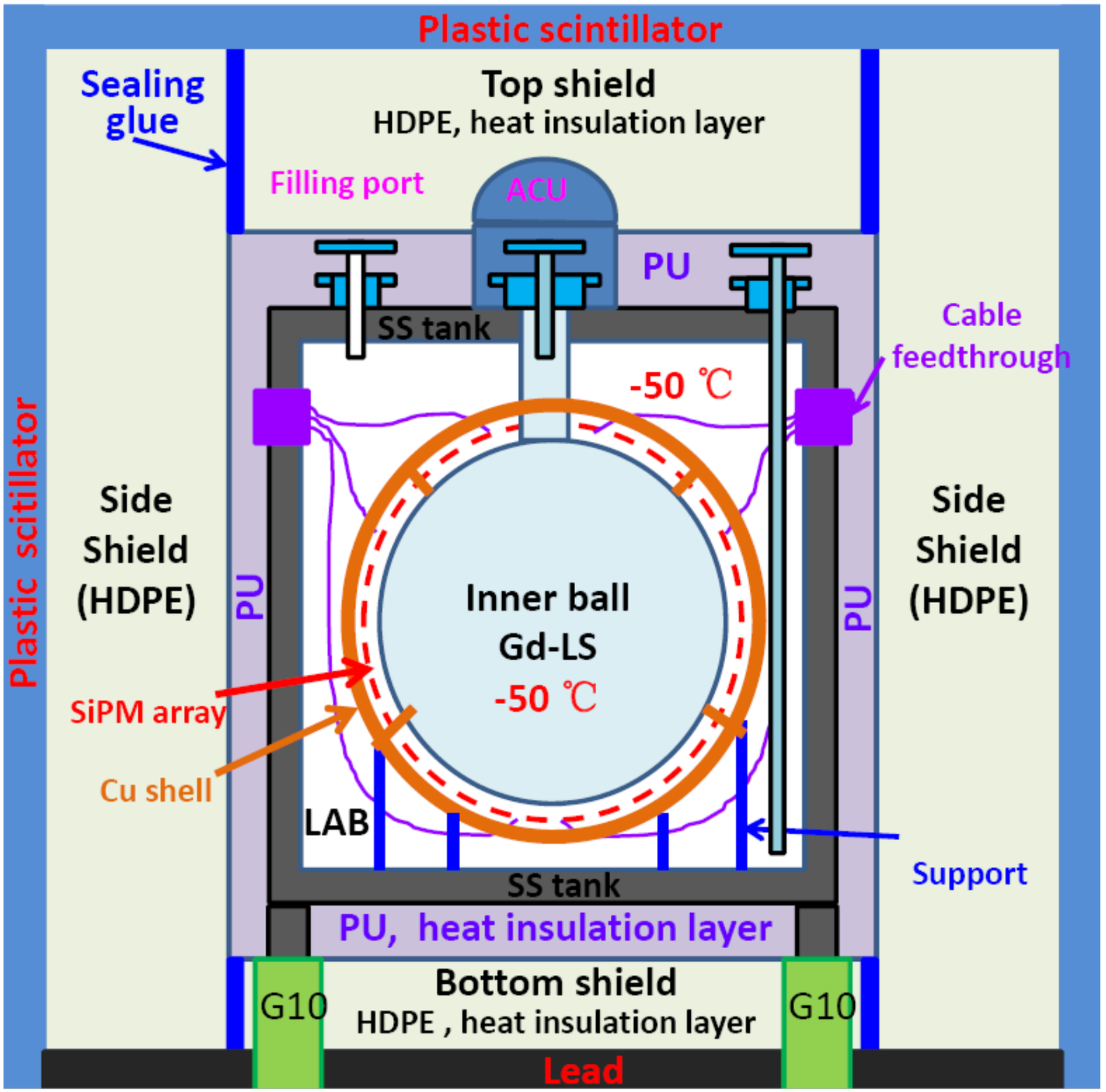
TAO DETECTOR SIMULATION

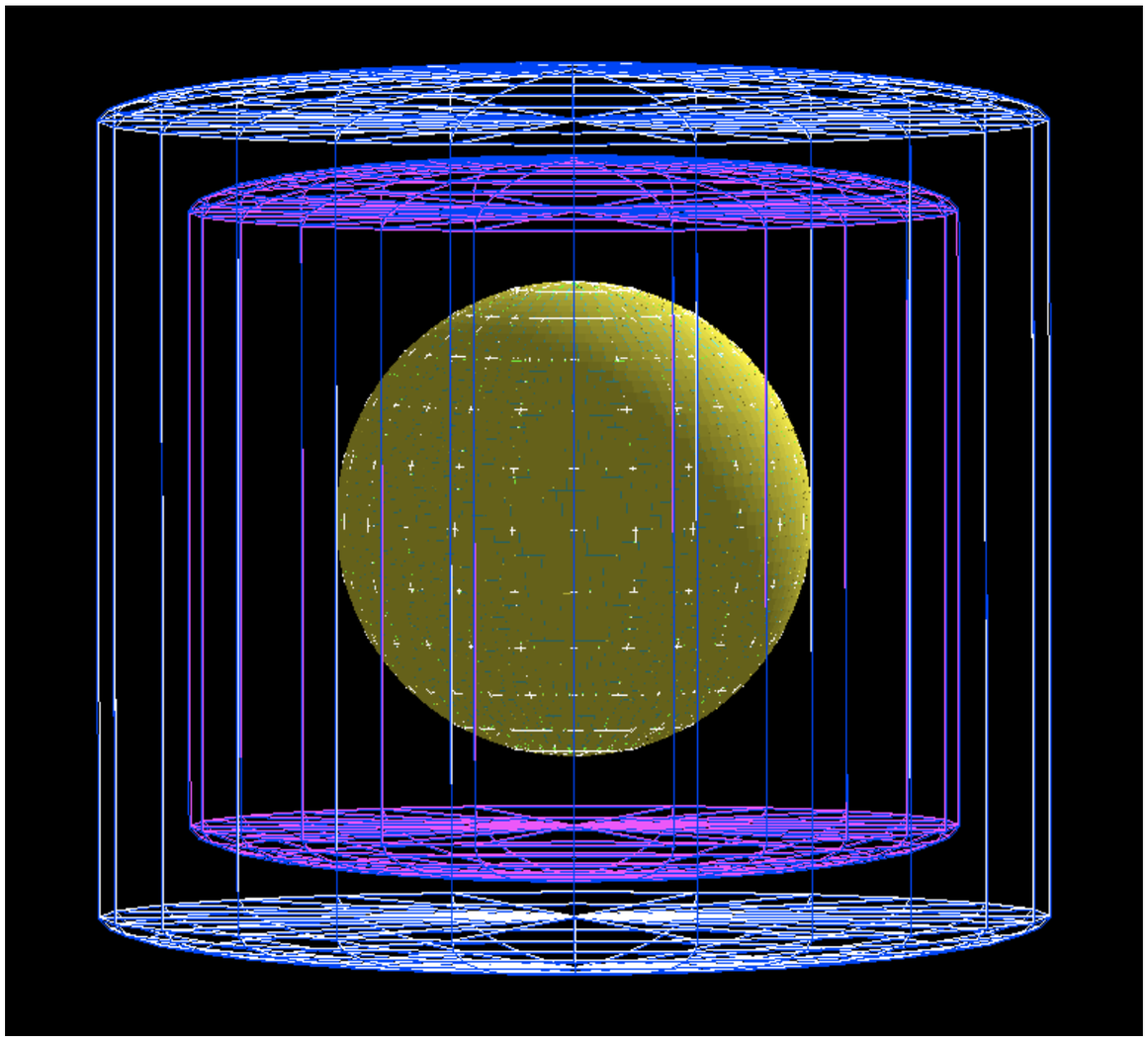
PAOLO MONTINI - ROMA TRE

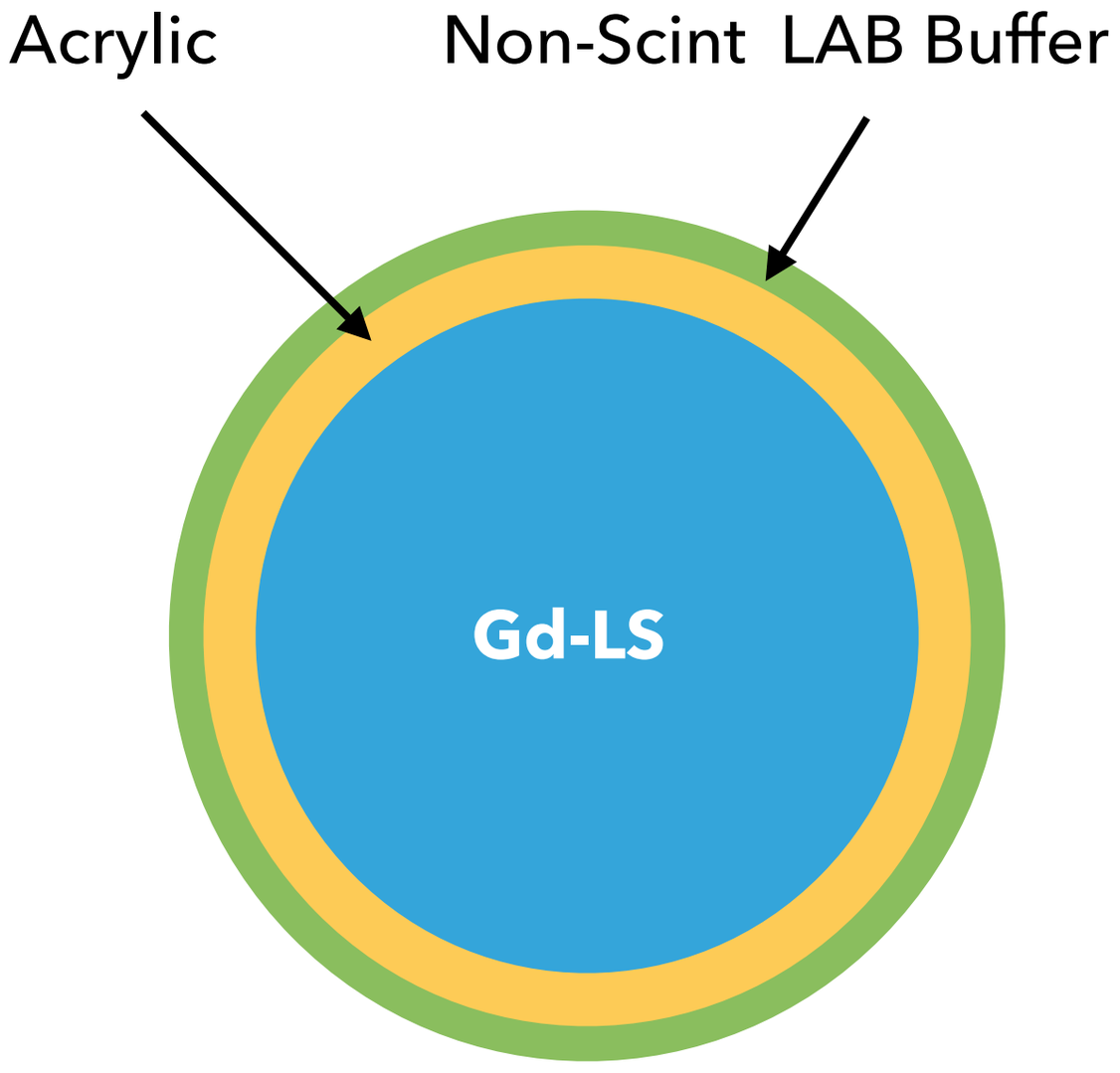
TAO DETECTOR



