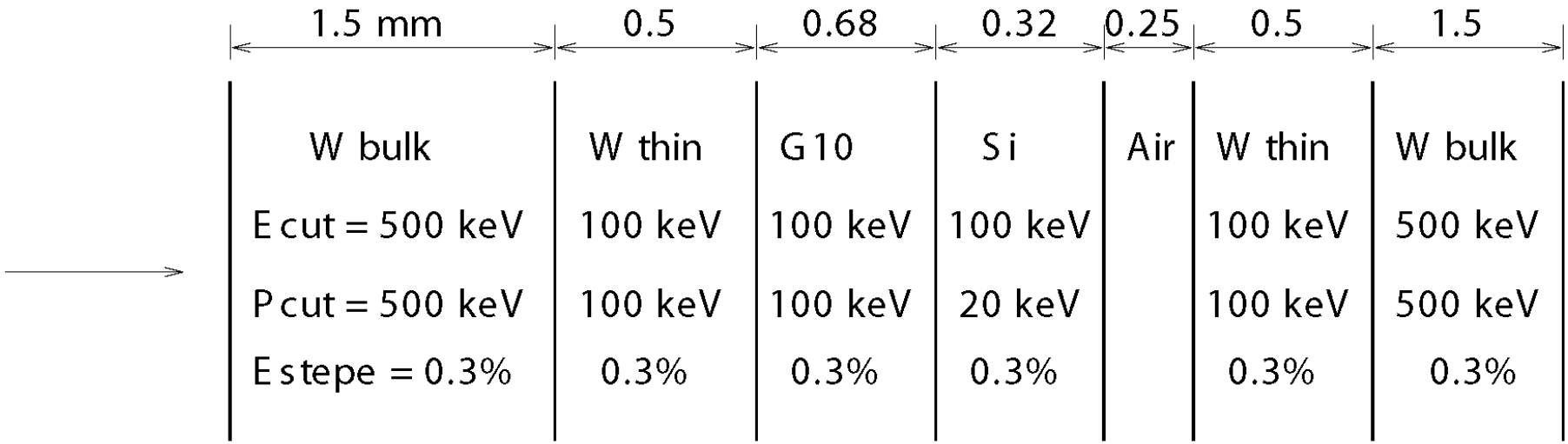
Some EGS Studies…

- Compare with Geant4
  - Questions of range/cutoff parameters
- EM Resolution understood?

- Moliere radius – readout gap relation
- Input shower widths for fast MC

- Calibration requirement (electronics design)
- ECal depth – need to develop quantified criteria
  - EM energy containment
    - Is the HCal of any use for EM shower tails?
    - hadron interactions in the ECal – good or bad?
  - Transverse/long. segmentation for pattern recognition
    - photons and hadrons
  - Optimize coarser sampling with depth
- Minimum number of silicon layers (30? 25? 20??) = cost

EGS4 Setup



Config (=SiD sim): 30 x [5/7 X0 (2.5 mm) + 1.25 mm gaps]

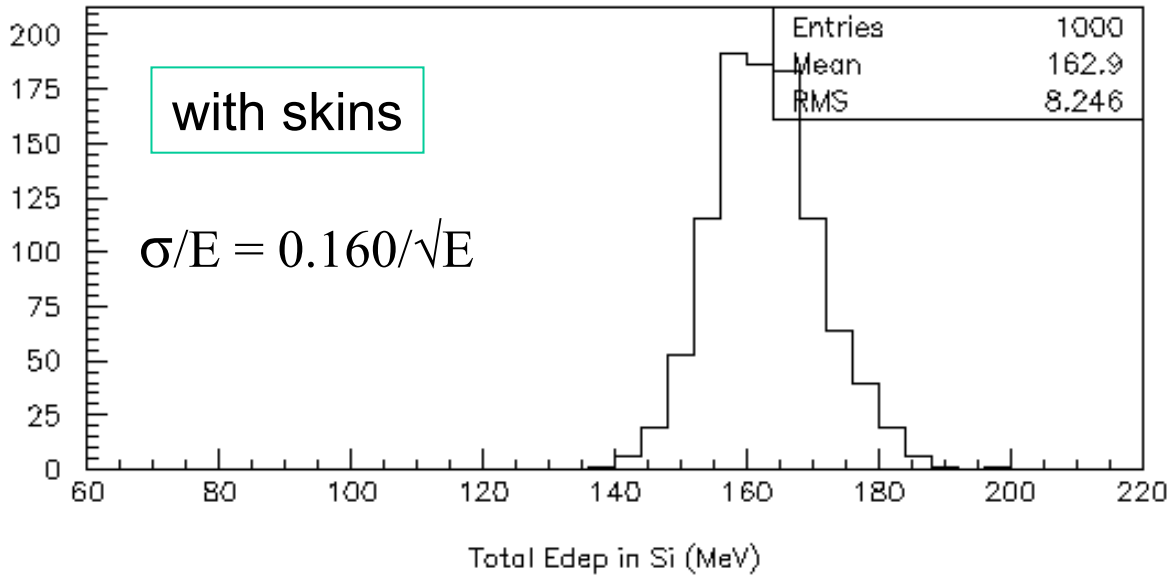
Thin EM sampling (Si)

