Gamma Flux

Bubble Chamber Expected Rates – Sept 2015

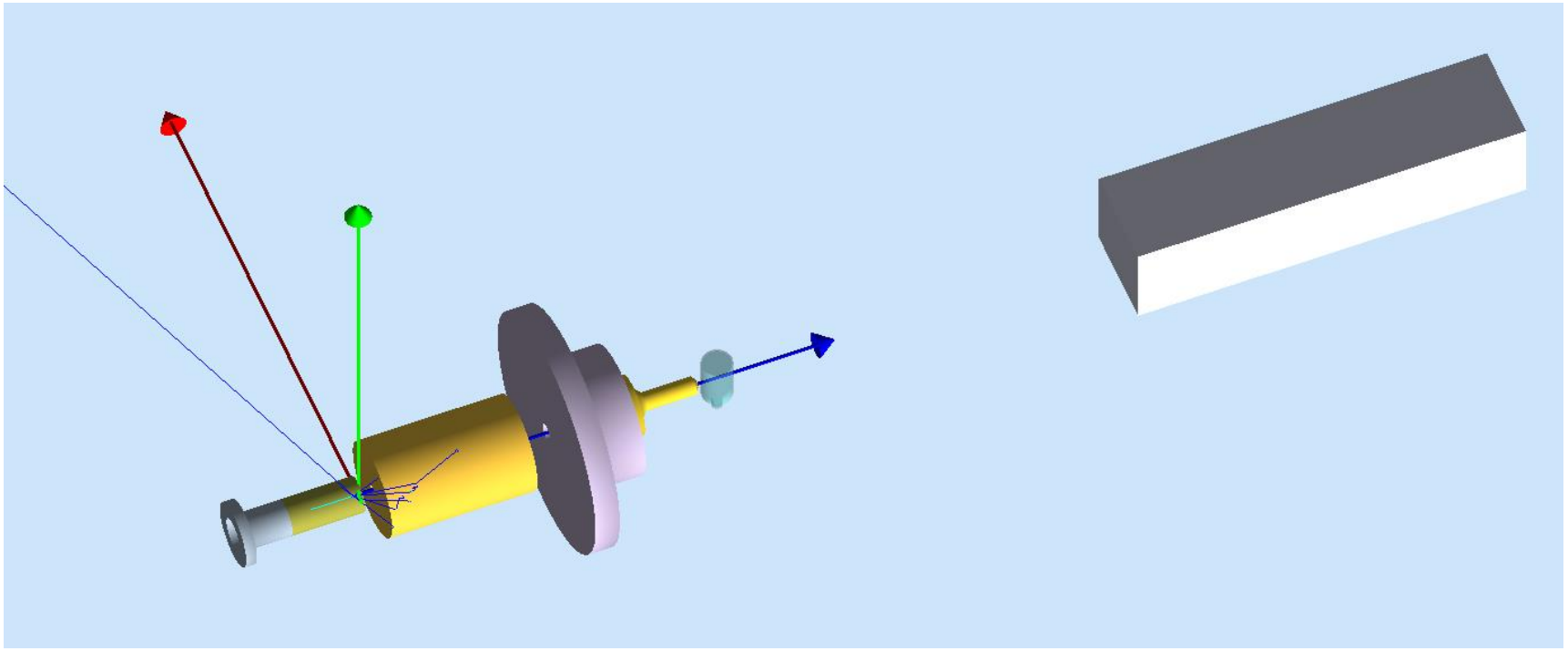
January 20, 2016

OUTLINE

- GEANT Model
- Gamma Flux vs Electron Kinetic Energy
- Expected Natural N_2O Rate
- Expected Rates of:
  I. $^{18}O(\gamma,\alpha)^{14}C$
  II. $^{17}O(\gamma,n)^{16}O$
  III. $^{14}N(\gamma,p)^{13}C$
- Remarks

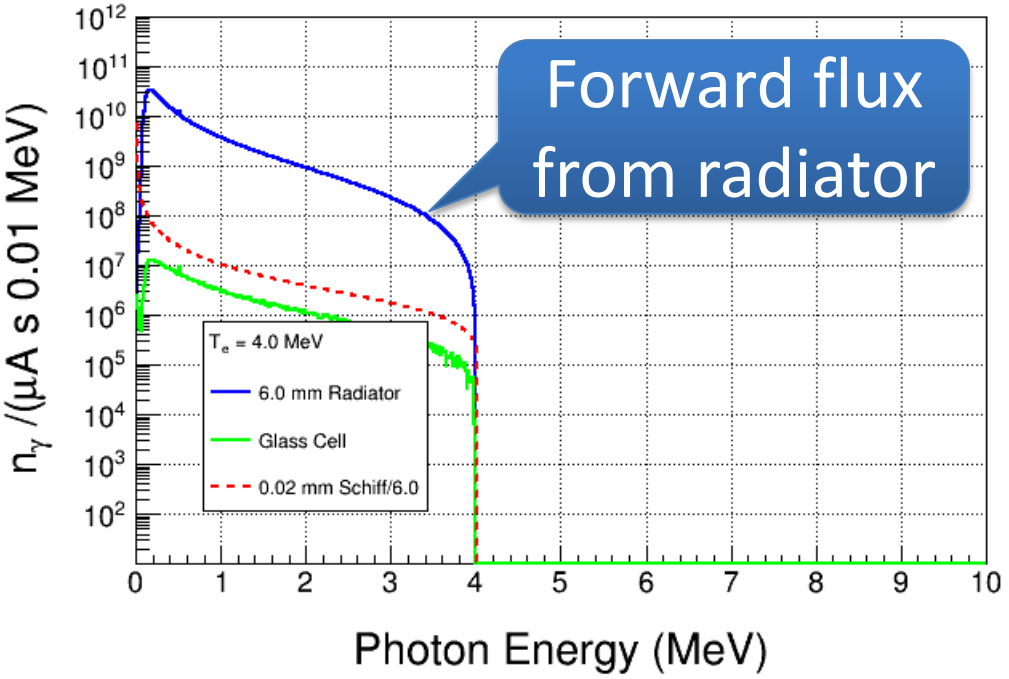
GEANT4 MODEL

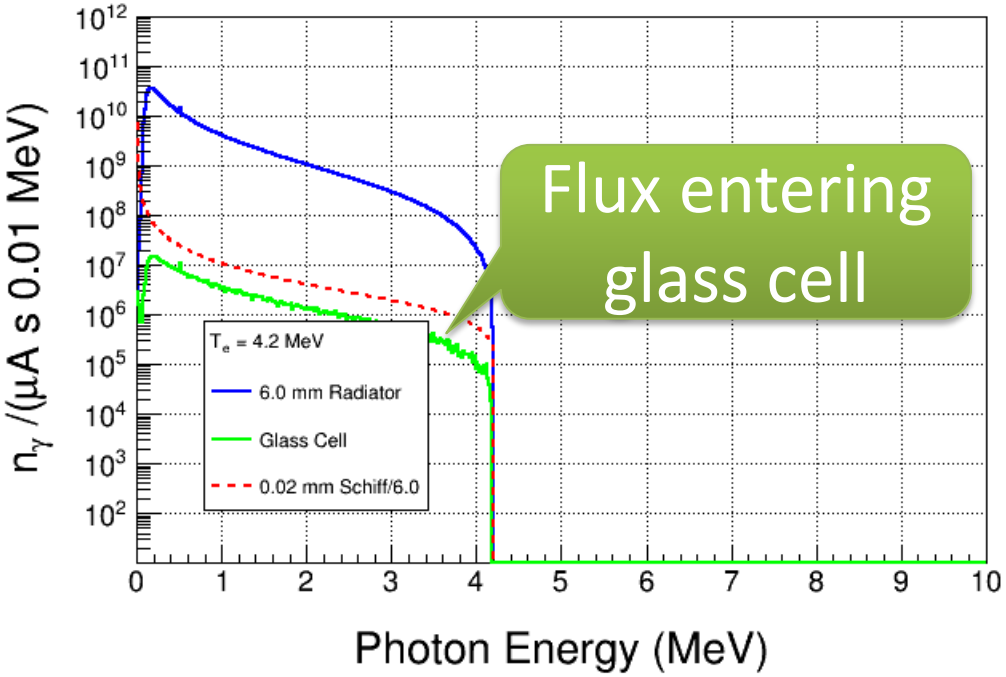
- Gap between radiator and collimator = 0.59 inches
- Distance between radiator and center of glass cell = 14.02 inches



Total N_γ =
9.3×10^8 /(μA s)

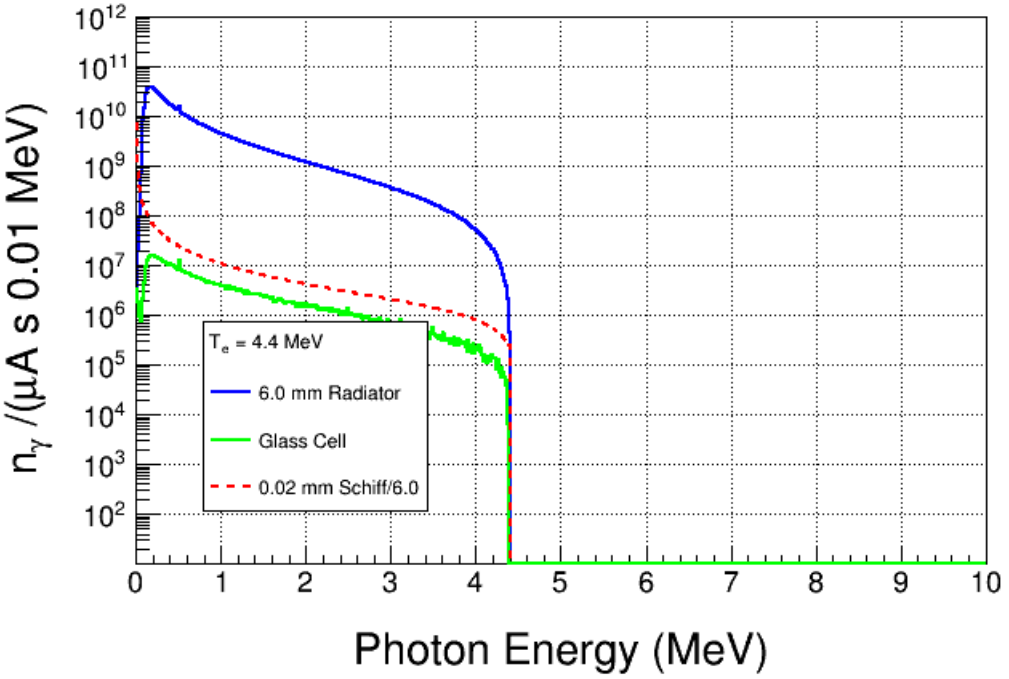
GEANT4 Cut = 1 keV

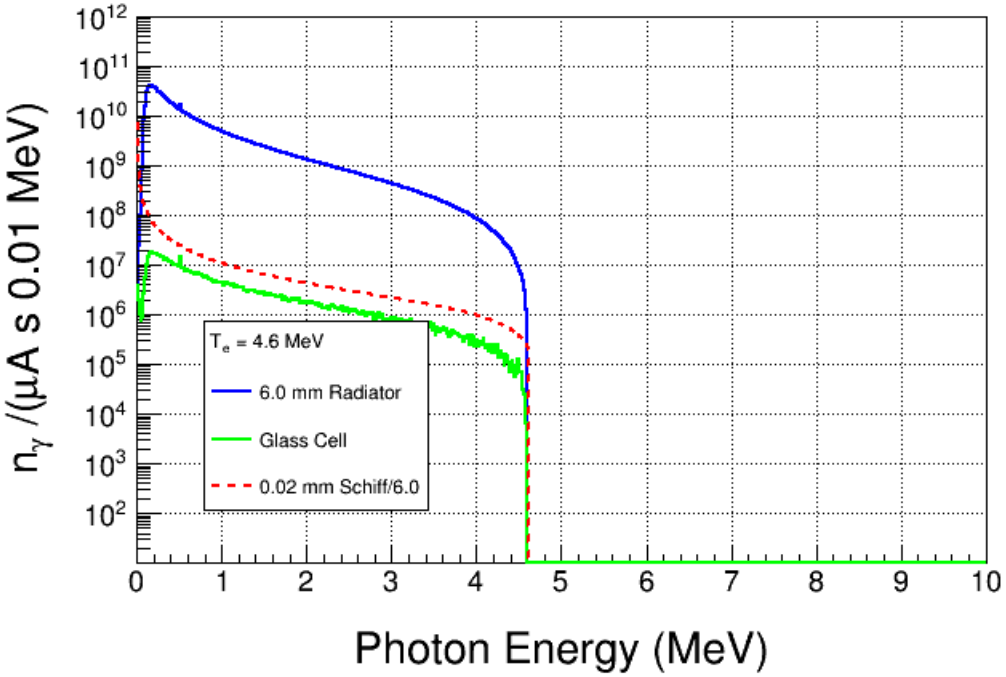




Total N_γ =
1.1×10^9 /(μA s)