TAO SIM. SOFTWARE

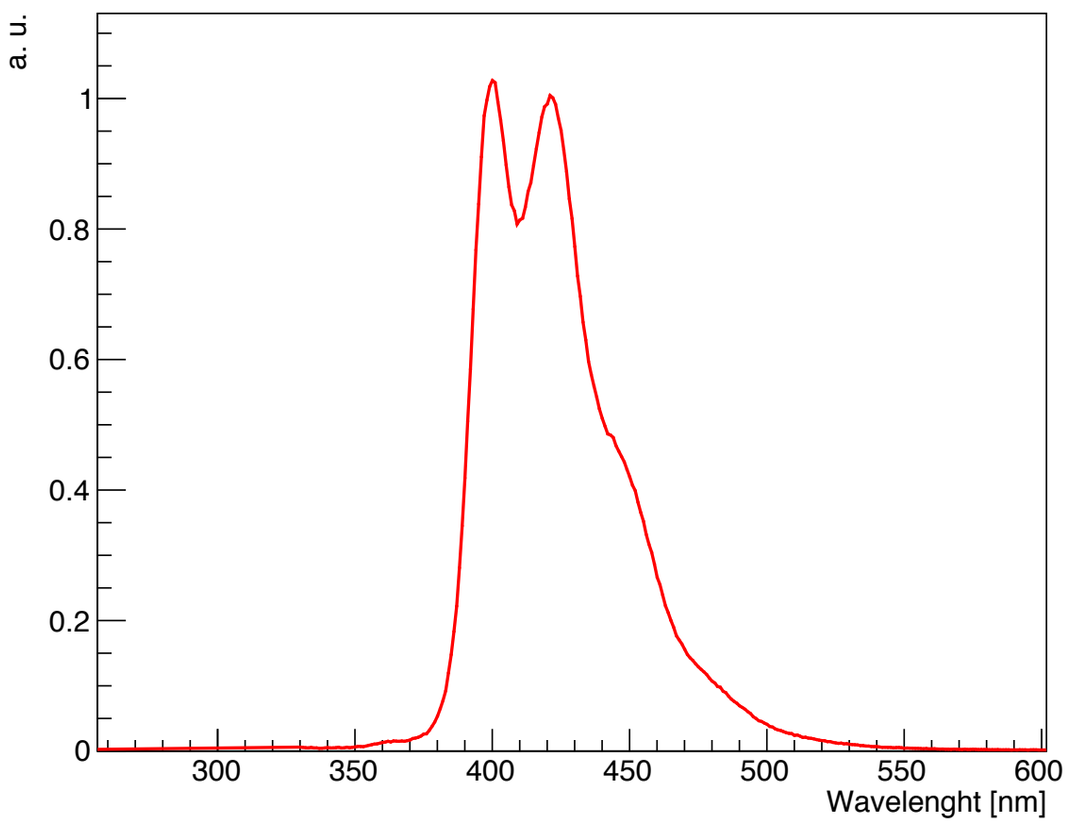
- Geant4 10.4 p02
- Gd-LS sphere 90 cm diameter
- 2 cm thick acrylic shell
- 1 cm thick LAB Buffer (non scintillating)
- Total surface ~ 10.9 m^2