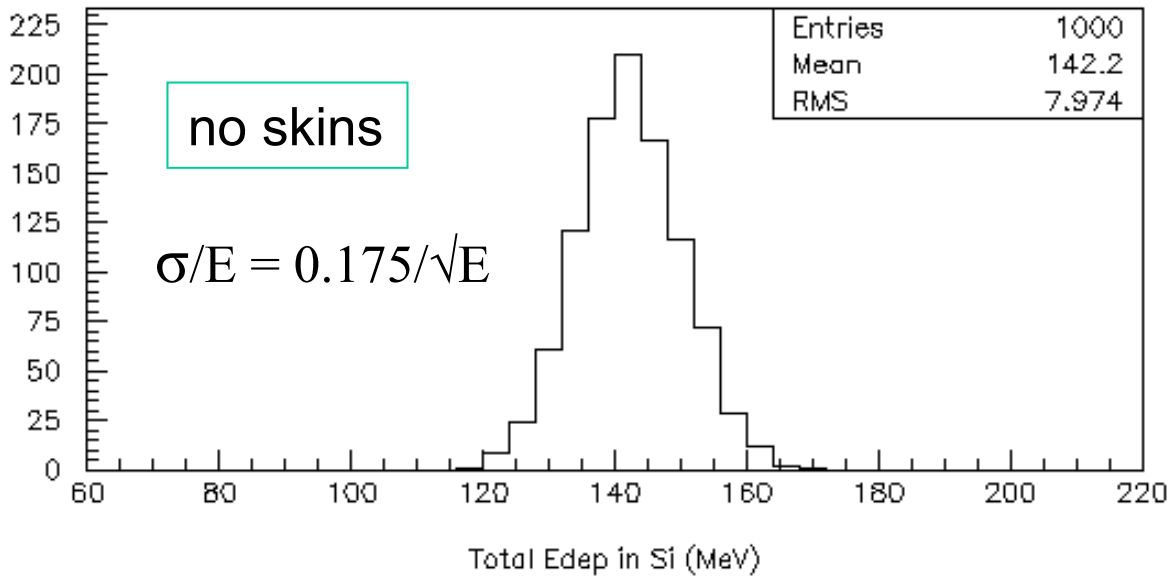
If energy cutoffs (EGS) or range parameters (G4) are too large, then the simulated range of low energy secondaries exceeds the physical range

$\Rightarrow$ Their energy doesn't get deposited in the sensitive region.