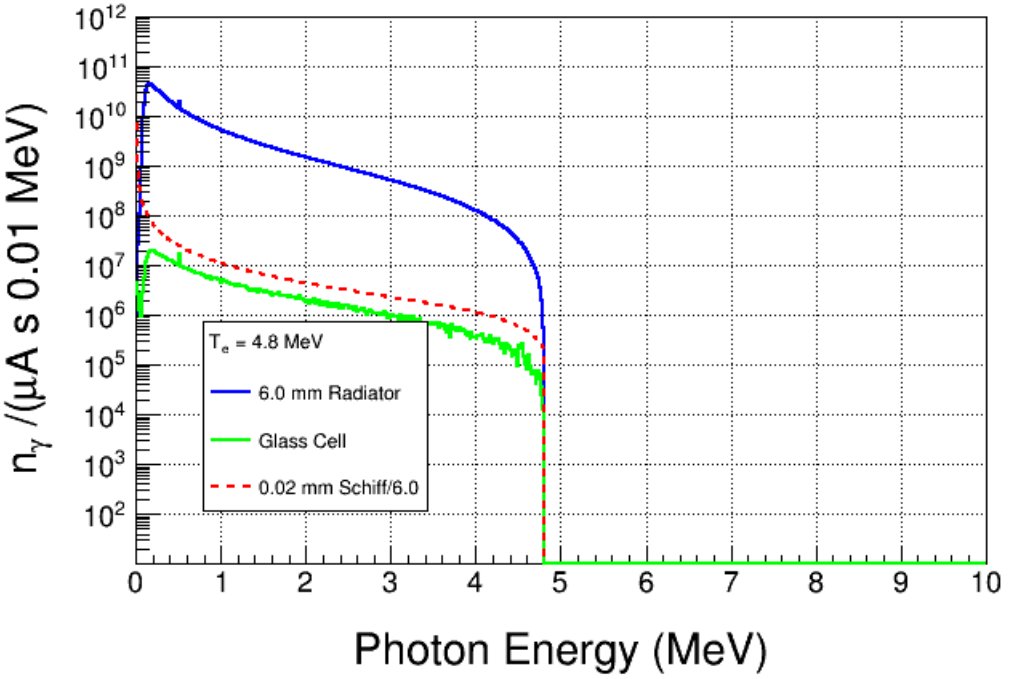
Total N_γ =
1.2×10^9 /(μA s)

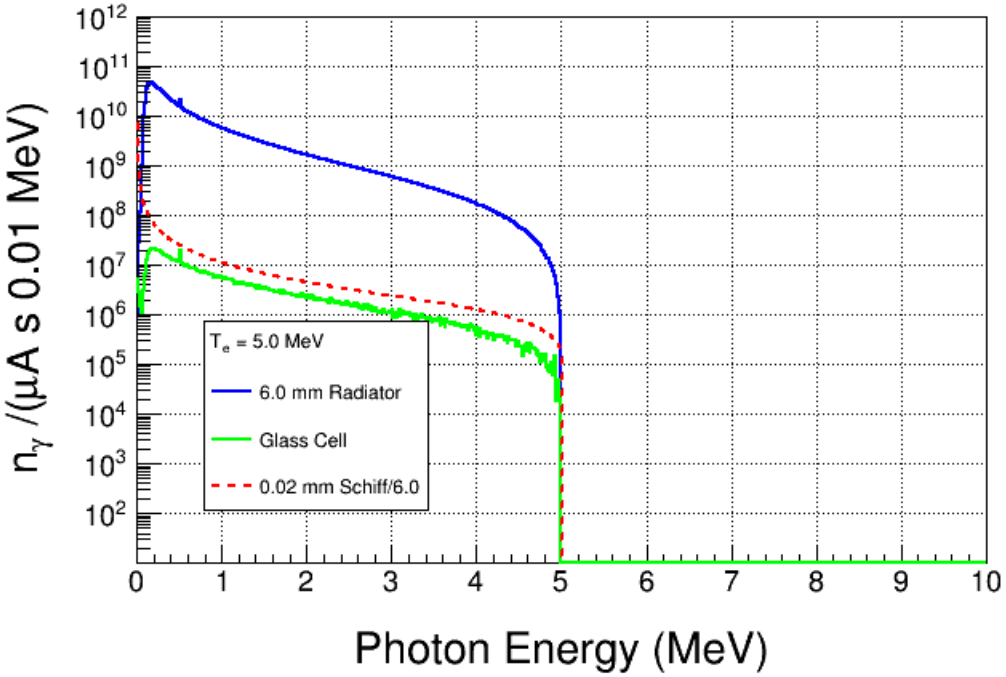




Total N_γ =
1.3×10^9 /(μA s)

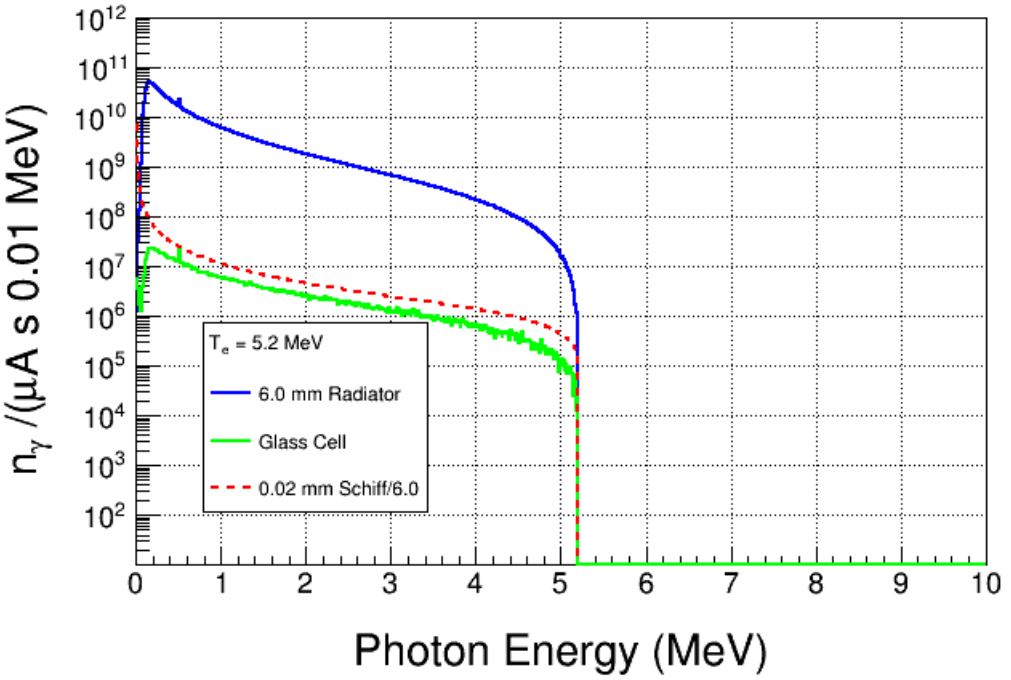
Total N_γ =
1.5×10^9 /(μA s)

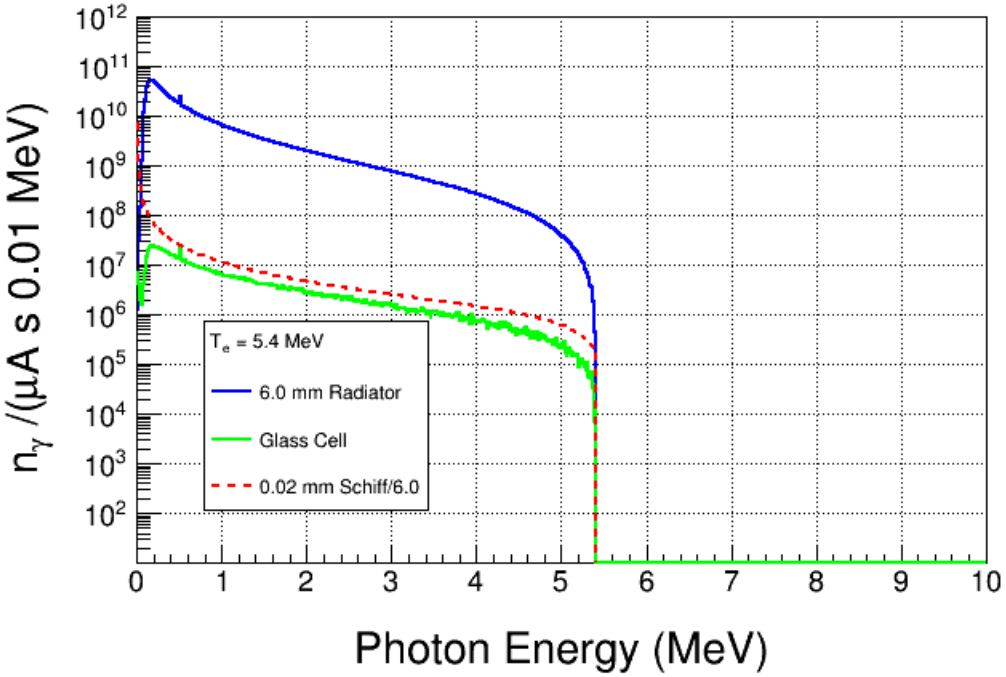




Total N_γ =
1.7×10^9 /(μA s)