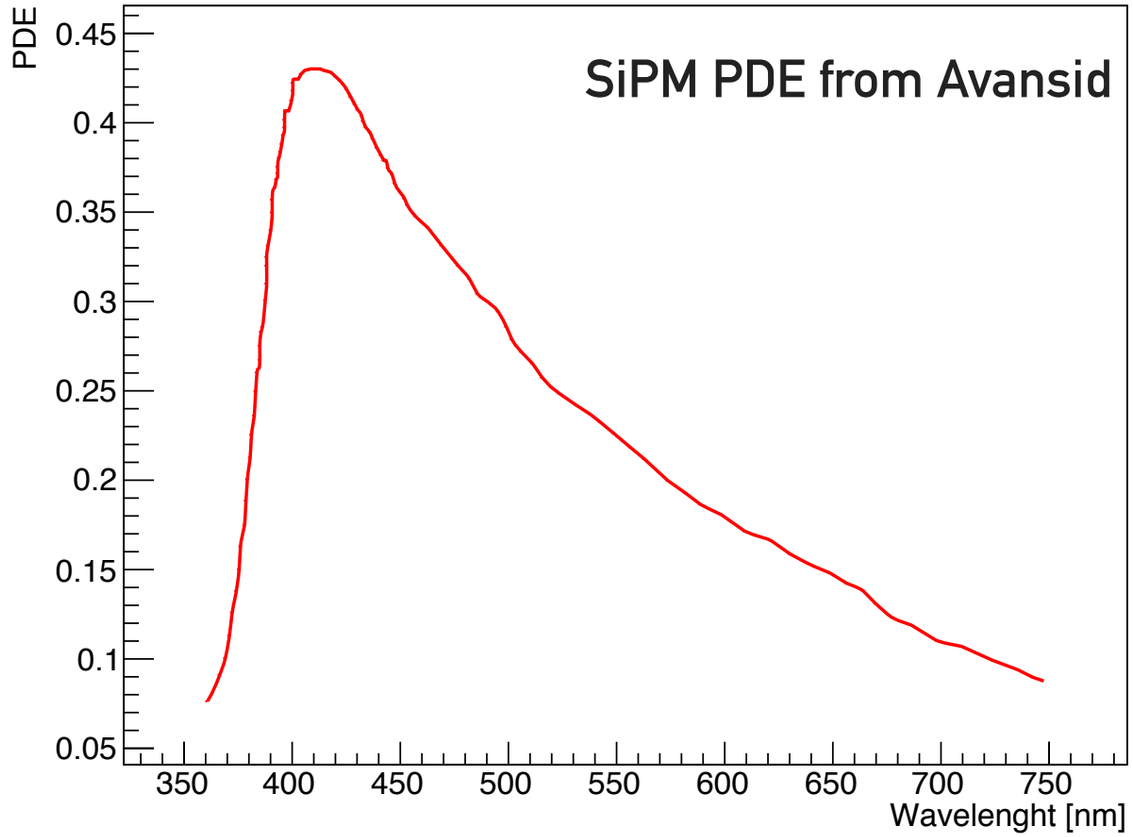




OPTICAL MODEL

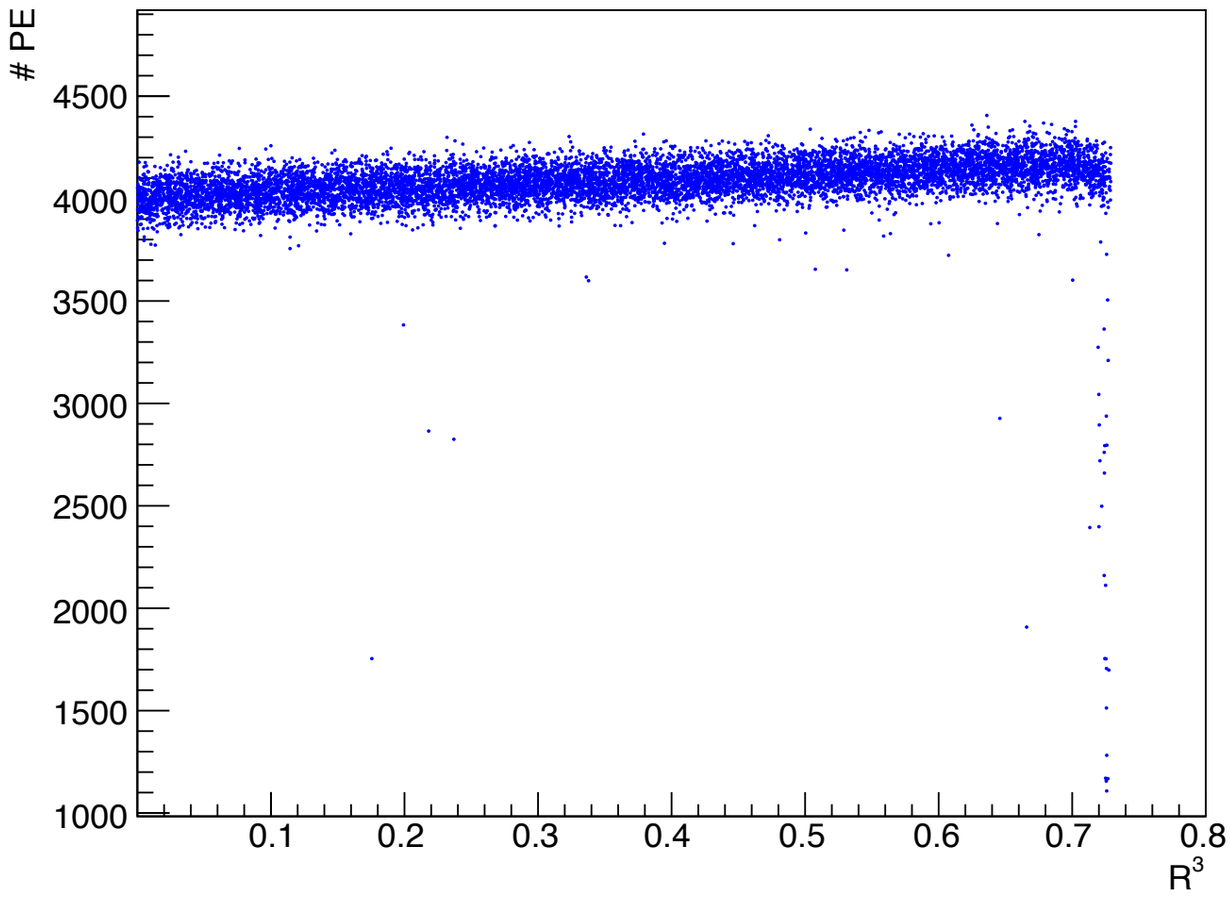
- “Naive optical model”
- GdLS emission spectrum & att. len. Taken from Day Bay
- Use standard G4 scintillation
- No scintillation by particle type —> no psd (WIP)

