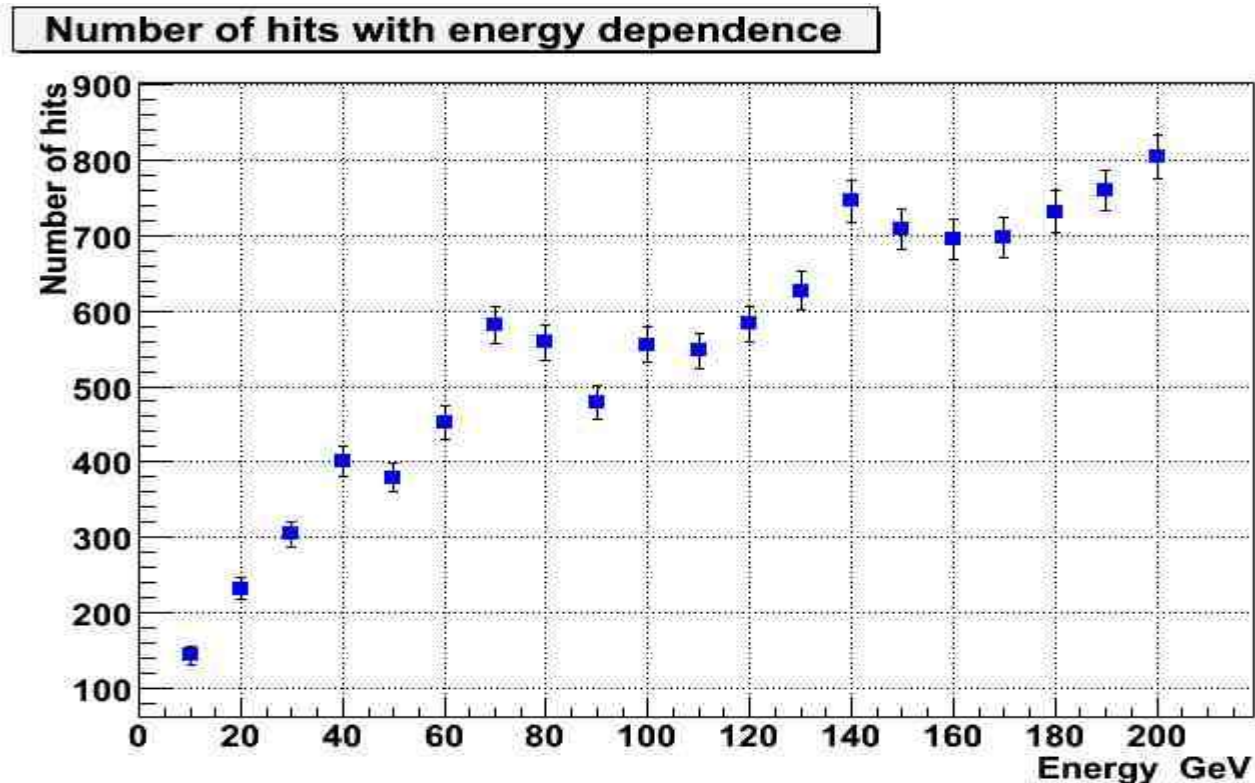


Number of Hits: 181
Mean of Hits: 75.4 KeV



Energy Dependence for Number of Hits

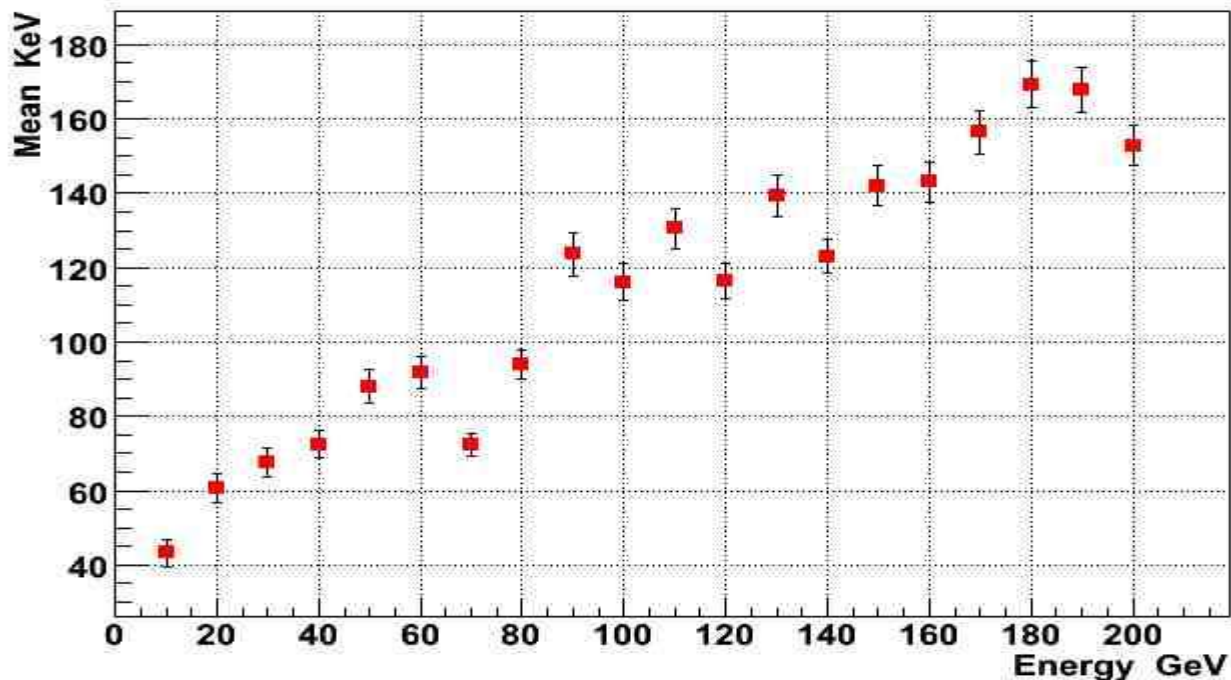
- Single electron event
- Si Sensitive thickness is 0.015 mm
- Si Non-sensitive thickness is 0.485 mm