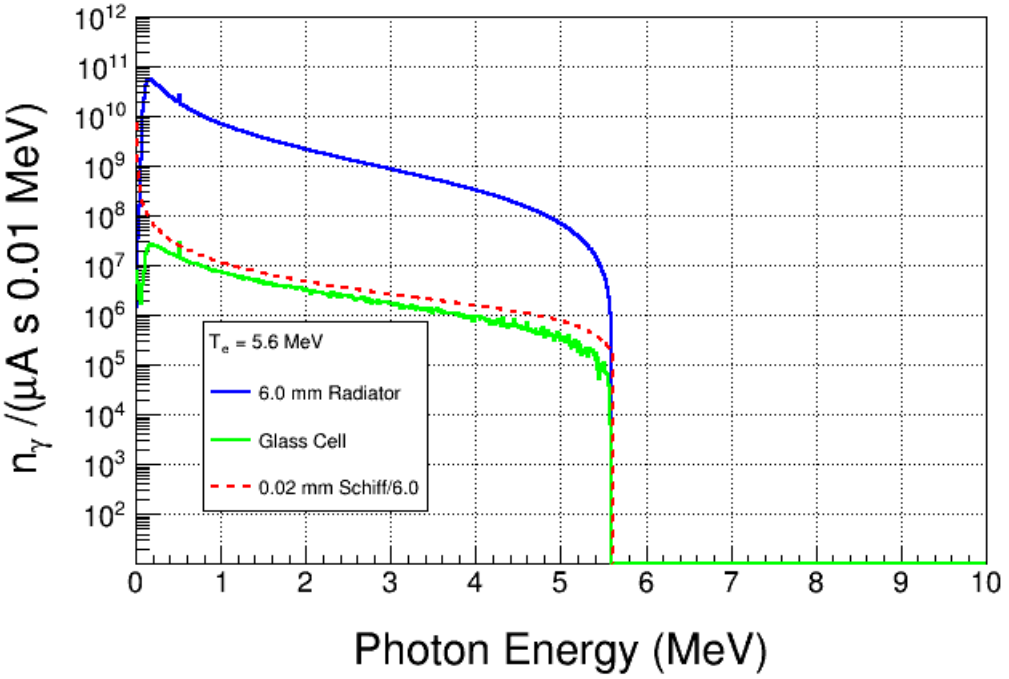
Total N_γ =
1.9×10^9 /(μA s)

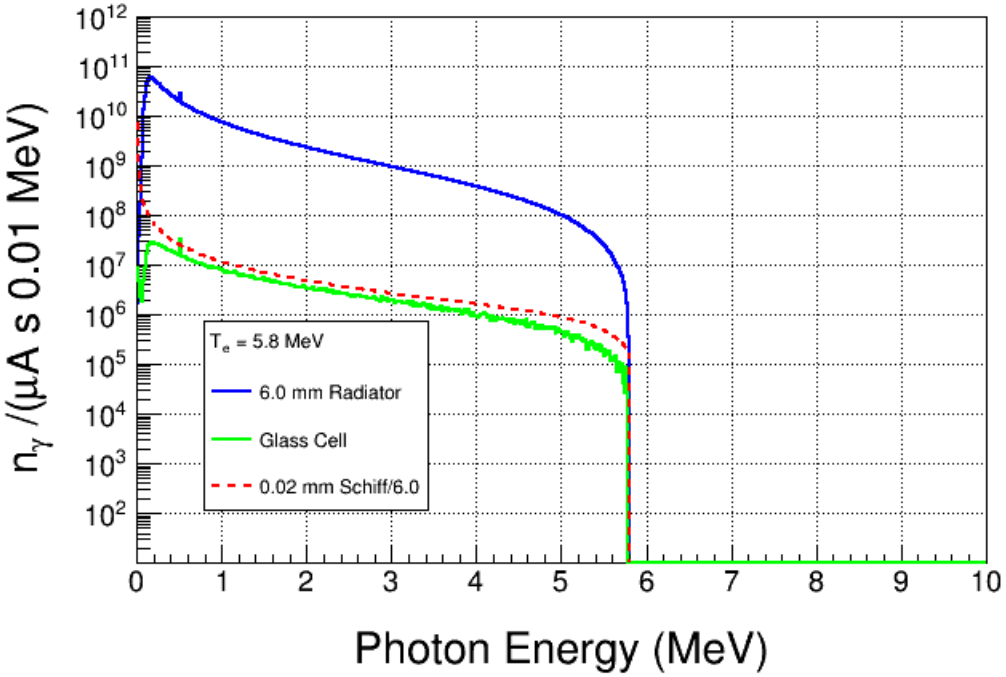




Total N_γ =
2.1×10^9 /(μA s)

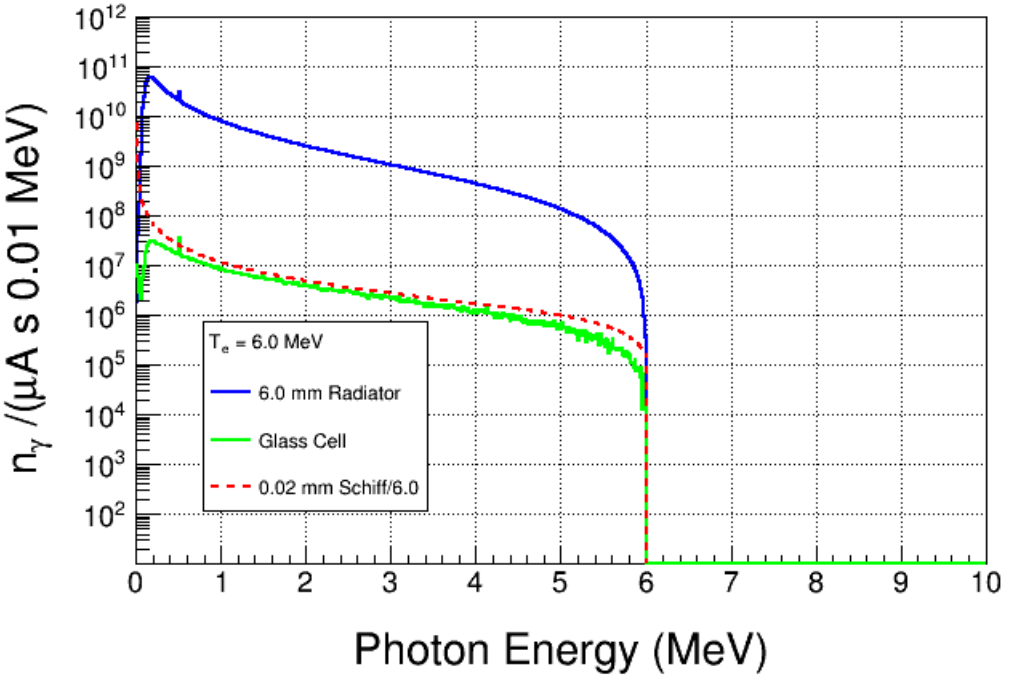
Total N_γ =
2.3×10^9 /(μA s)

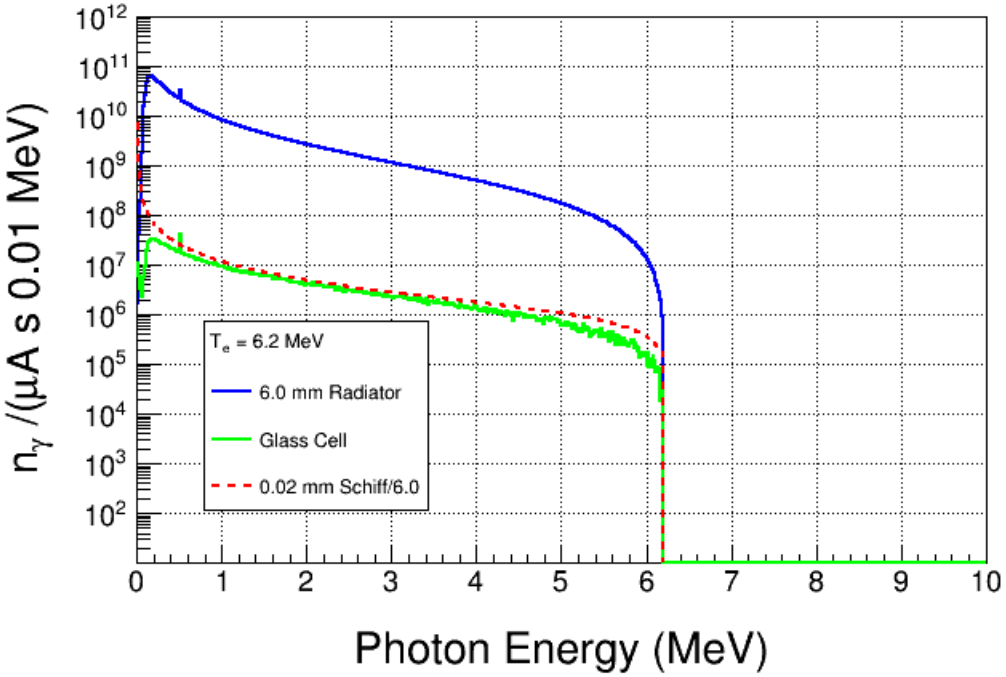




Total N_γ =
2.5×10^9 /(μA s)

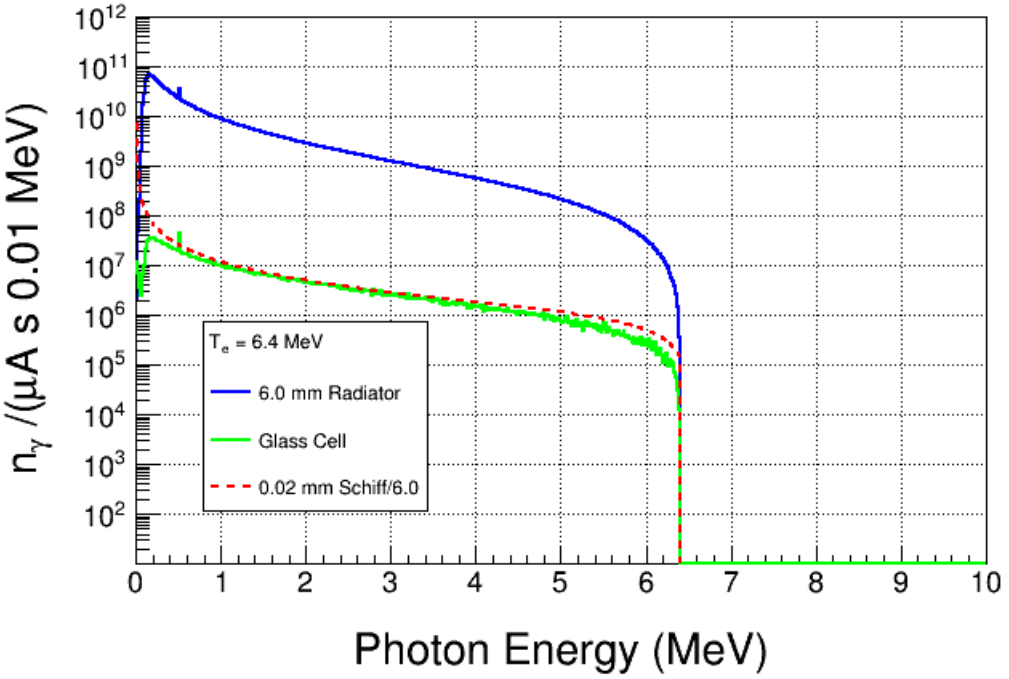
Total N_γ =
2.7×10^9 /(μA s)