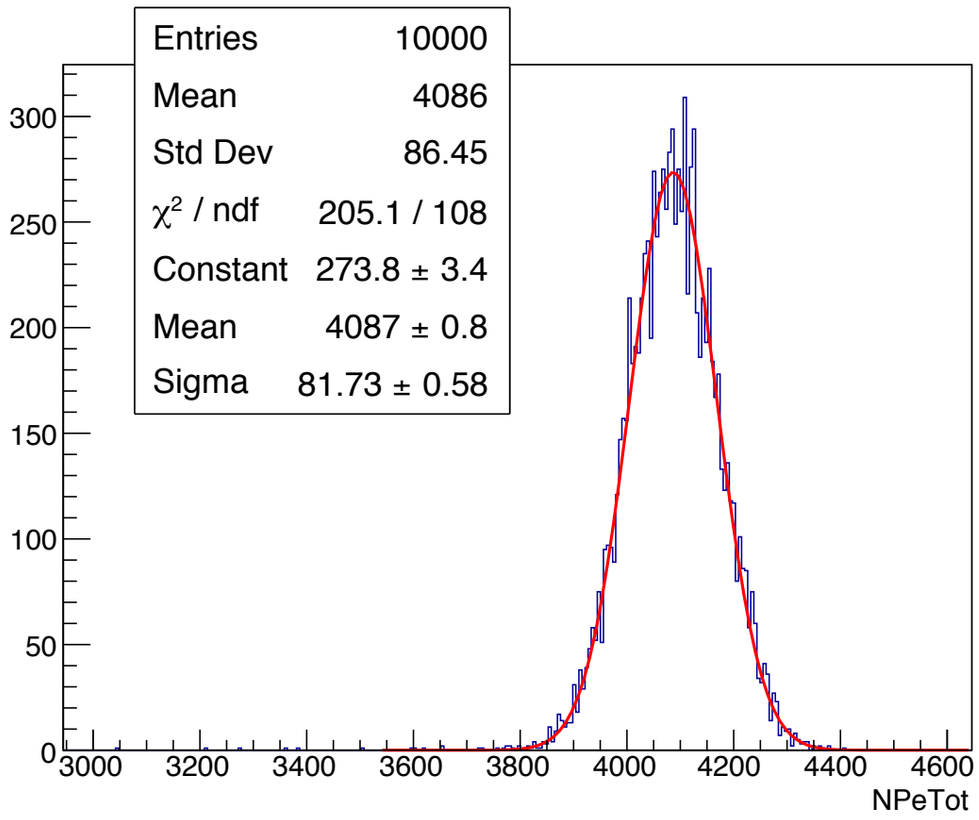


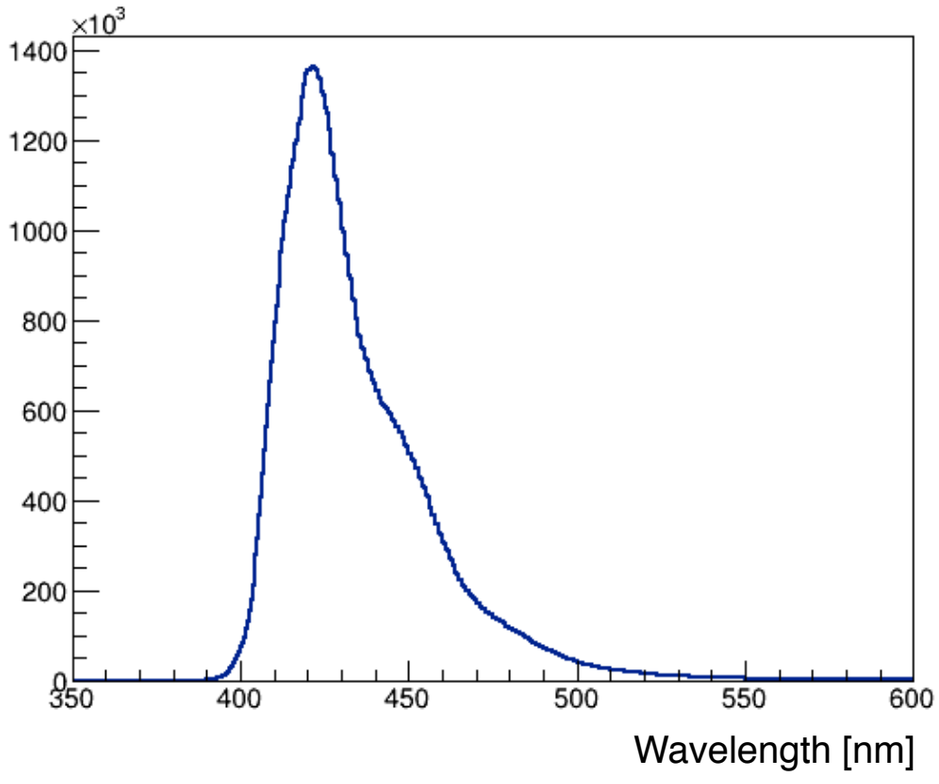


BASIC DISTRIBUTIONS

- 1 MeV electron randomly distributed in the LS volume

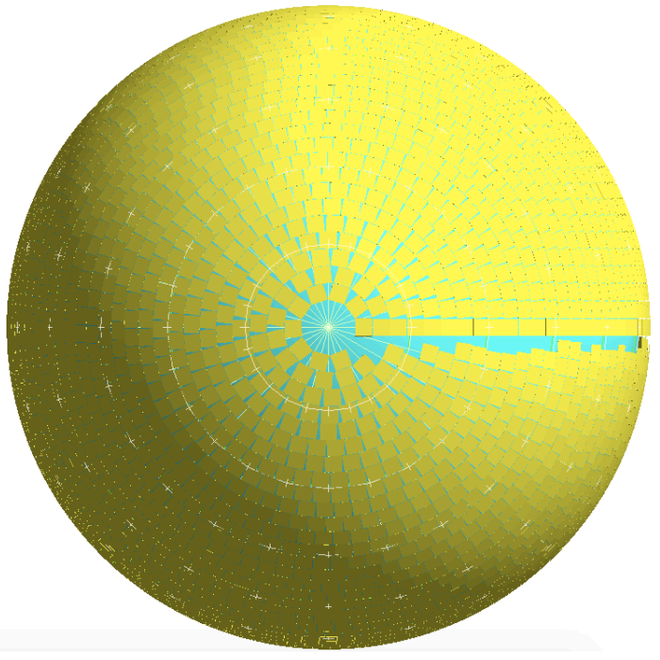


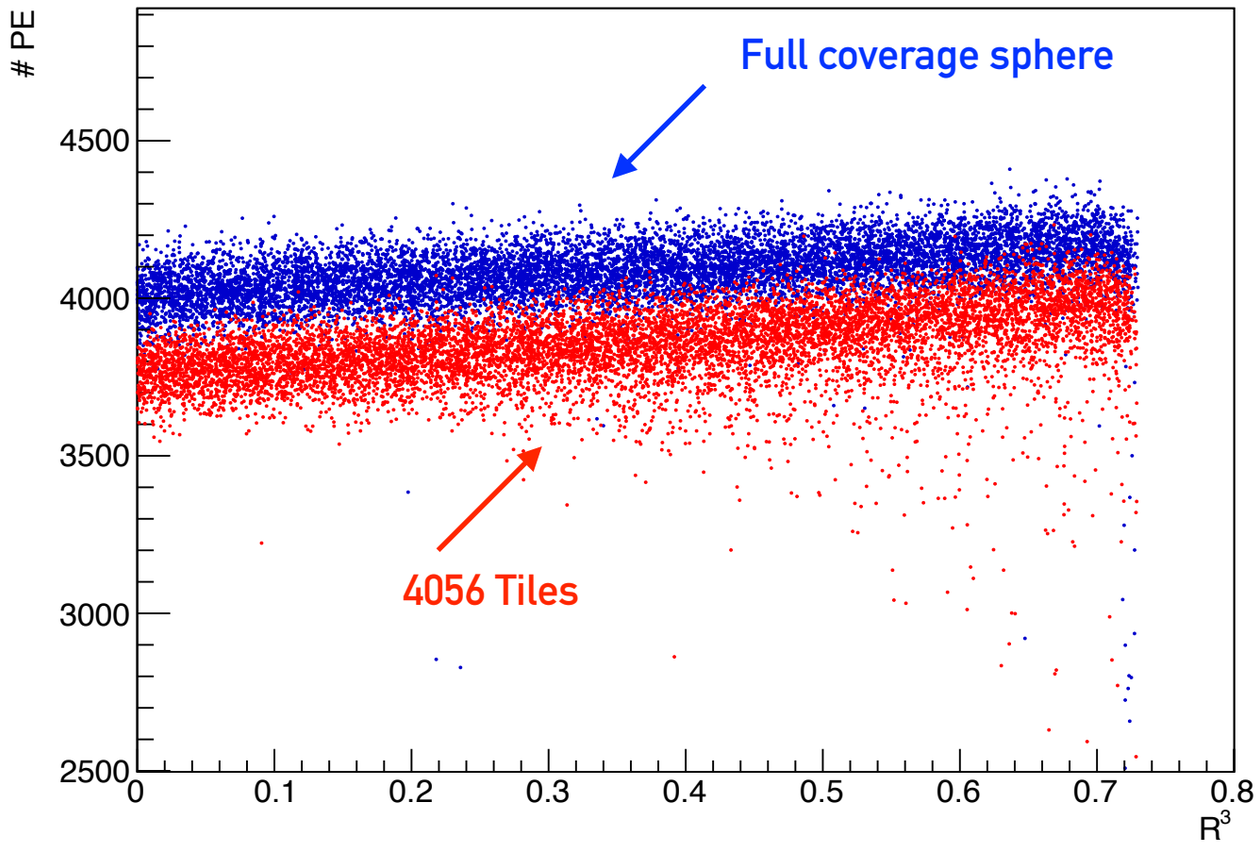