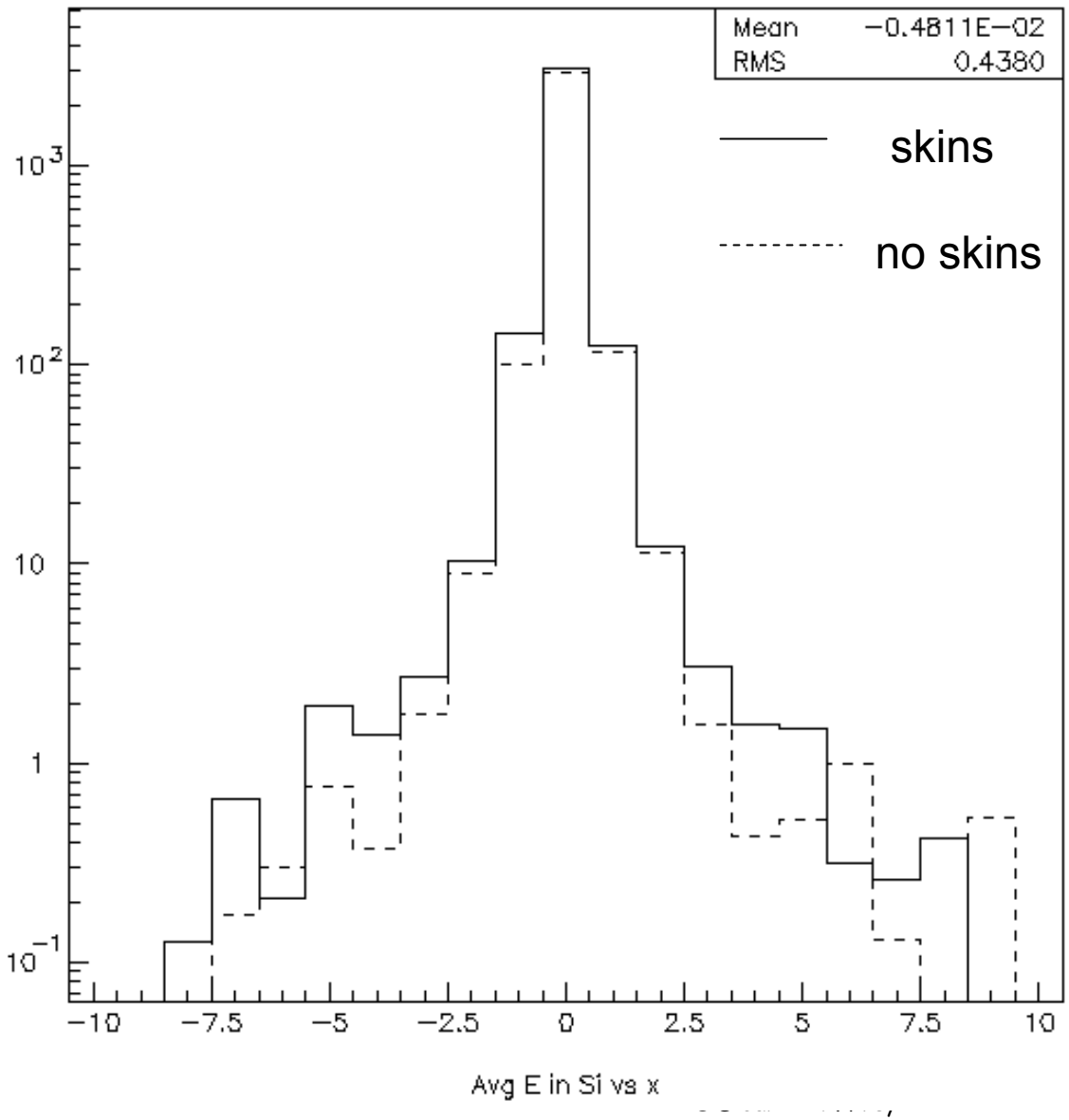
Do we need the “skins” in this case?

- 10 GeV photons
- about 8x more CPU time to do it “right”





transverse spatial distributions (10 GeV photons)



E vs x at layer 4

Note: rms is 0.44 pixel (2,2 mm)