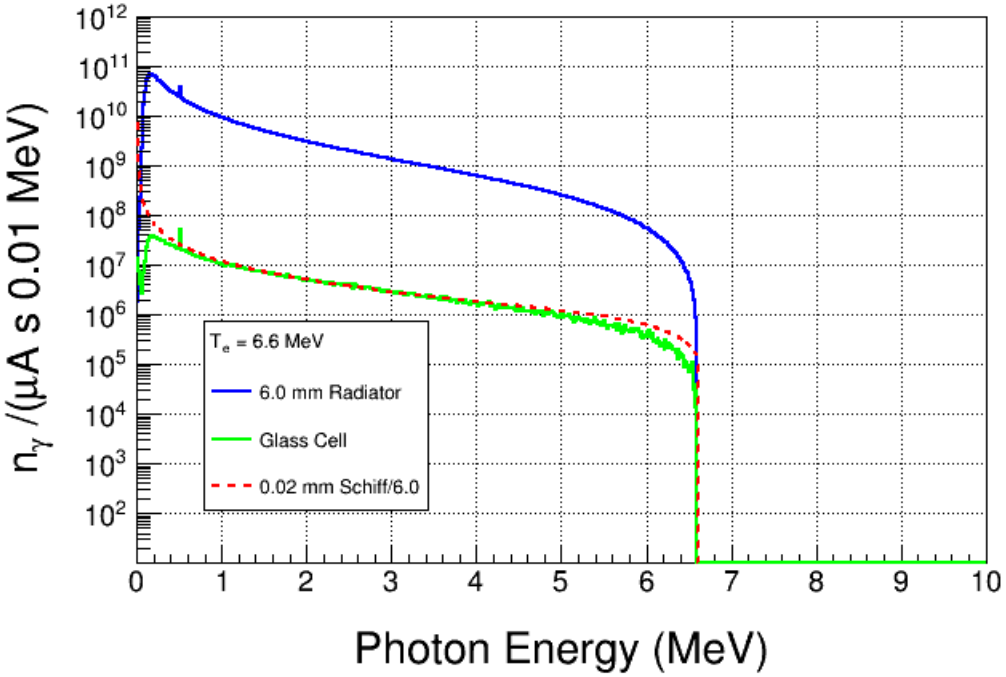




Total N_γ =
3.0×10^9 /(μA s)

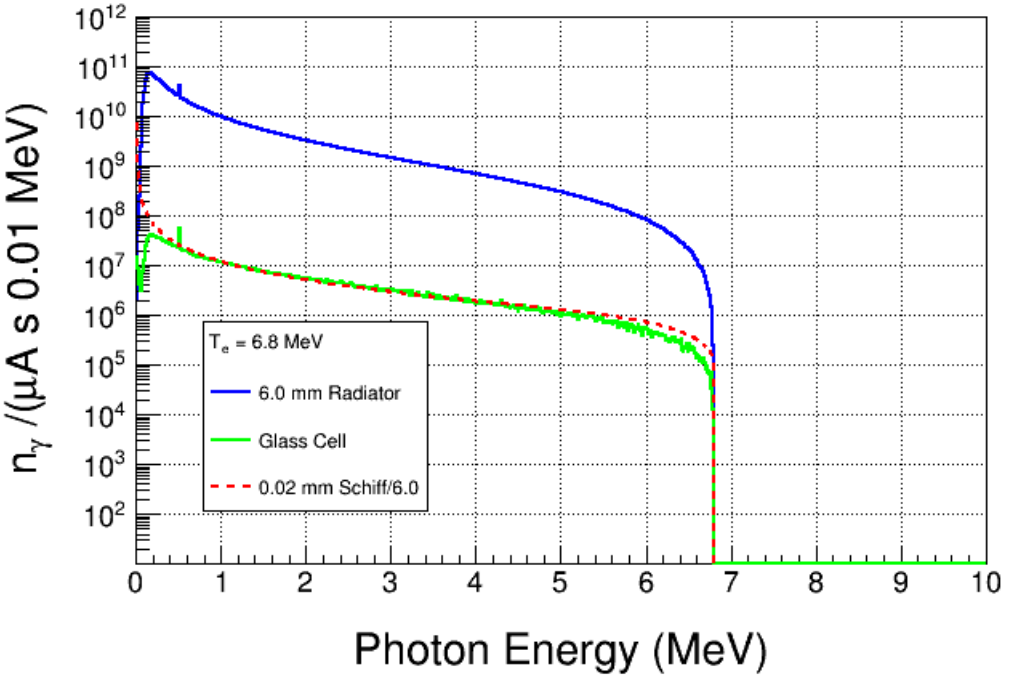
Total N_γ =
3.2×10^9 /(μA s)

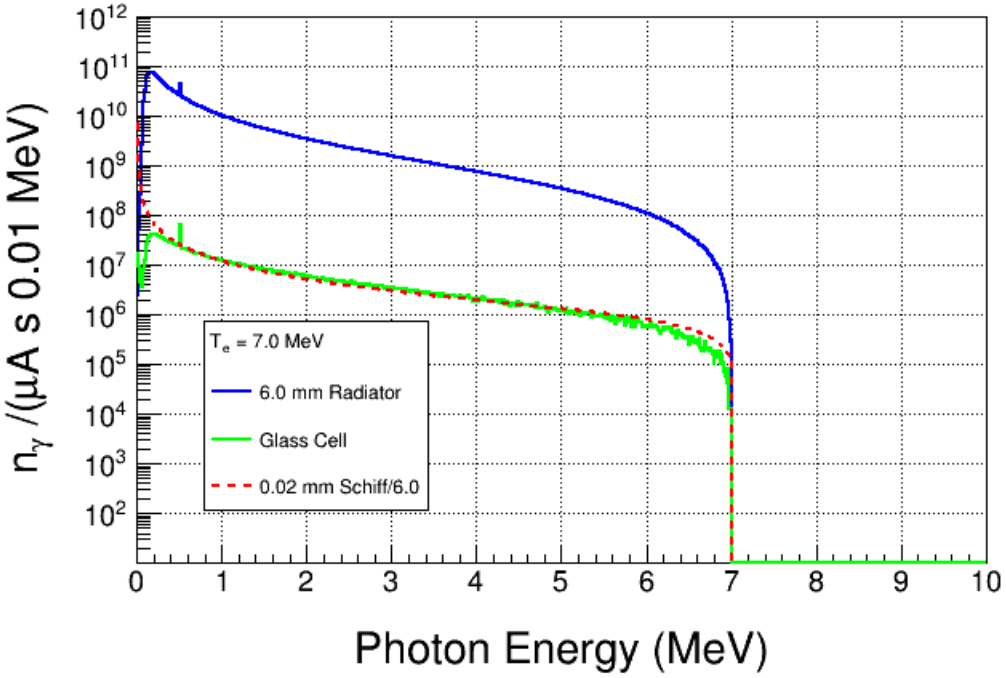




Total N_γ =
3.5×10^9 /(μA s)

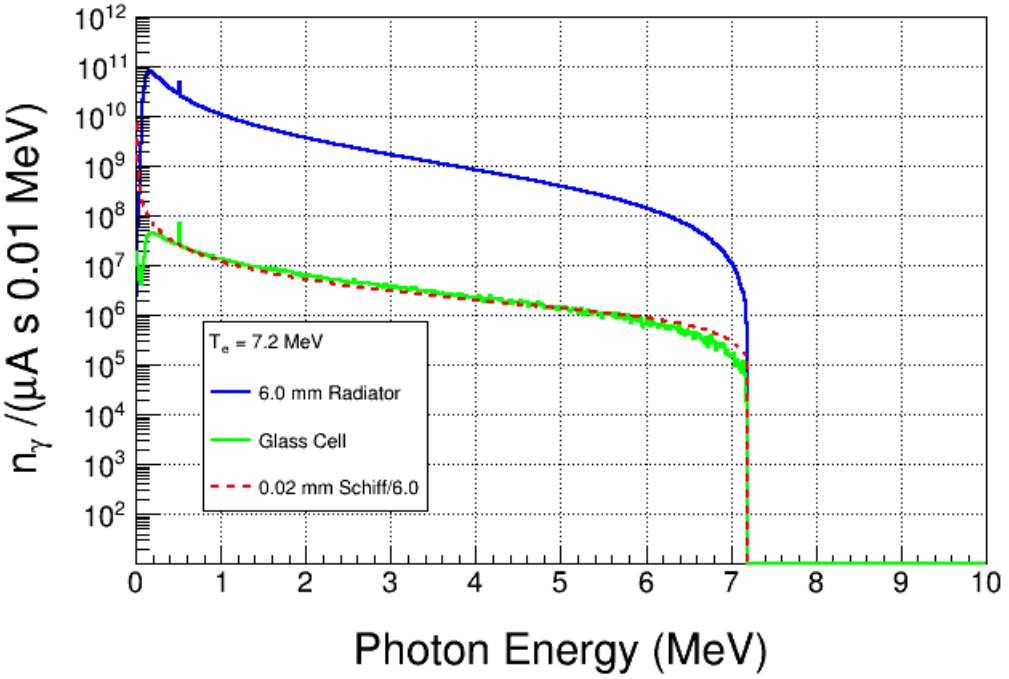
Total N_γ =
3.8×10^9 /(μA s)

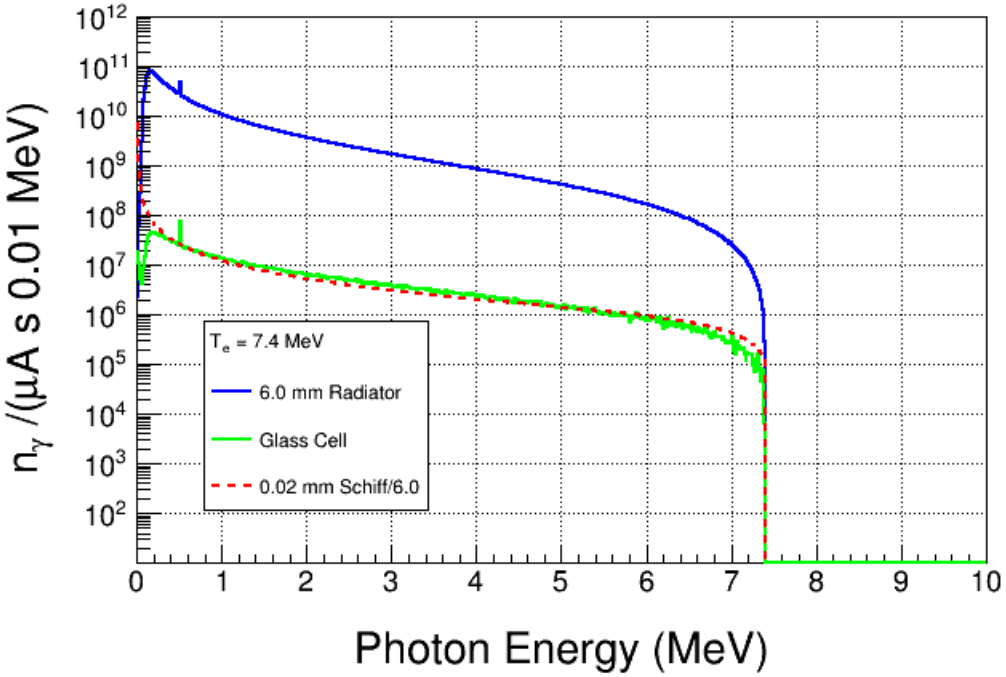




Total N_γ =
4.1×10^9 /(μA s)