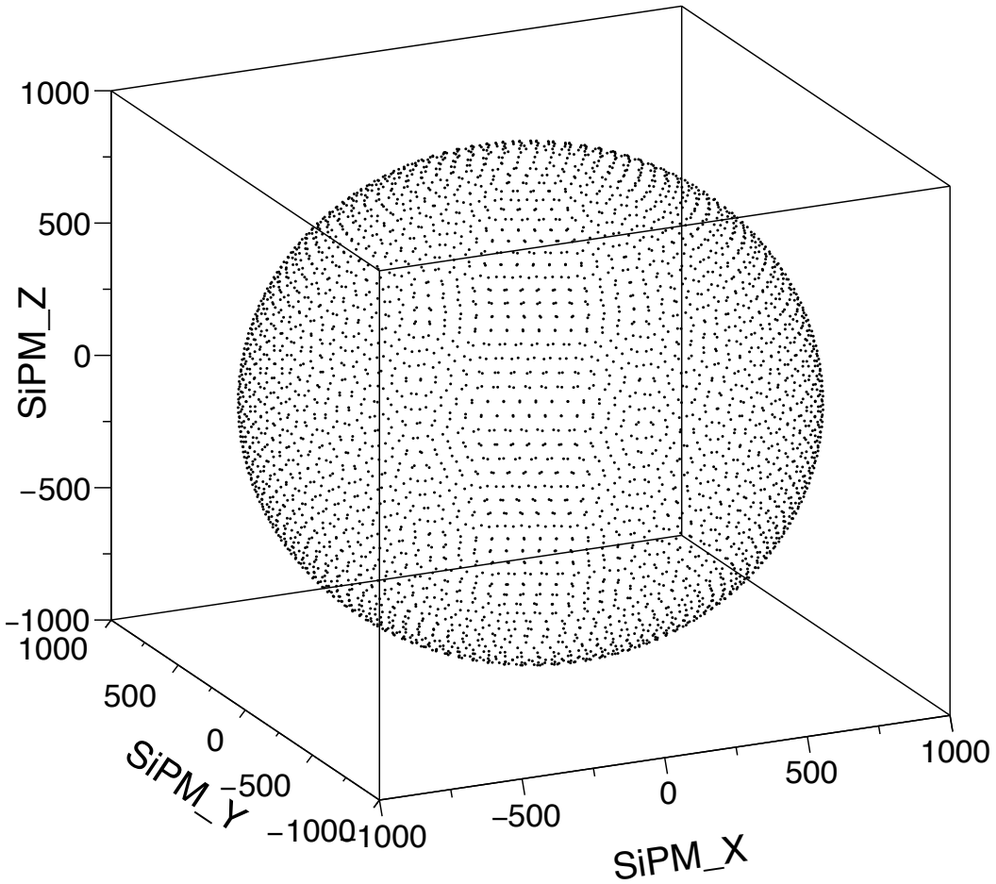


SIPM GEOMETRY

- 4056 5x5 cm^2 SiPM tiles
- PDE ~ 45% @ 420 nm
- Coverage loss due to the gaps between the SiPM boards
- Need to optimize the arrangement on the sphere
- ~94% Coverage