Superb Position Resolution for 1 GeV Photons

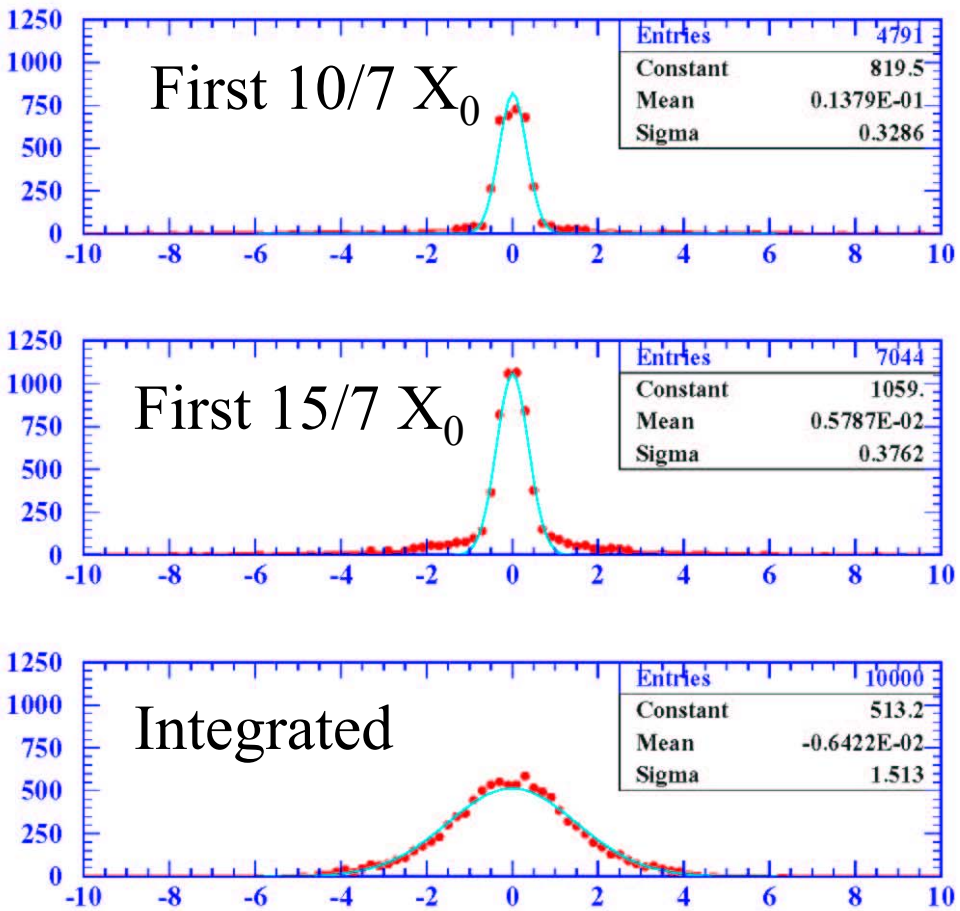
For illustration purposes only !:

Si-W, 42 layers,
1mm x 1mm pixels,

R_M = 13.5 mm

1 GeV photons

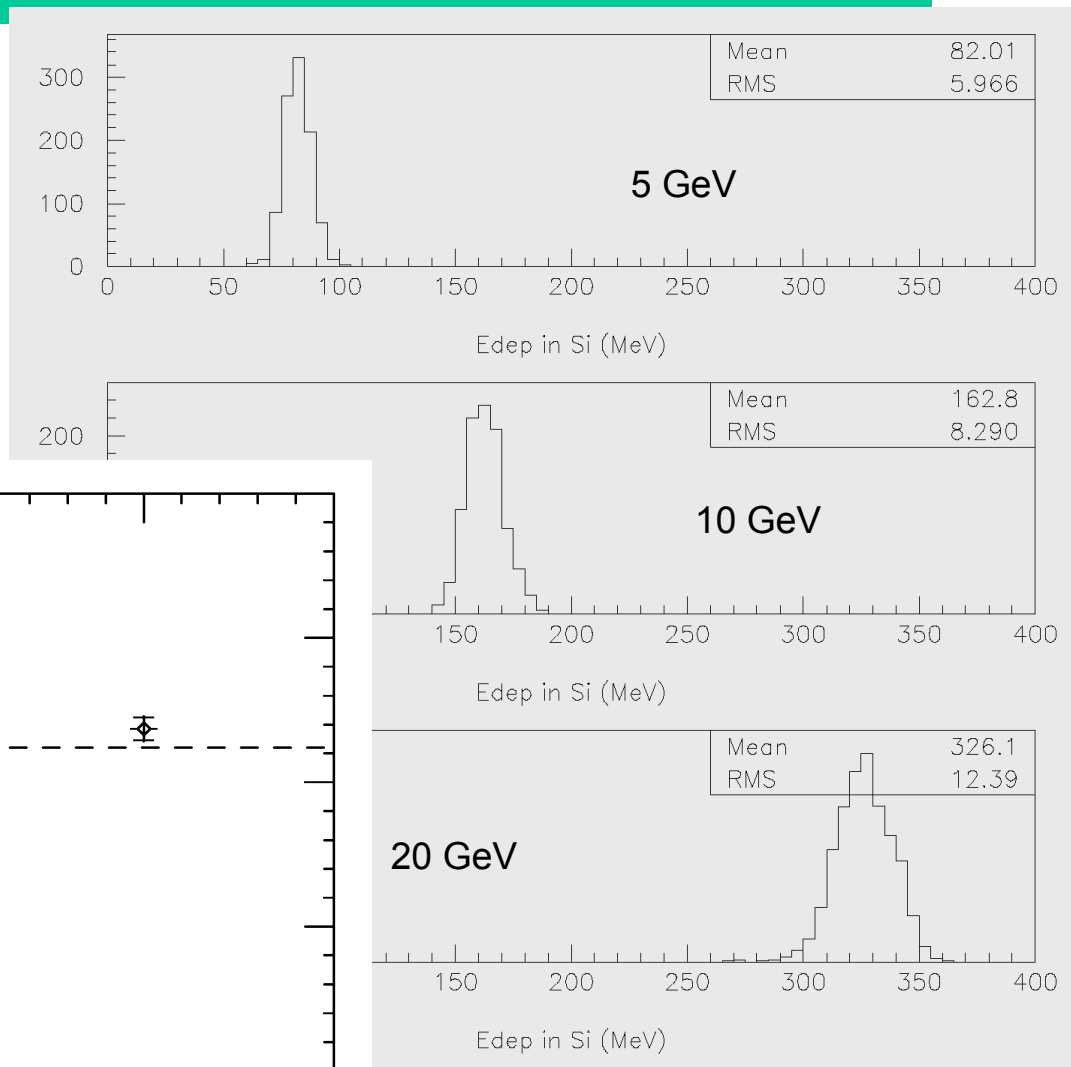
Transverse segmentations much finer than 5 mm may be useful – Si strips ?