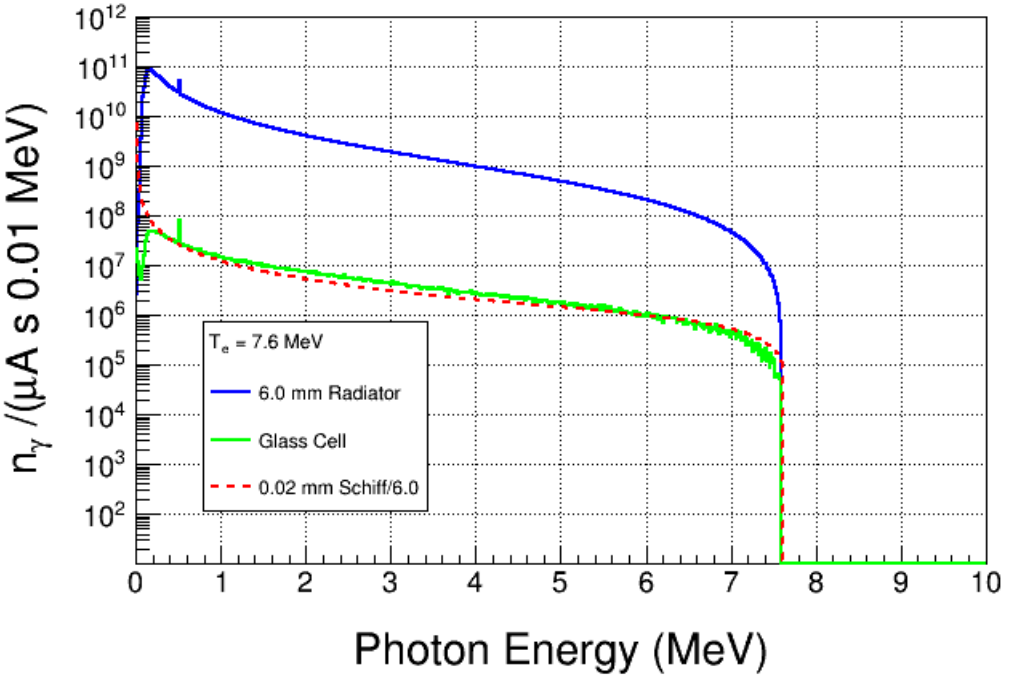
Total N_γ =
4.4×10^9 /(μA s)

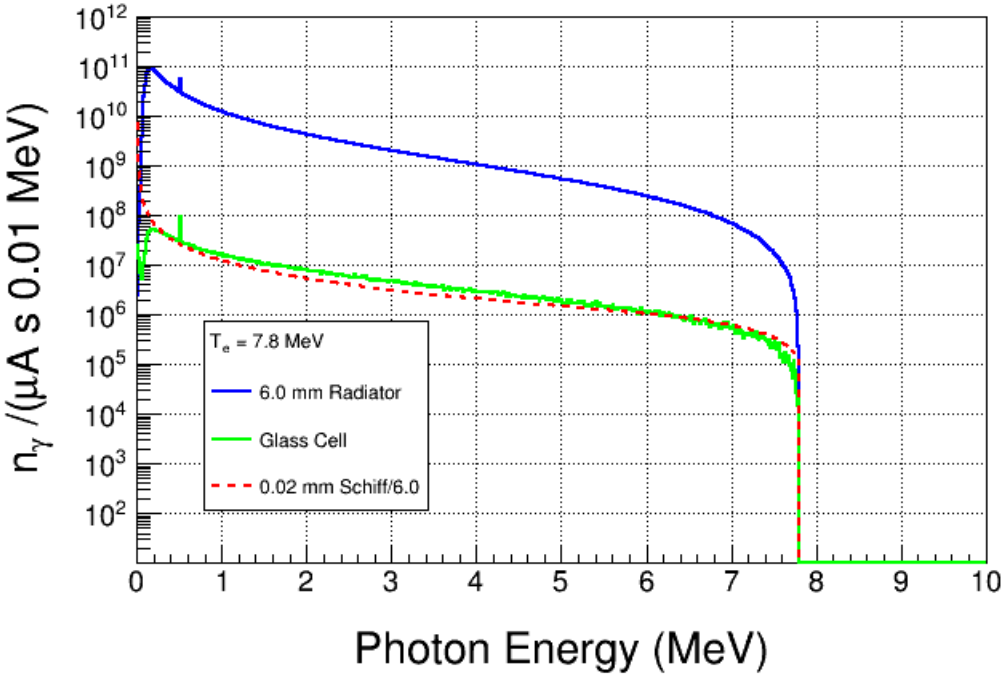




Total N_γ =
4.5×10^9 /(μA s)

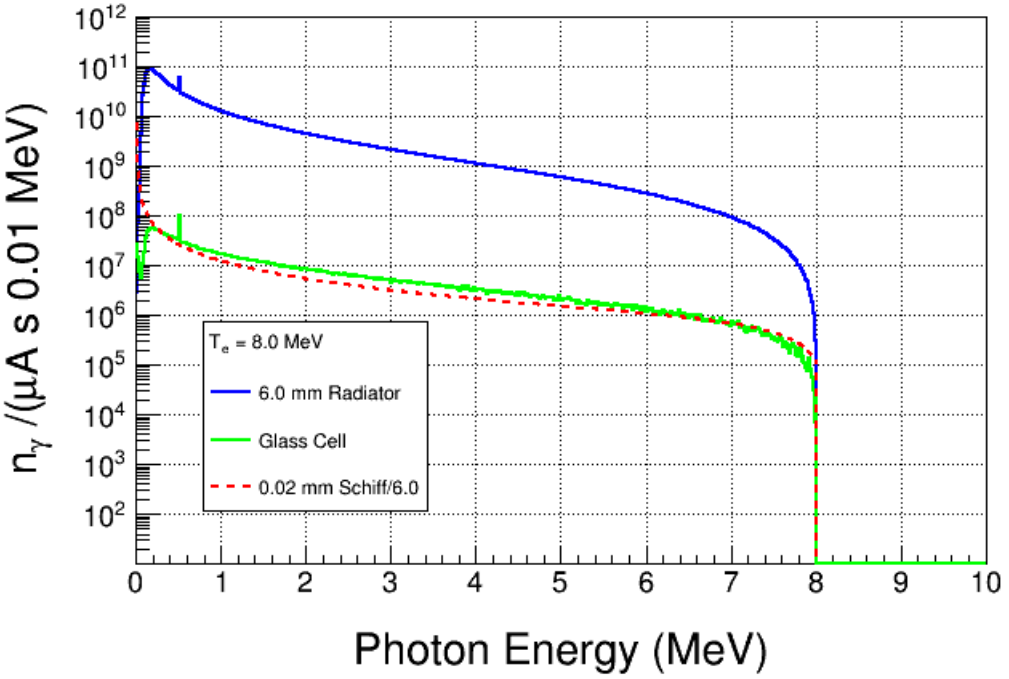
Total N_γ =
5.1×10^9 /(μA s)

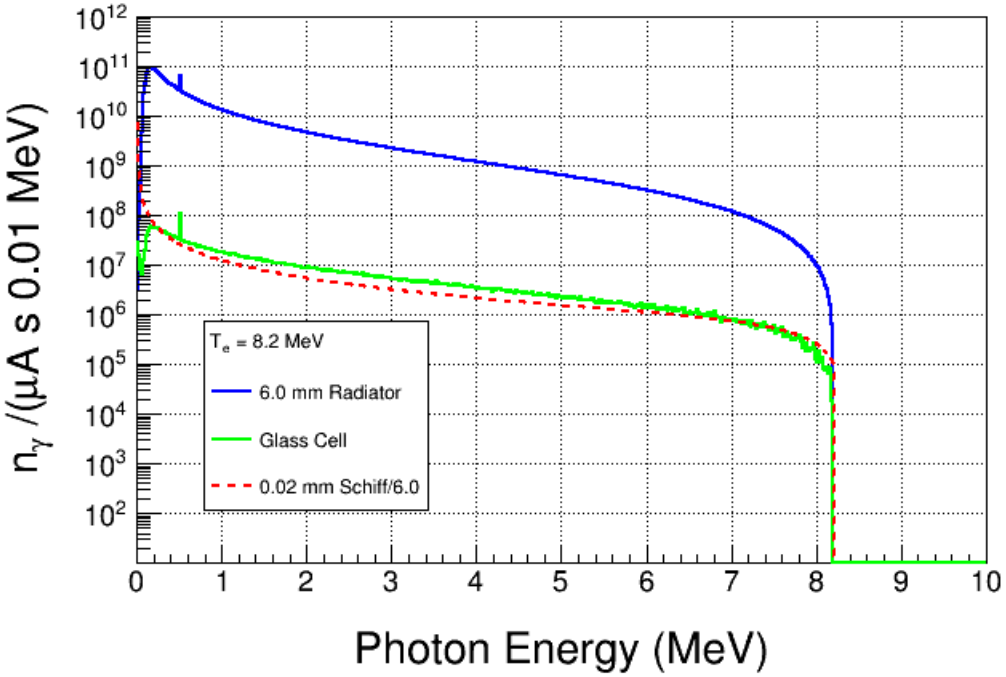




Total N_γ =
5.5×10^9 /(μA s)

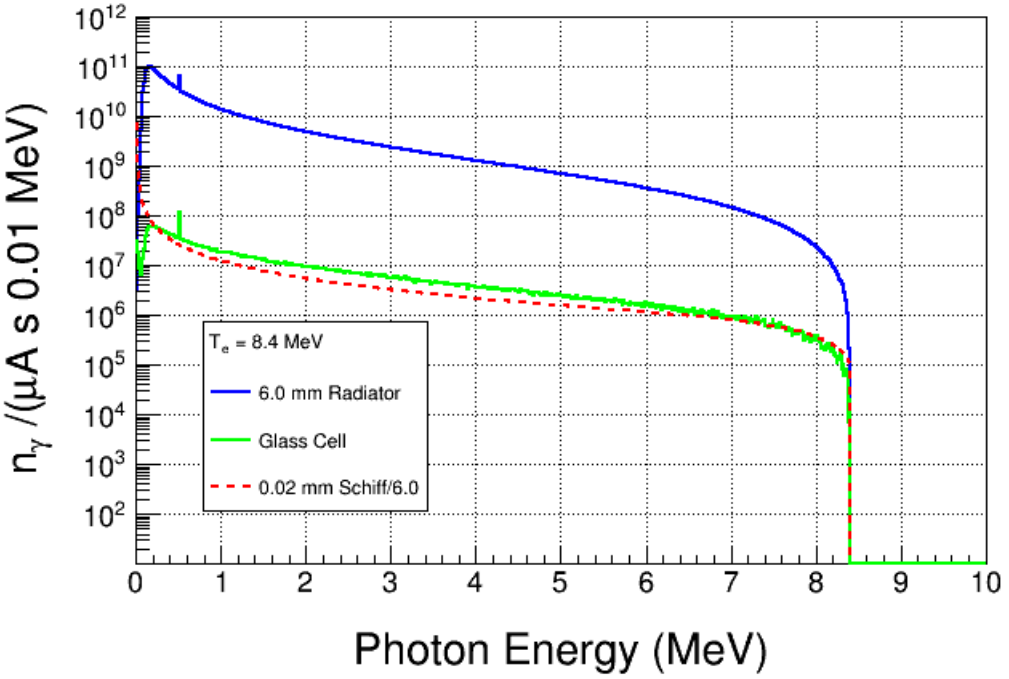
Total N_γ =
5.9×10^9 /(μA s)