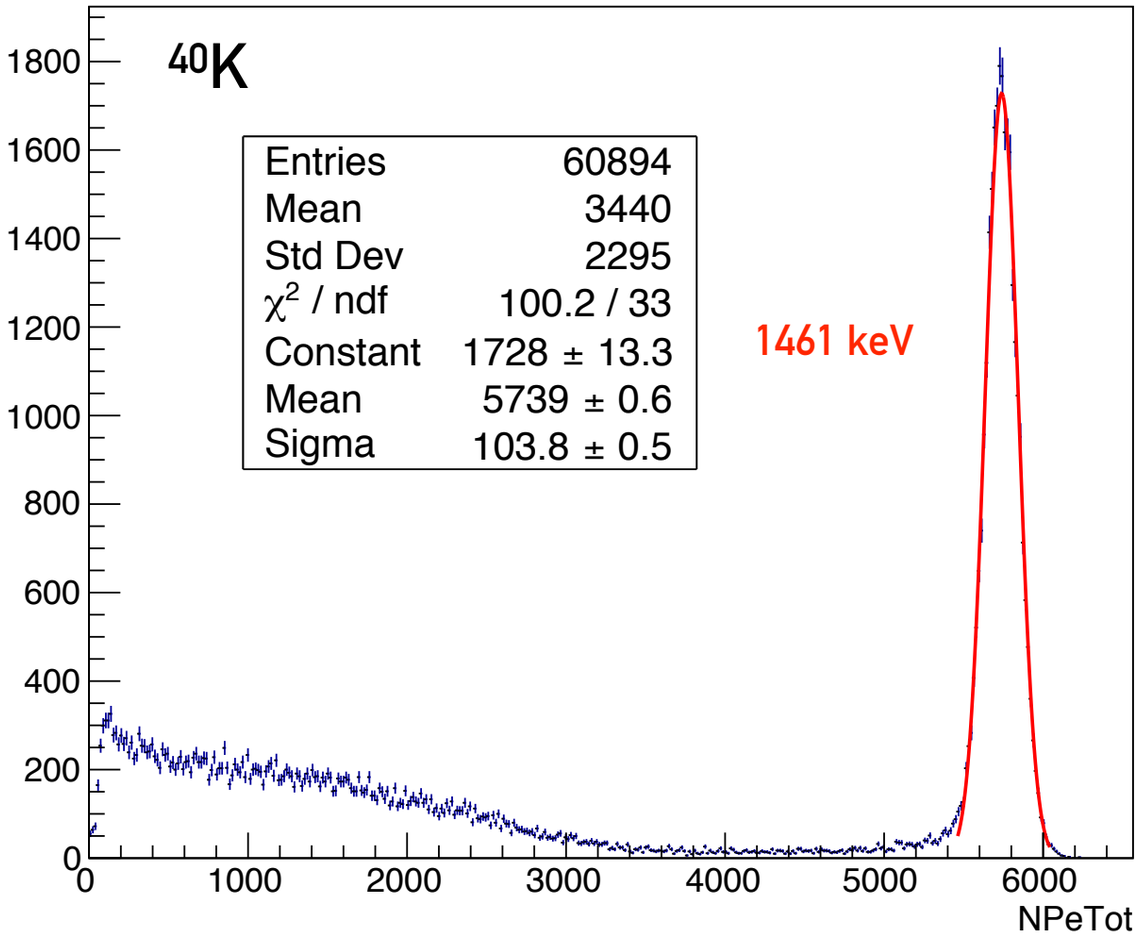


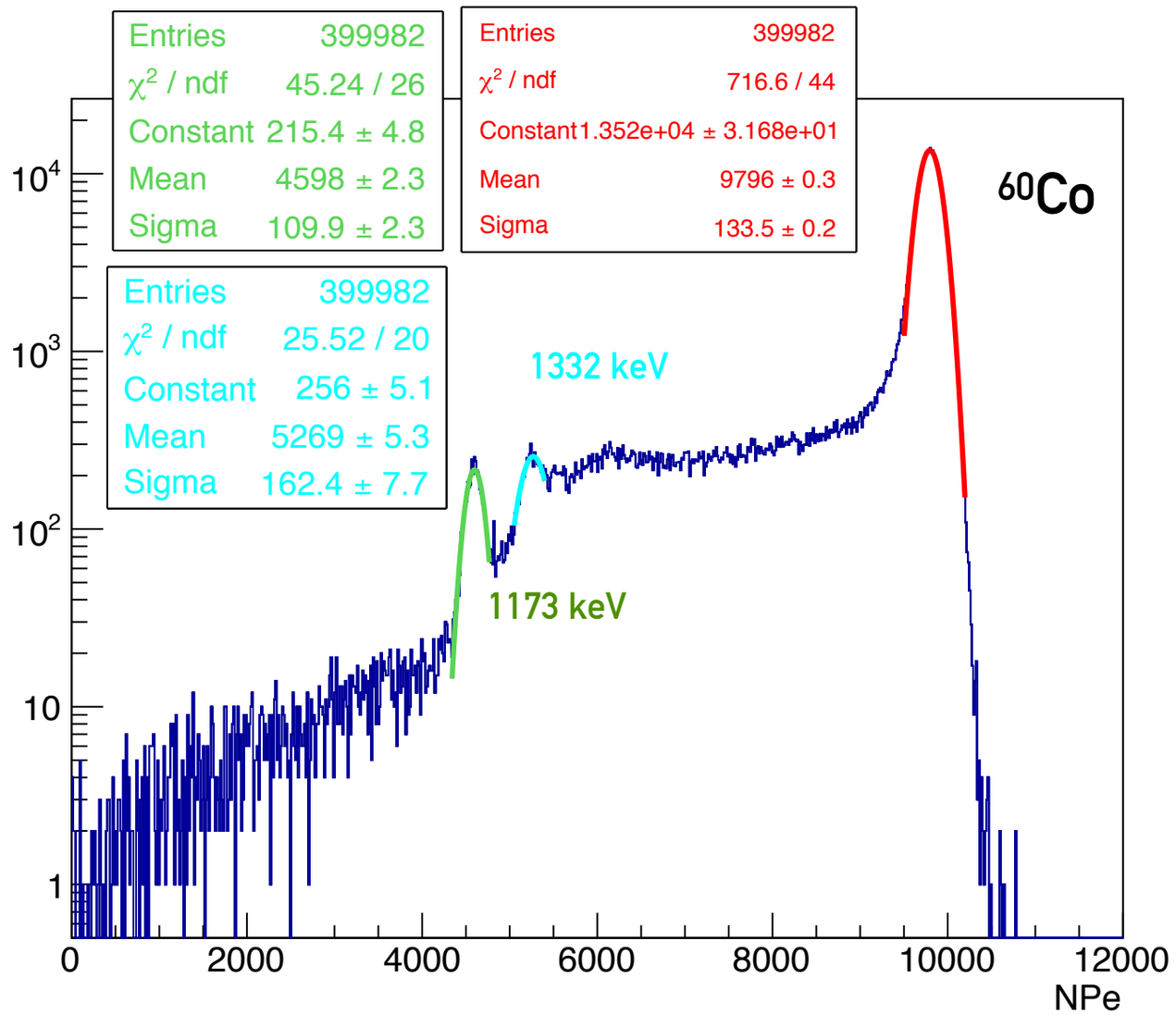




DETECTOR RESPONSE & RESOLUTION

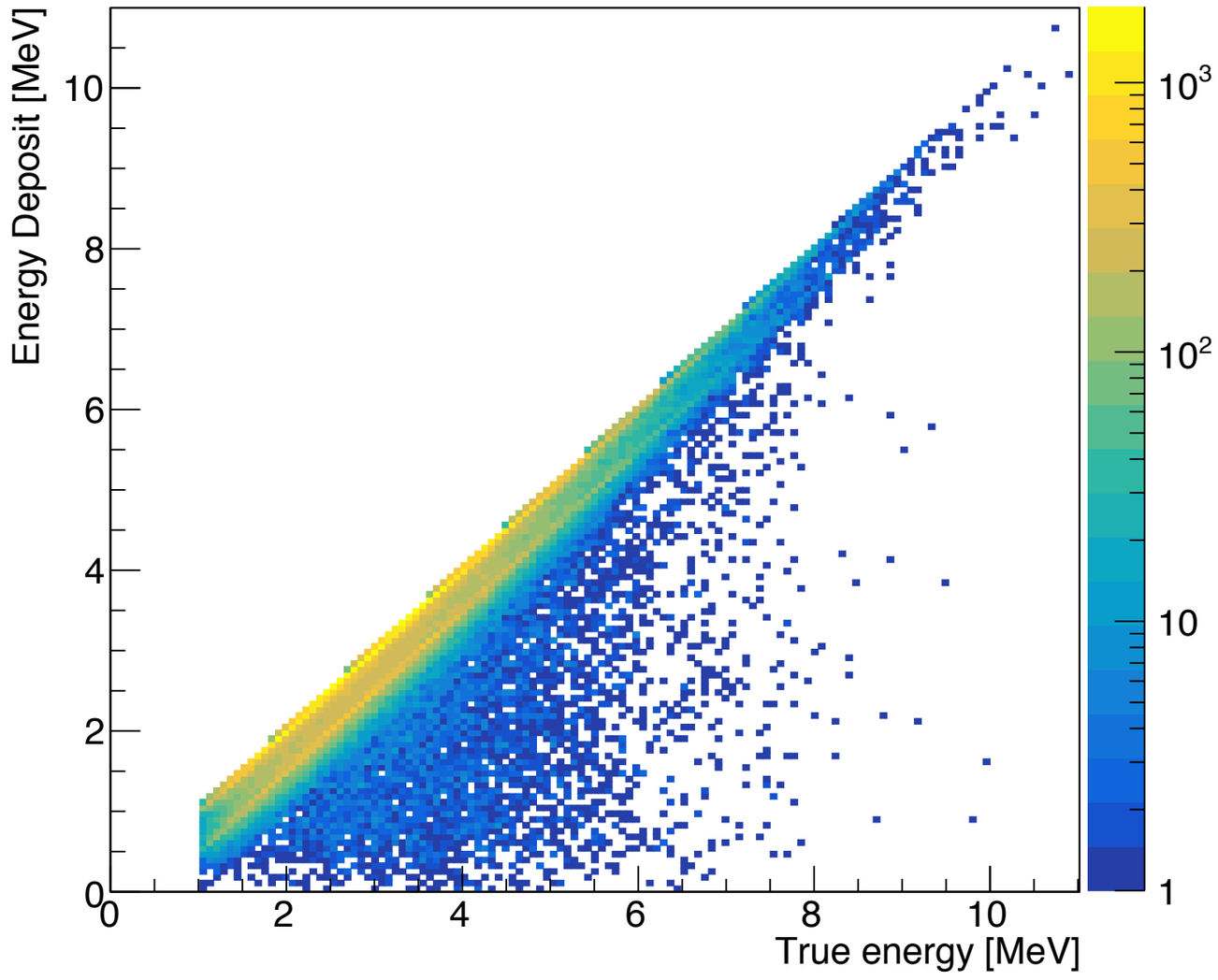
- "Calib. Source" in the detector center
- LY > 3900 PE/MeV
- Resolution ~ 1.6%/MeV