- Cell size is still 1 cm times 1 cm



Mean of Hits Energy with Energy Dependence

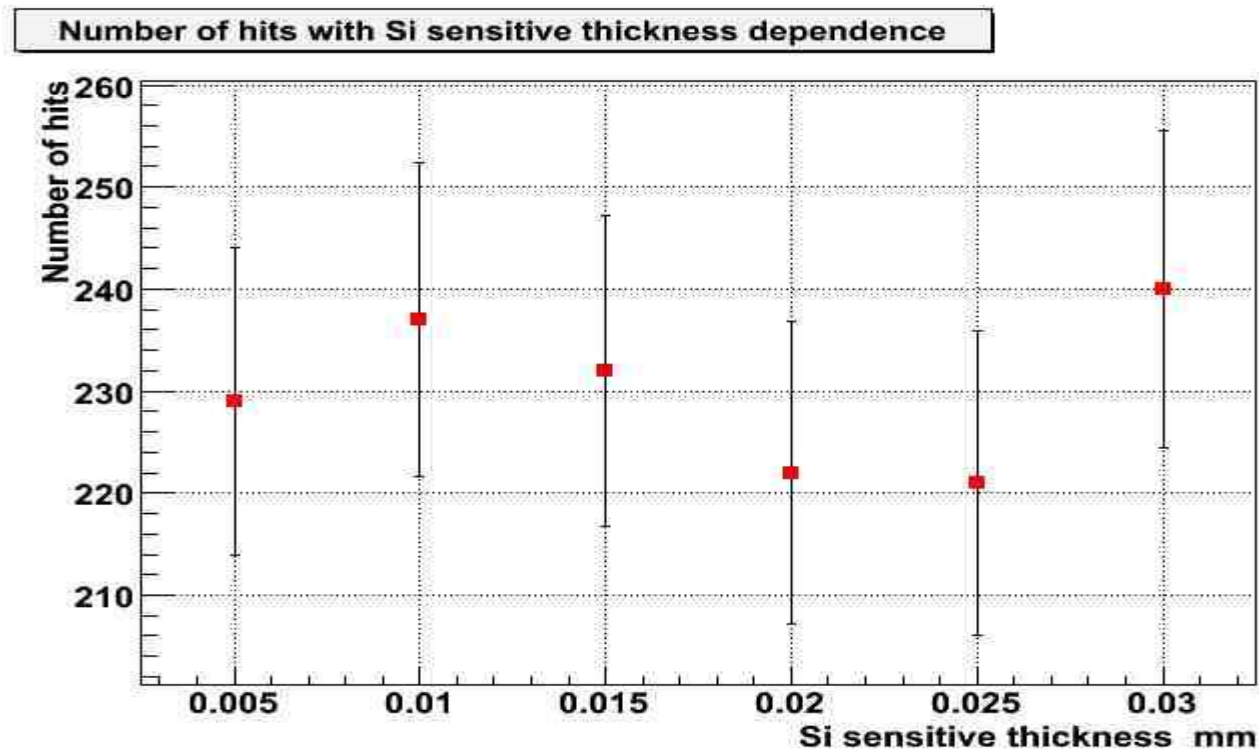
- Single electron event
- Si Sensitive thickness is 0.015 mm
- Si Non-sensitive thickness is 0.485 mm
- Cell size is still 1cm times 1cm