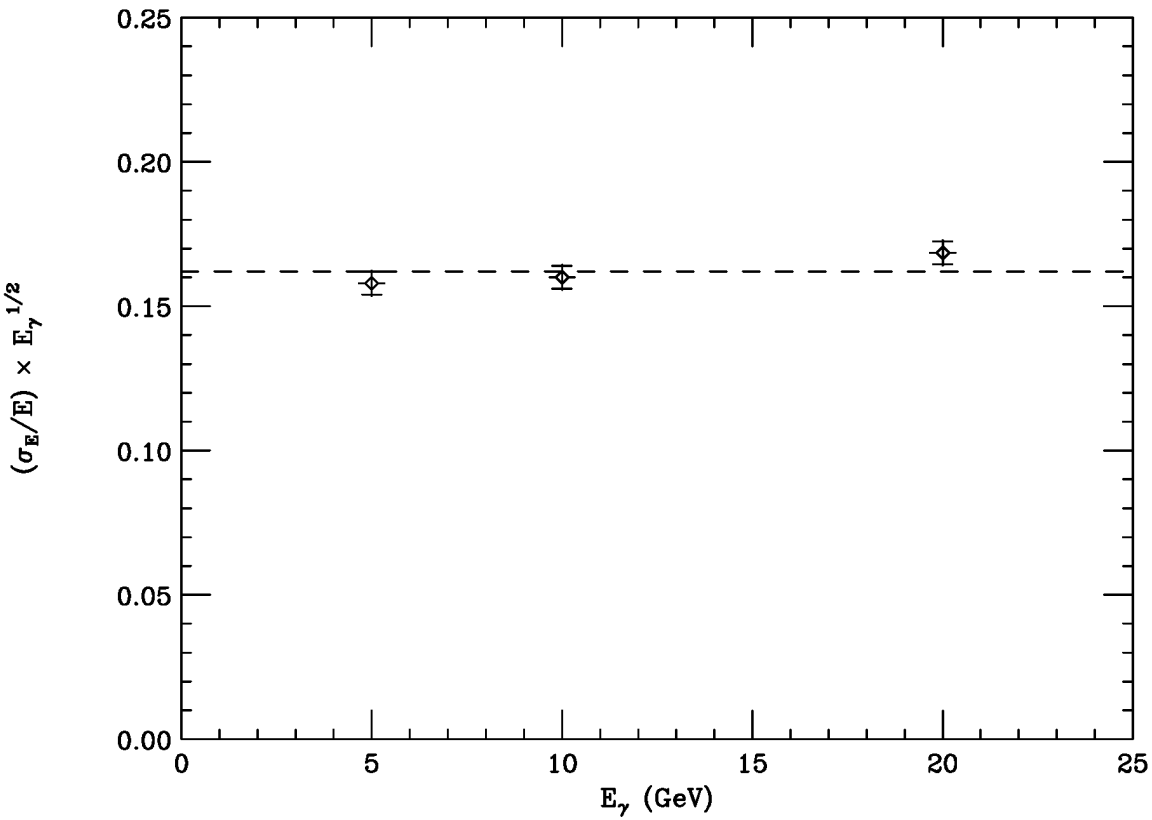


energy resolution (photons)

use rms for width:

$0.16/\sqrt{E}$



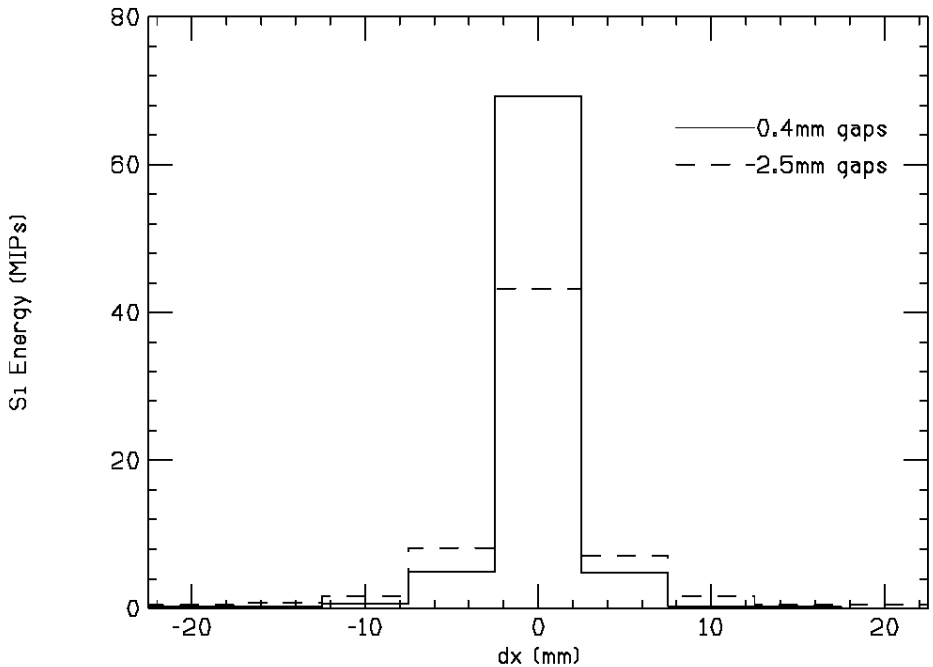


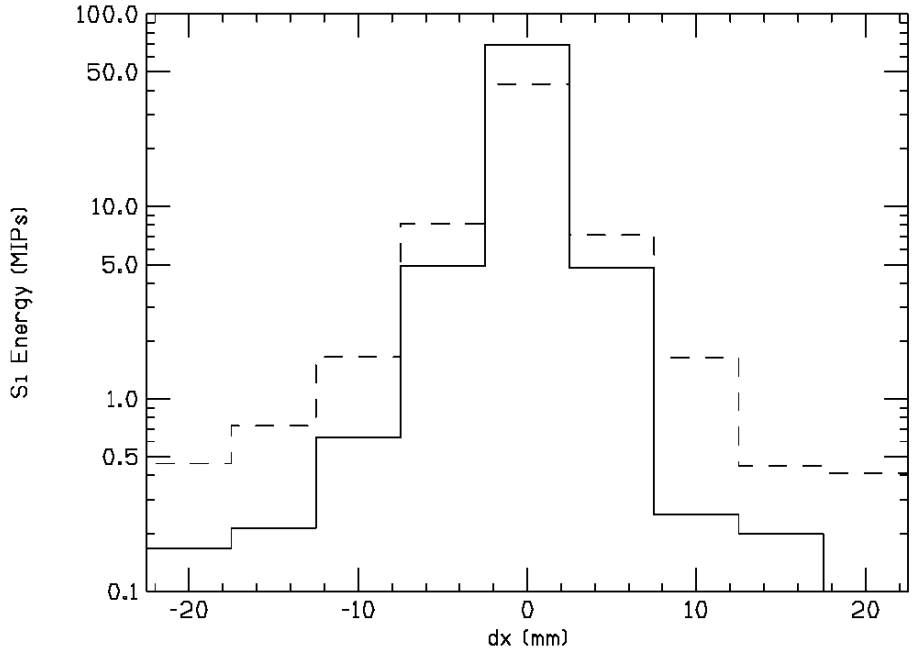
Compare with Geant4
N. Graf, G. Wilson, RF