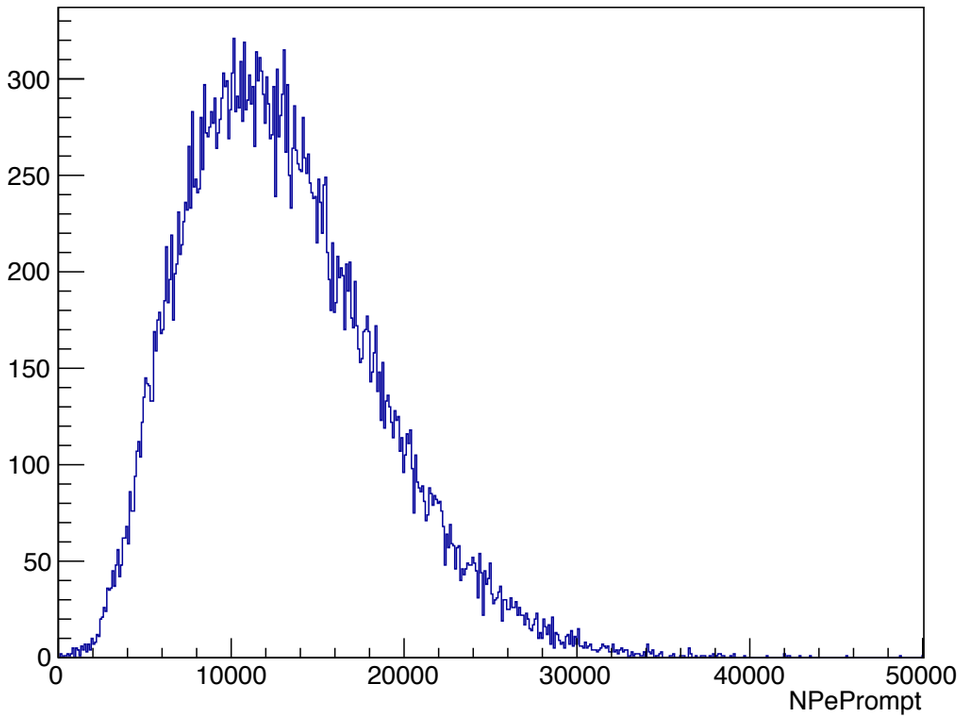


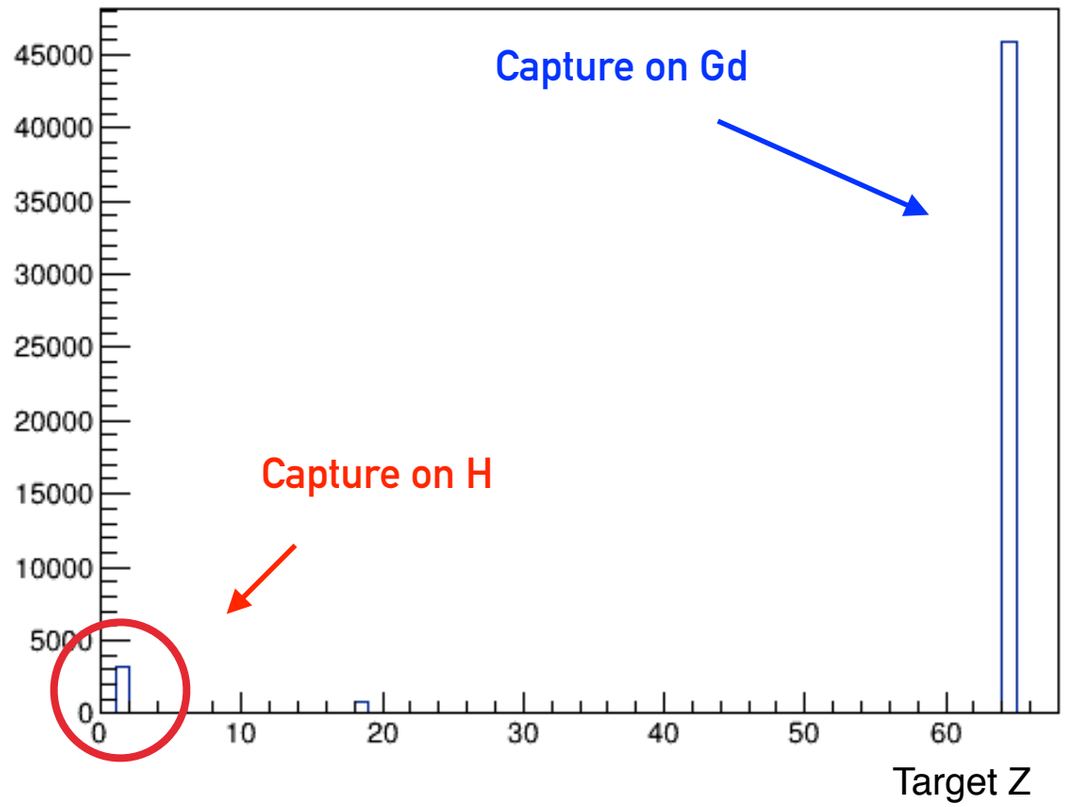
ENERGY LEAKAGE

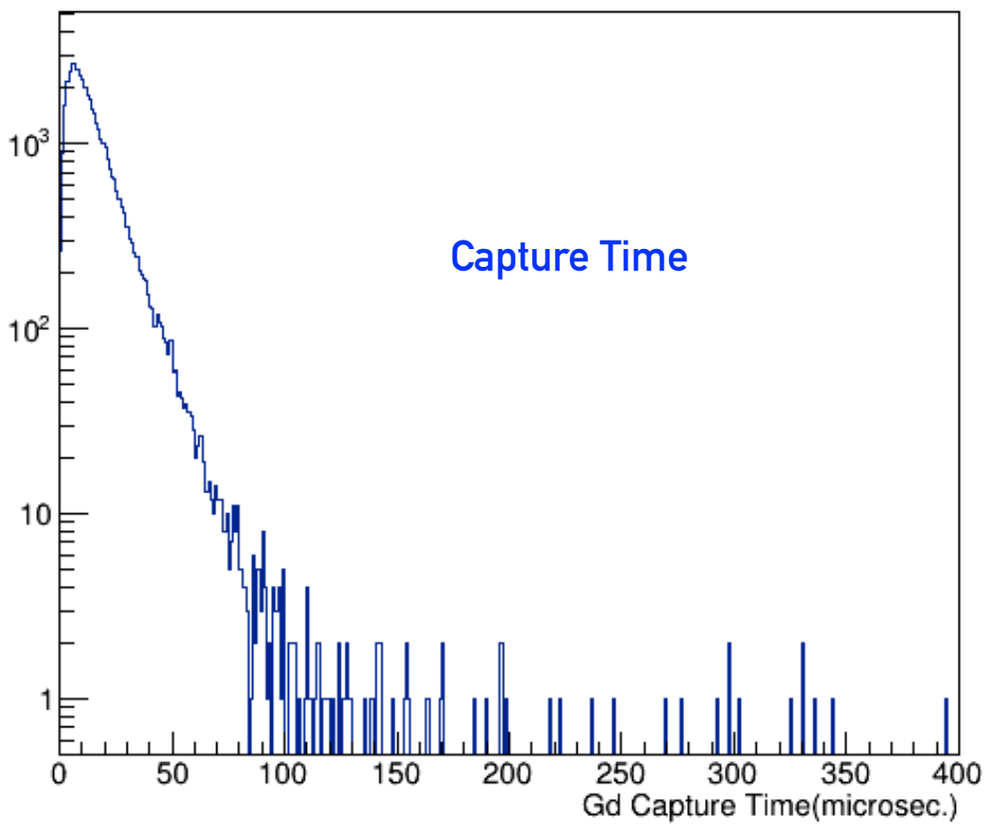
- Investigate the spectral distortion due to the size of the detector
- Fiducial cut is needed