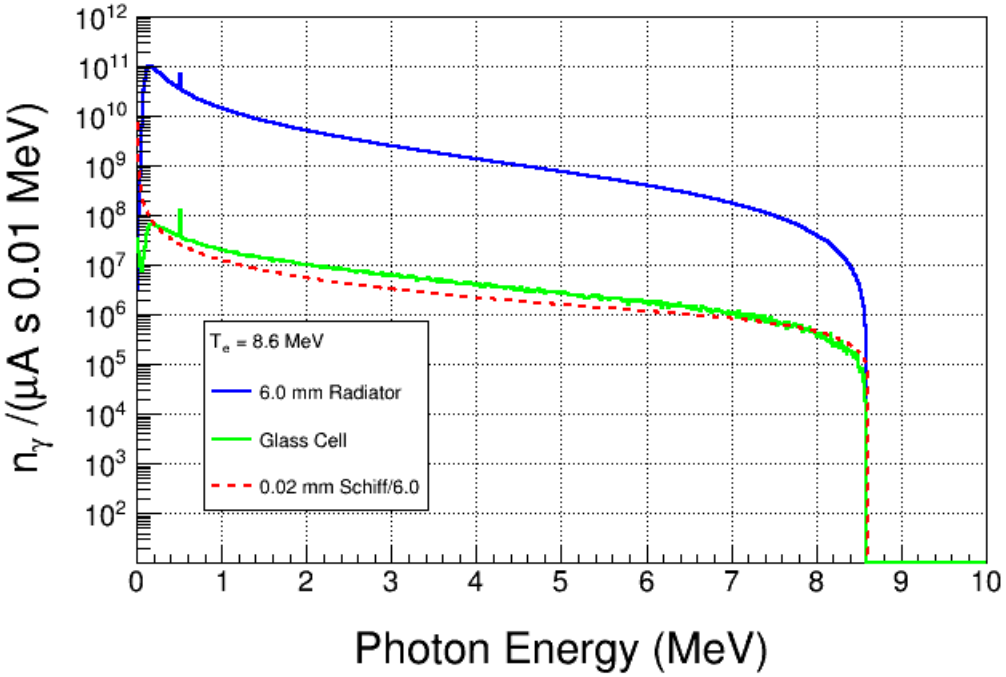




Total N_γ =
6.3×10^9 /(μA s)

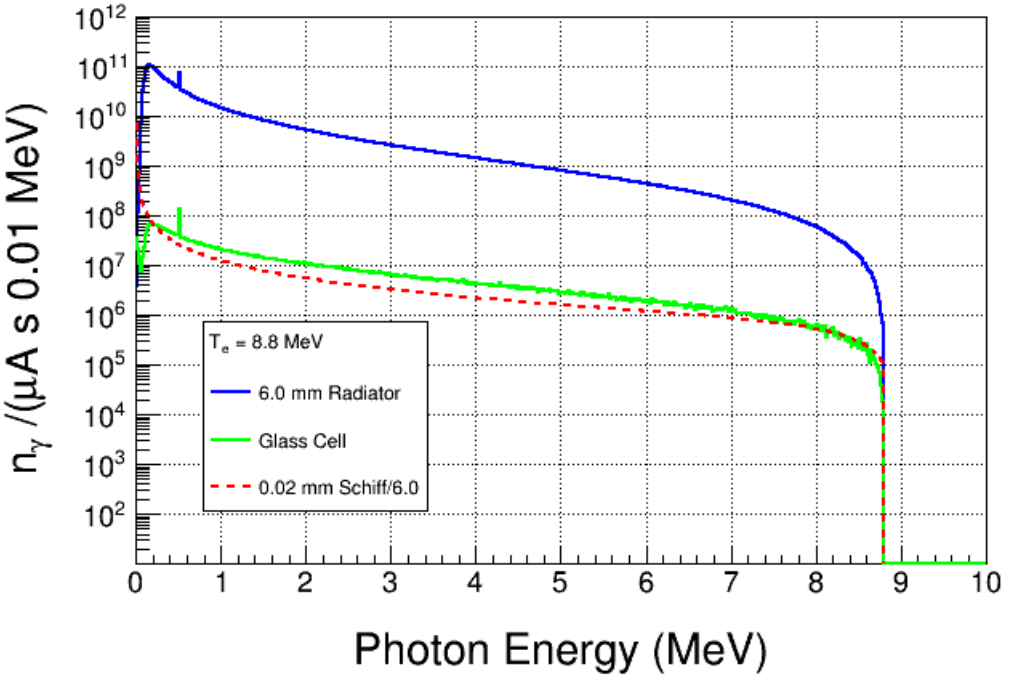
Total N_γ =
6.7×10^9 /(μA s)

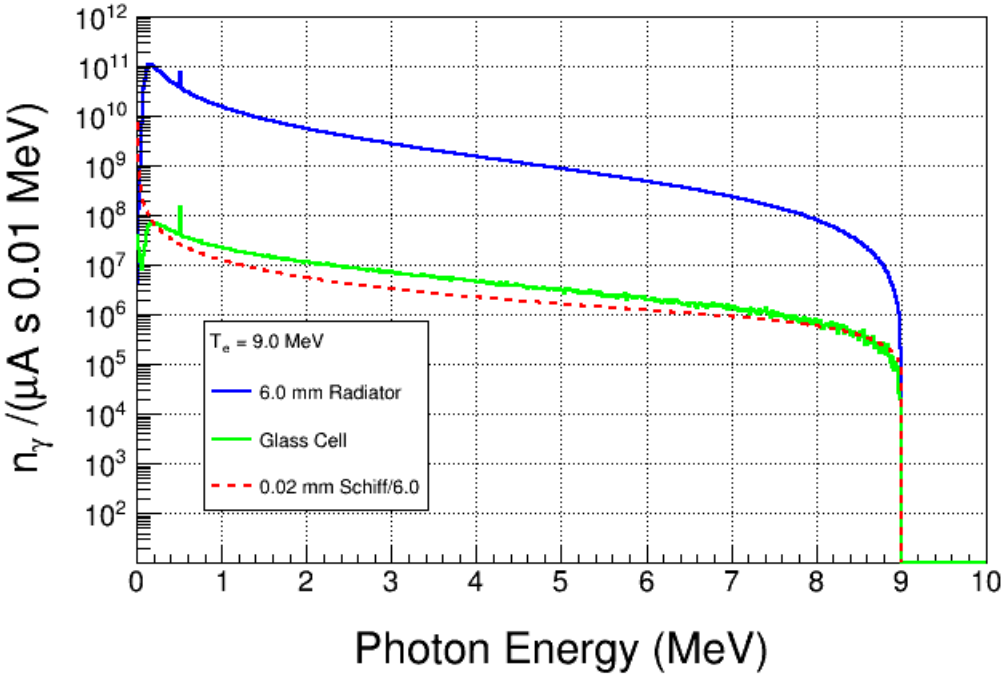




Total N_γ =
7.1×10^9 /(μA s)

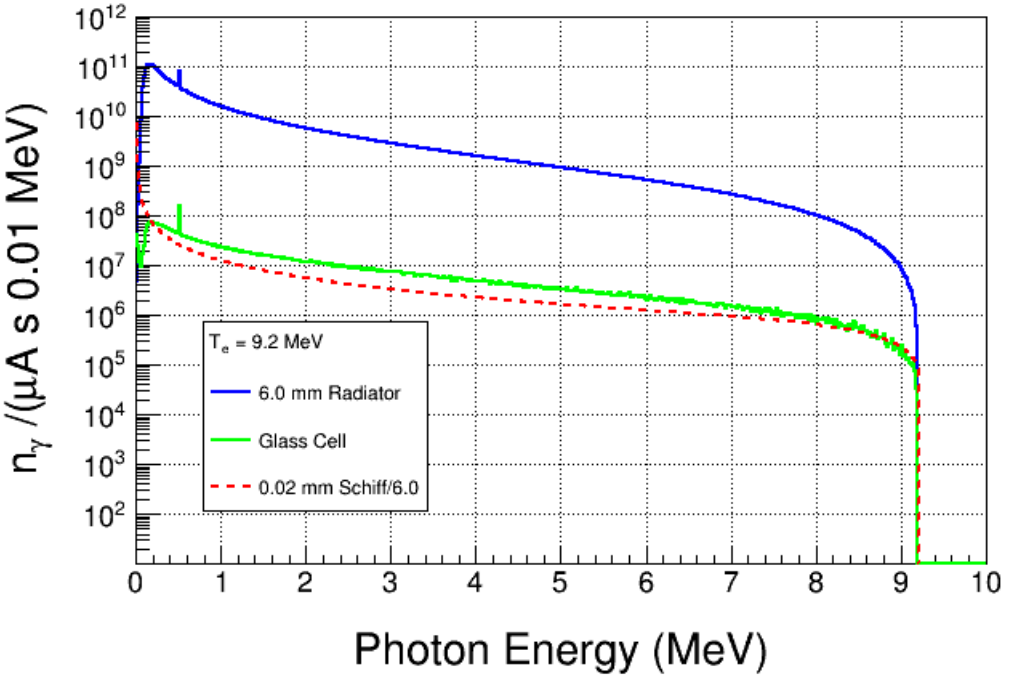
Total N_γ =
7.5×10^9 /(μA s)

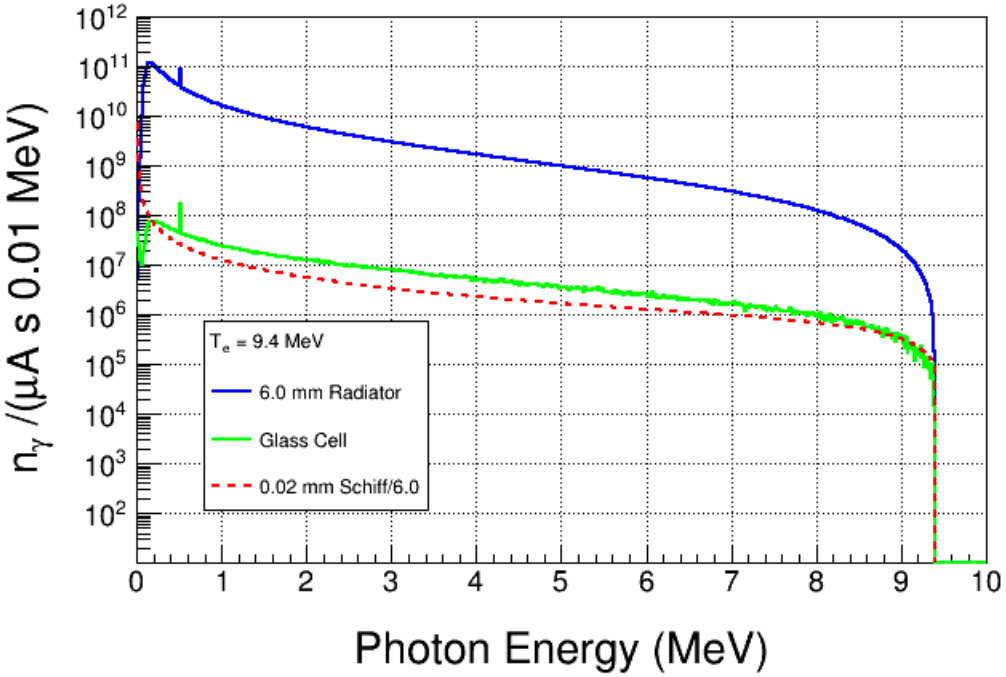




Total N_γ =
8.0×10^9 /(μA s)