- Used infinite planes of 2.5 mm W + 1mm G10 + 0.4mm Si
- Found that Geant4 with (standard?) 1mm range cut underestimated the energy deposited in the silicon by 15-20% (and hence the standard Geant4 gets poorer energy resolution)
- Found convergence to EGS for a Geant4 range cut of 0.1mm (!)
- CPU time increases by factor 30
- Can make EGS approximate Geant4 with 1mm range cut by removing the skins and changing energy step from 0.3% to 2%

Effective Moliere radius - old → want to fill out the parameter space

- Standard SD: 5x5 mm^2 pixels with (1) 0.4mm or (2) 2.5mm readout gaps.
- 10 GeV photons; look at layer 10



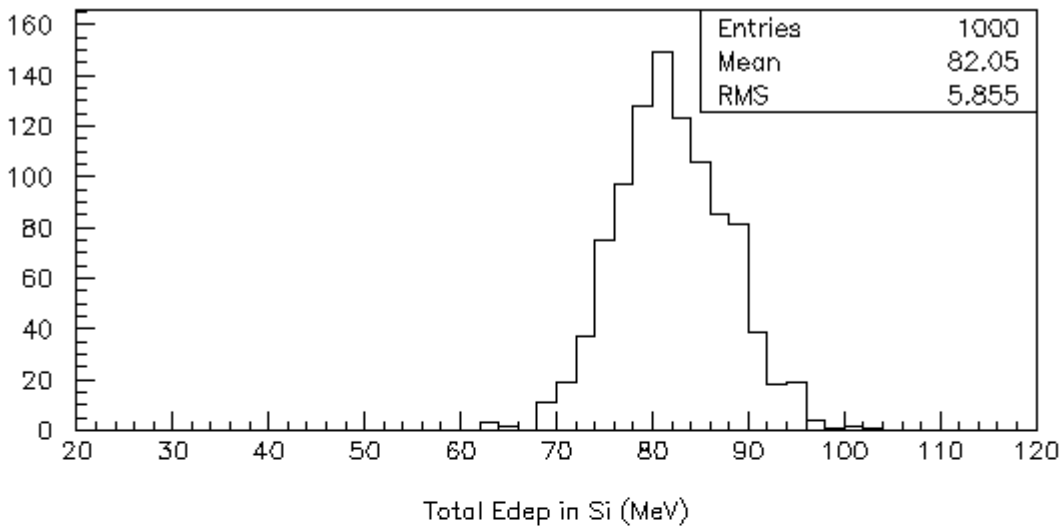


Calibration

simulate effect of calibration errors:

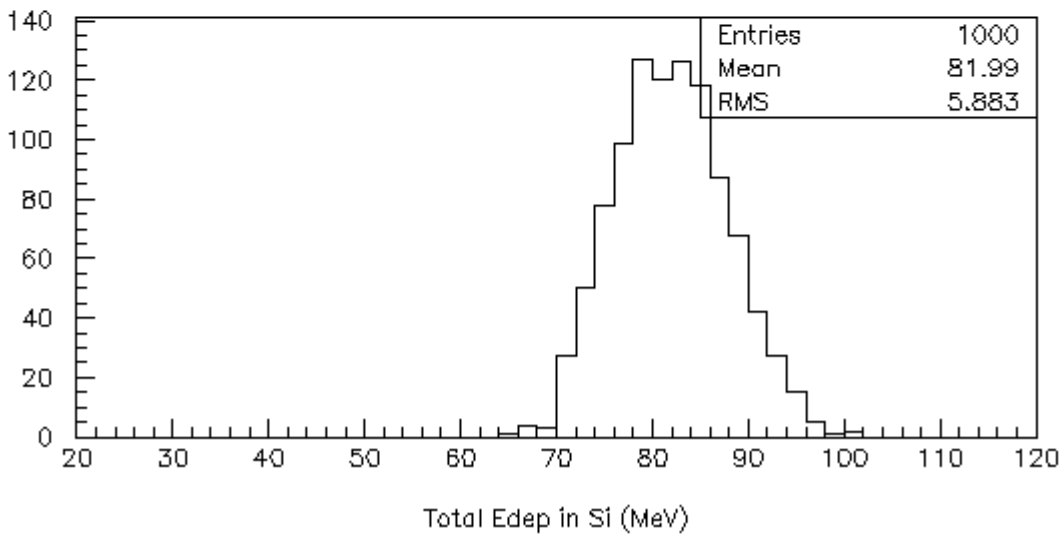
- pixel to pixel (expect this to be small, $< 1\%$)
- wafer to wafer (hope for1 %)

Just starting….