IBD SIGNAL

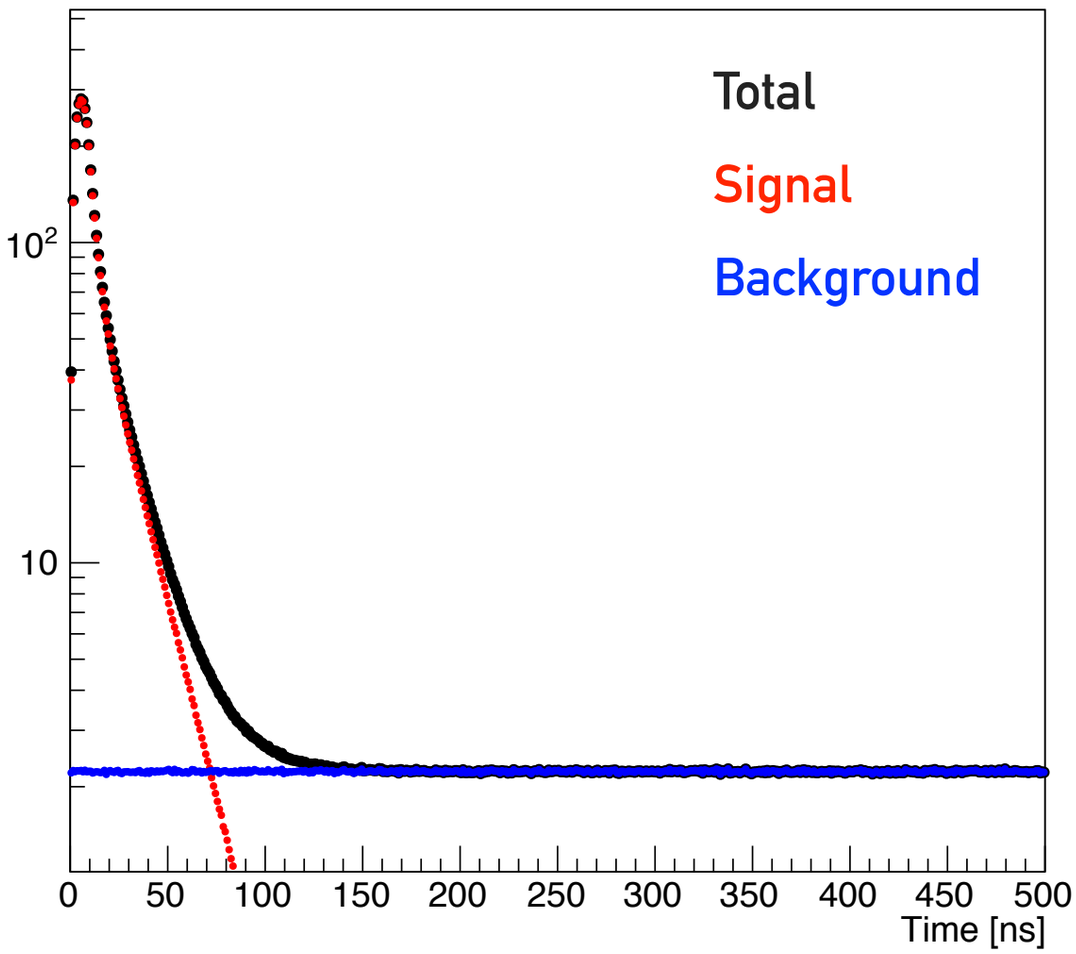

300
250
200
150
100
50
0
0
10000
20000
30000
40000
50000
NPePrompt

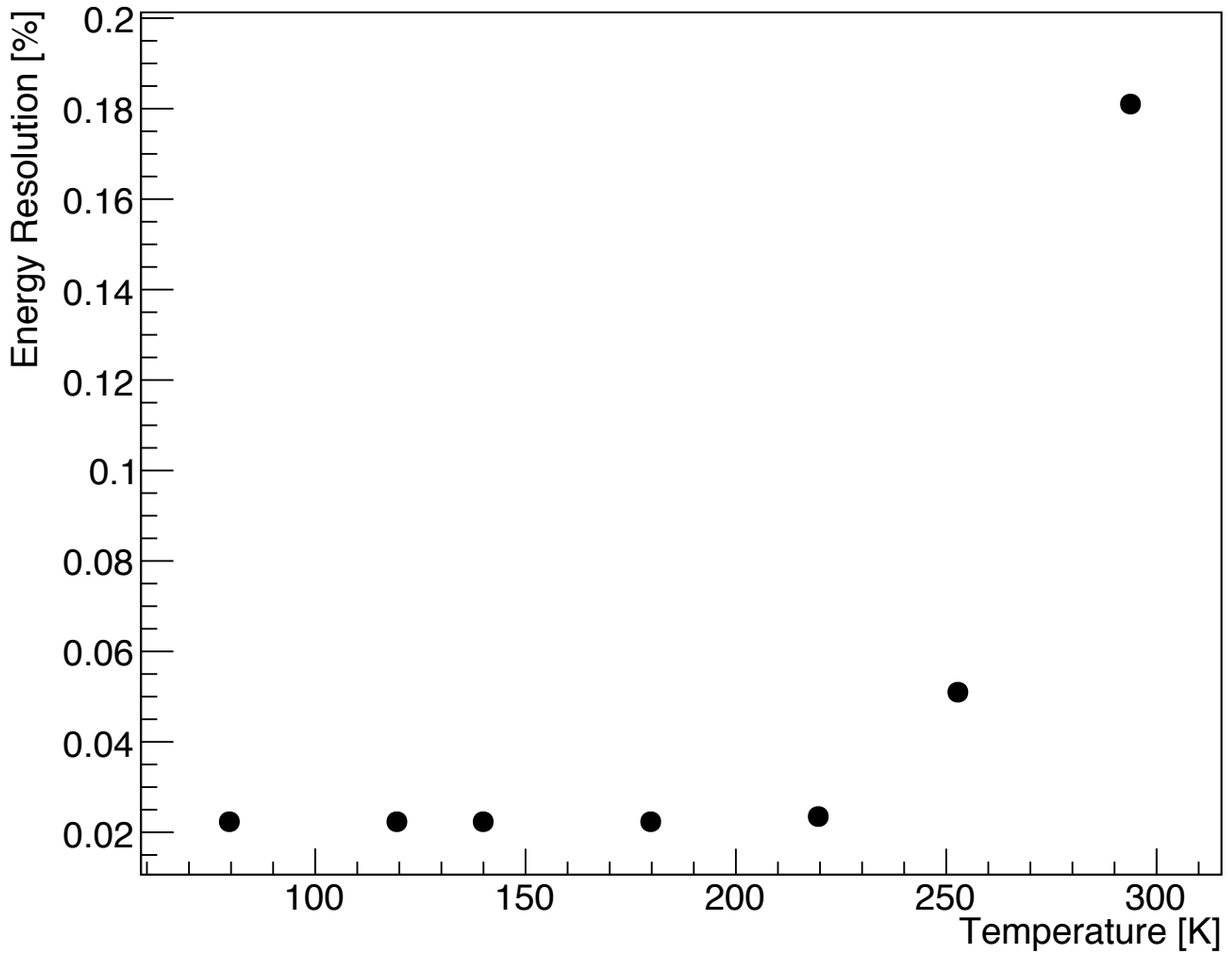

45000
40000
35000
30000
25000
20000
15000
10000
5000
0
0
10
20
30
40
50
60
Capture on Gd
Capture on H
Target Z


10^3
10^2
10
1
0
50
100
150
200
250
300
350
400
Gd Capture Time(microsec.)
Capture Time

ENERGY RESOLUTION

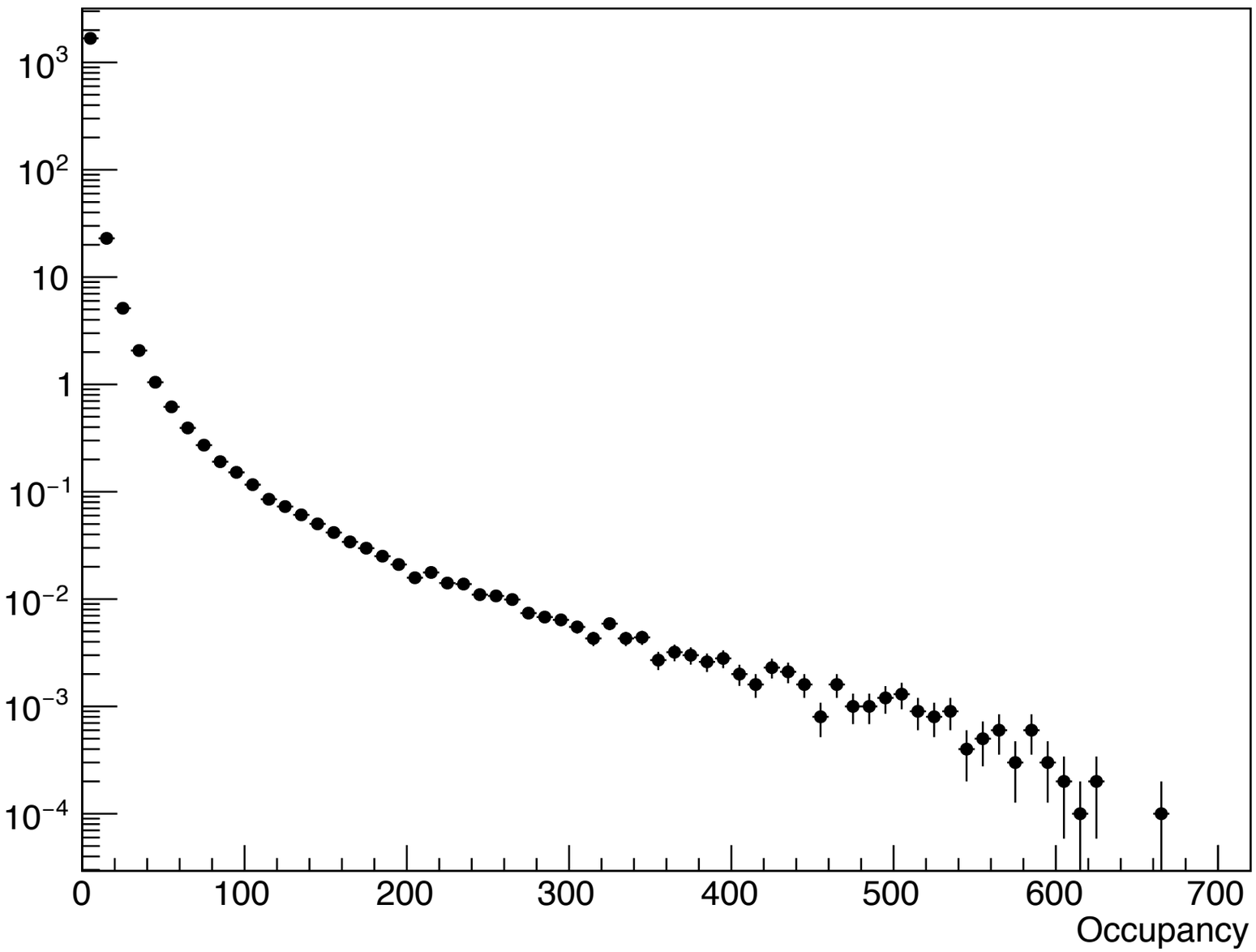
- Add random noise to each channel
- Energy resolution depends on the SiPM dark noise
- Assuming a 500 ns integration time window Energy resol. Is ~ 2% @ 220 K





OCCUPANCY

- Number of photos seen by each 5*5 cm2 SiPM Tiles
- 10.000 1 MeV electrons randomly distributed in the Scintillator sphere



CONCLUSIONS

- Code is finally stable
- Basic distributions seem ok
- Need some optimization and improvements
  - More accurate optical model
  - Scintillation by particle type —> PSD
- Coordination with the Chinese colleague
- Deeper investigation on the SiPM occupancy
  - Electronics dynamic range
  - Trigger