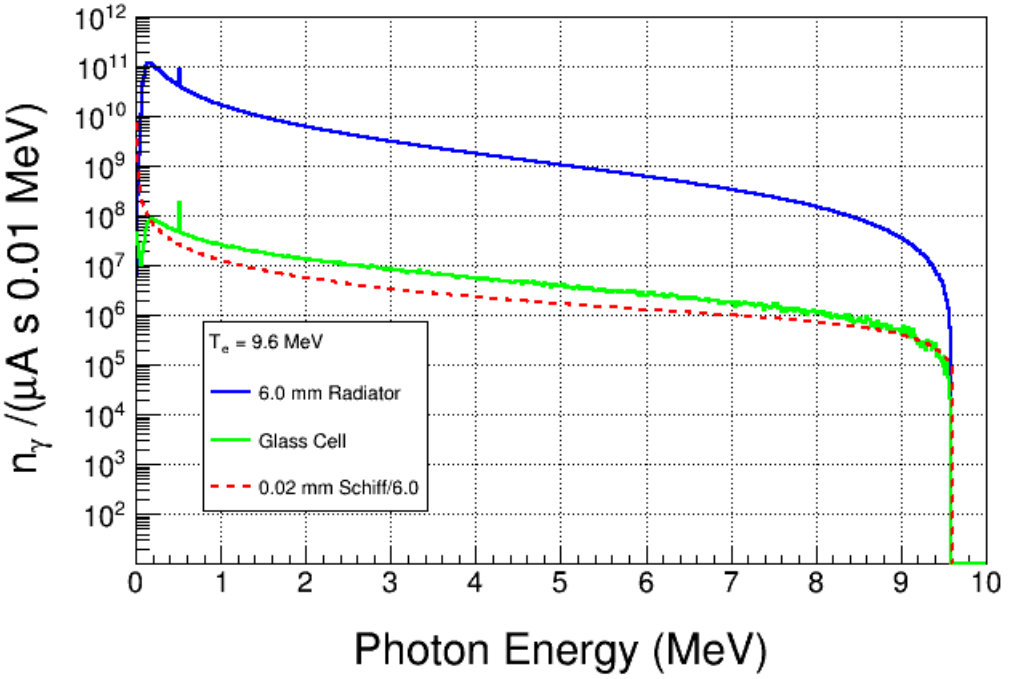
Total N_γ =
8.4×10^9 /(μA s)

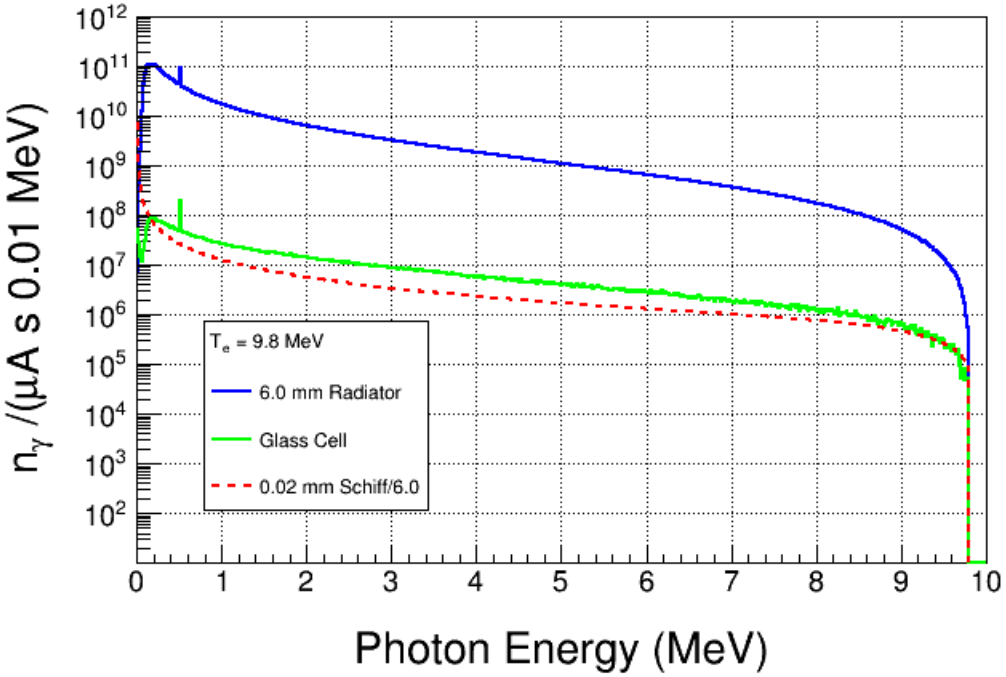




Total N_γ =
8.9×10^9 /(μA s)

Total N_γ =
9.4×10^9 /(μA s)

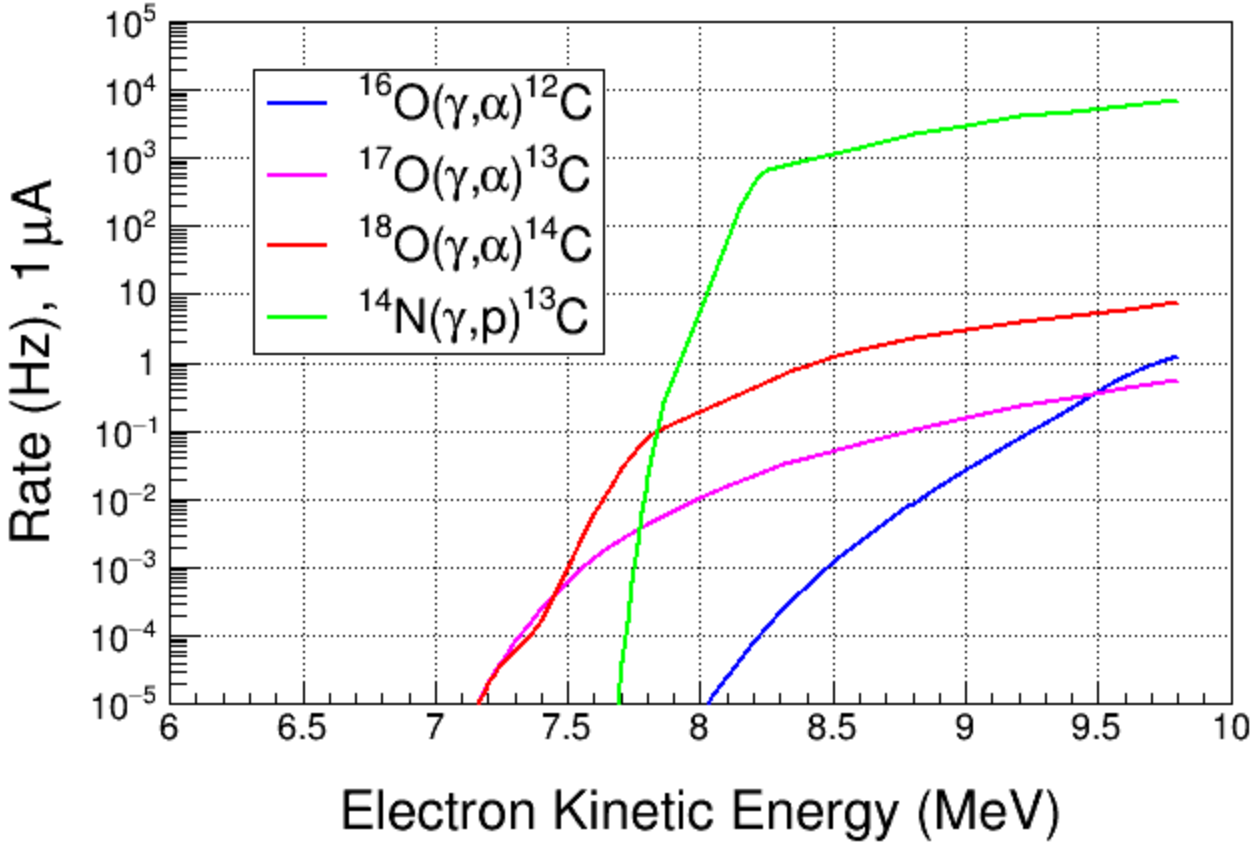




Total N_γ =
9.9×10^9 /(μA s)

Expected Natural N_2O Rates

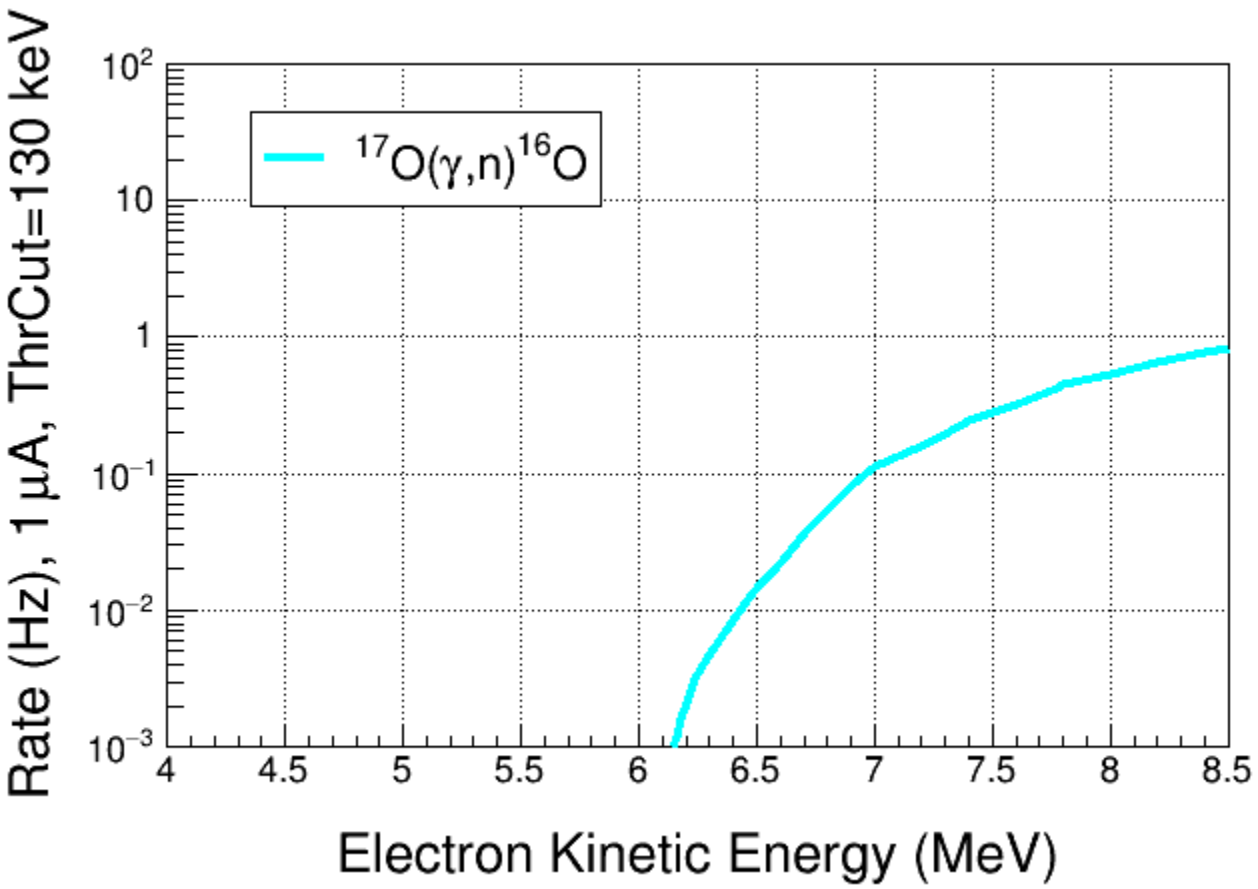
- For natural N_2O, most events are γ-α from ^{18}O