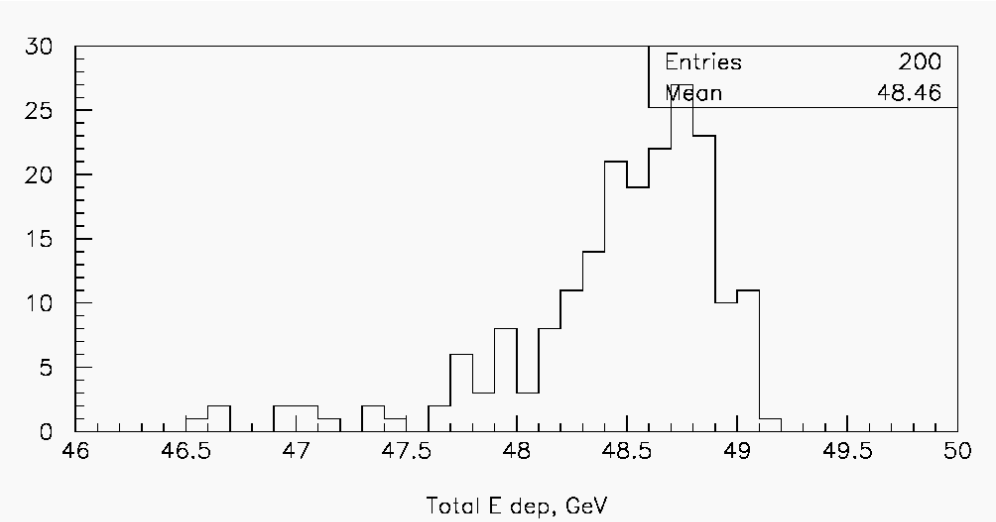


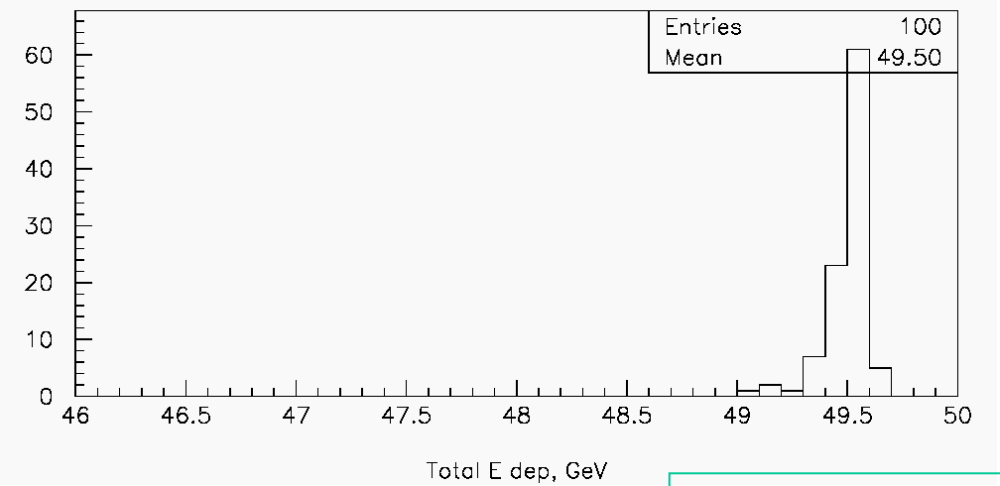
5 GeV photons

- no pixel cal. error
- 2% error



Alternative Sampling Configurations – old study





50 GeV electrons

30 x 5/7 X_0

20 x 5/7 X_0 + 10 x 10/7 X_0

- better containment
- poorer sampling

Cannot presently simulate the mixed config in standard SiD…

Graham: make it 40 x 5/7 X_0 but read out 10 of the last 20