Mean of hits with energy dependence



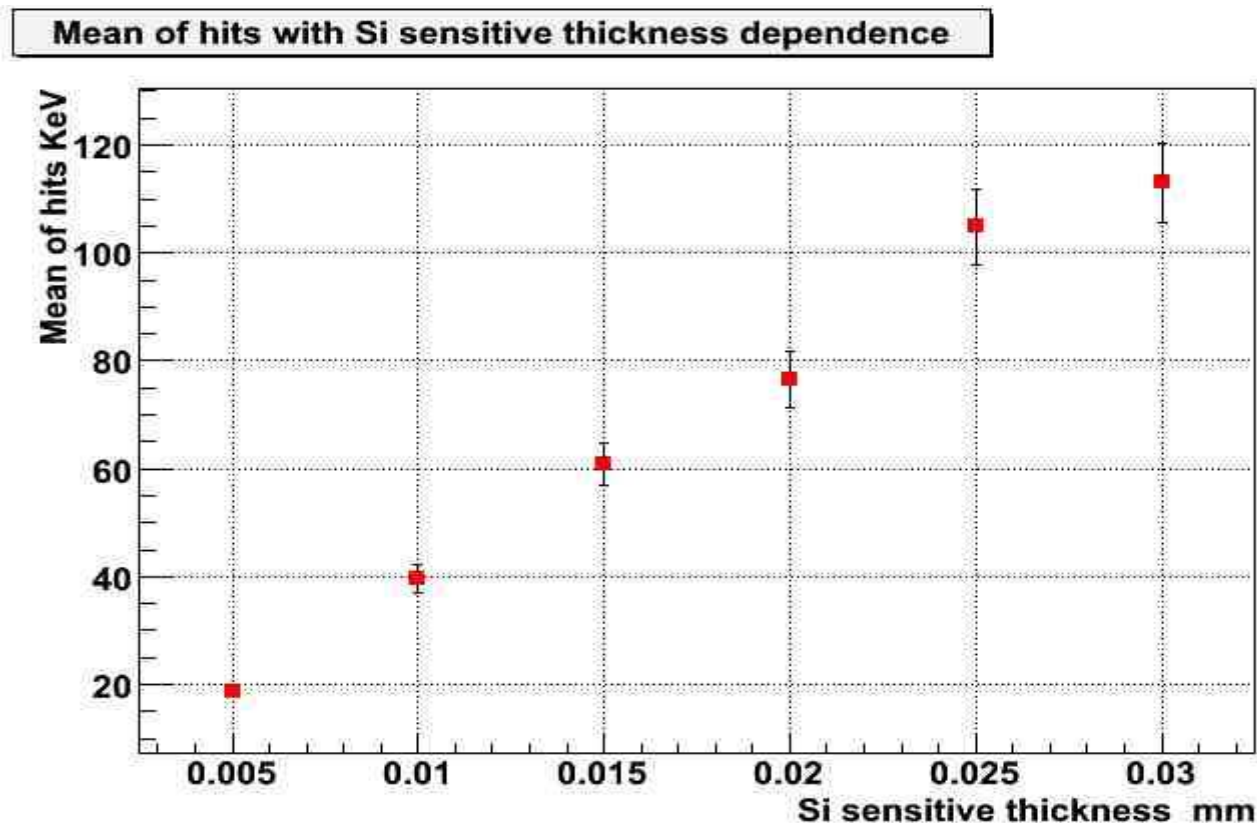
Number of Hits with Si Sensitive Thickness dependence

- 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



Summary and Next Steps

- Summary
 - We studied Si thickness modification. (Mokka-05-05 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