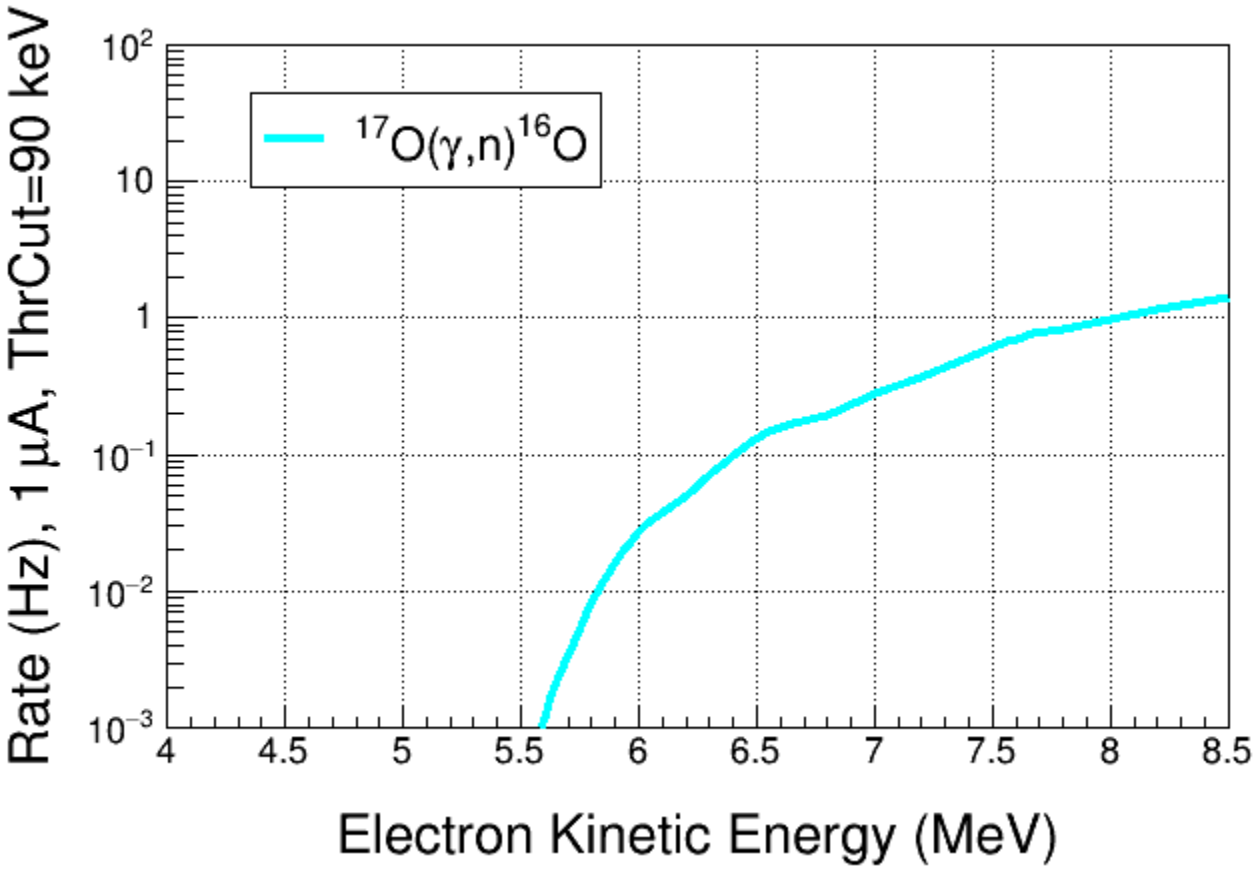
No Threshold Cut

EXPECTED $^{17}O(\gamma,n)^{16}O$ RATE

- Chamber threshold = 130 keV
- Elastic neutron scattering – $^{16}O(n,n)$ and $^{14}N(n,n)$ – is not included

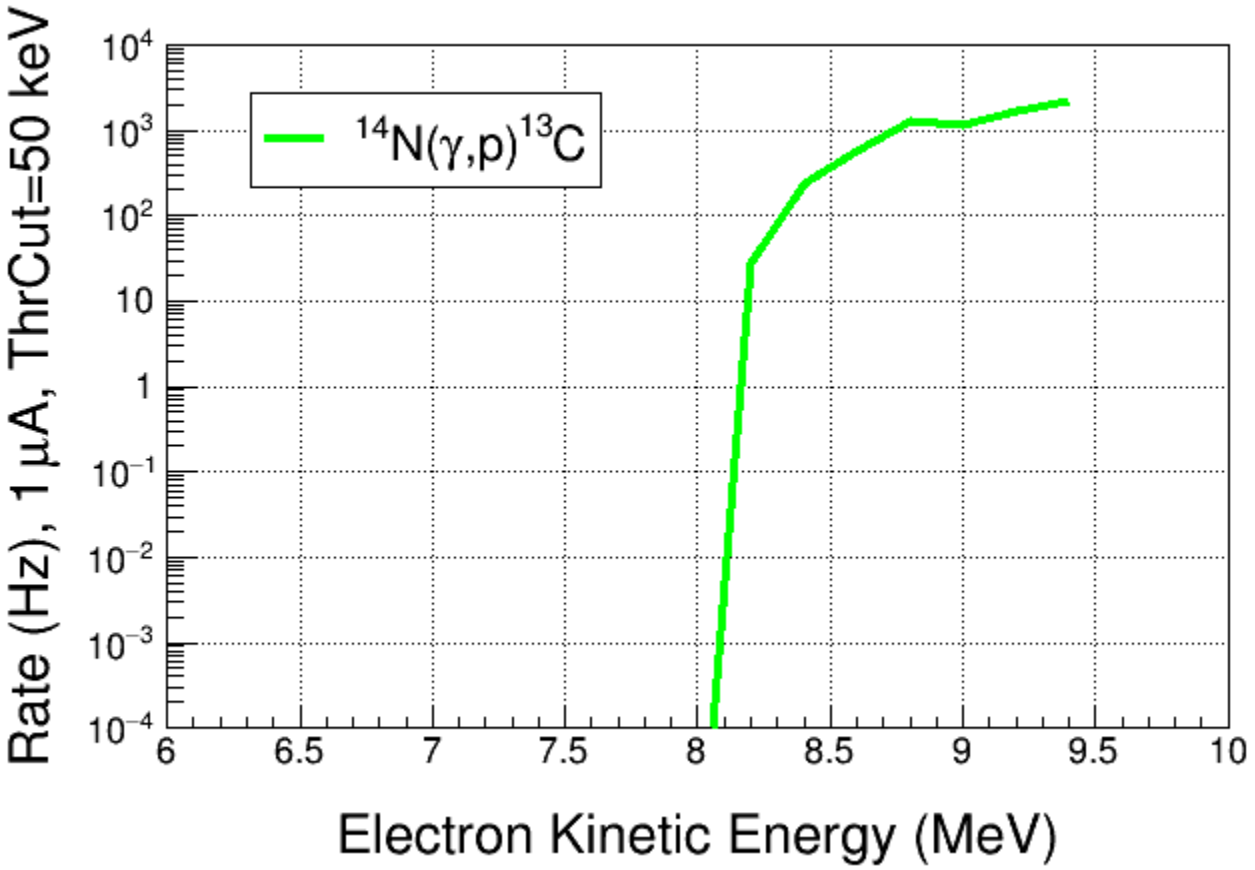


- Chamber threshold = 90 keV
- Elastic neutron scattering – $^{16}O(n,n)$ and $^{14}N(n,n)$ – is not included

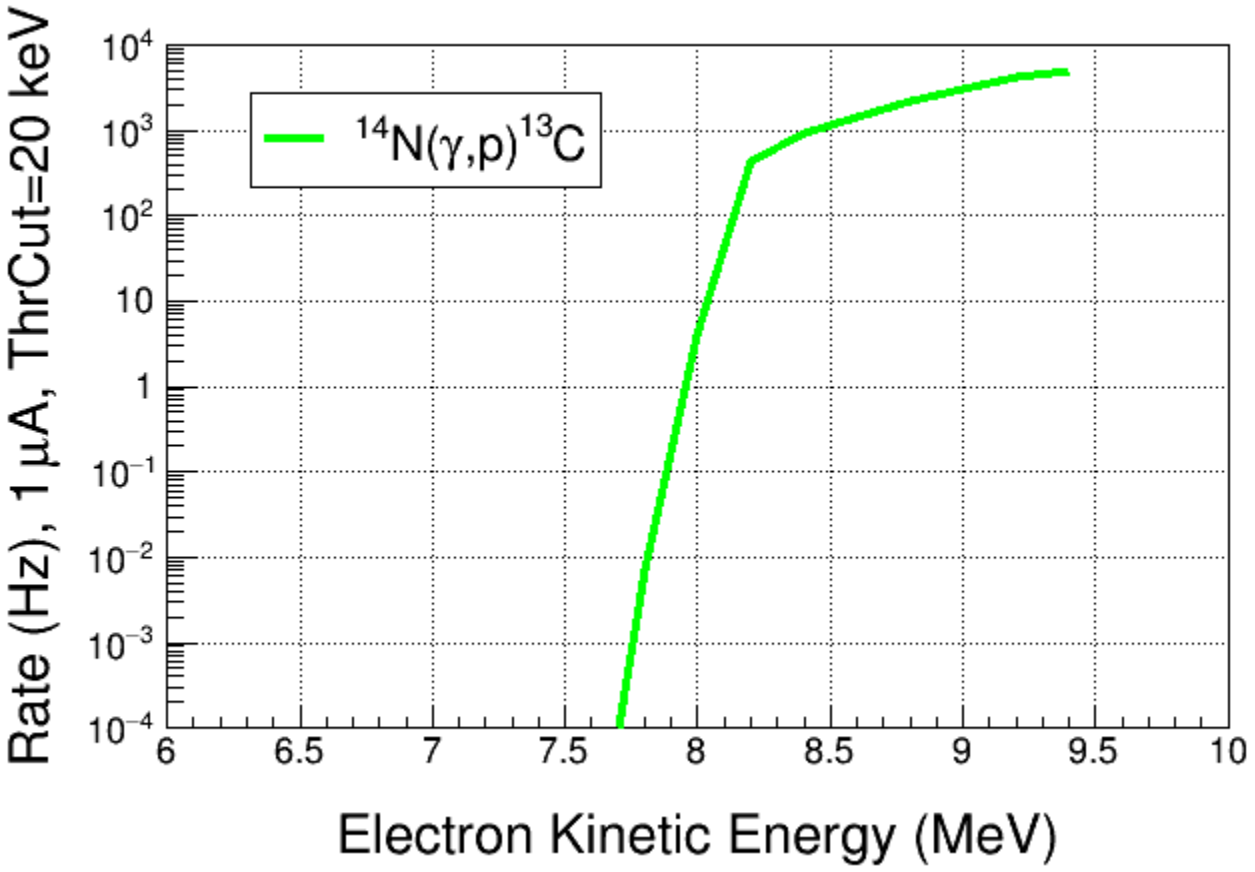


EXPECTED $^{14}N(\gamma,p)^{13}C$ RATE

- Expected rate from $^{14}N(\gamma,p)^{13}C$ with lower operational pressure (Chamber threshold = 50 keV)



- Expected rate from $^{14}N(\gamma,p)^{13}C$ with lower operational pressure (Chamber threshold = 20 keV)



Conclusions

- Design new radiator to match lower electron energy for $^{19}F(\gamma,\alpha)^{15}N$
- Must reduce distance between radiator and chamber to increase flux by at least a factor of 10
- Use silver (or even gold) radiator?
- Use silver collimator