

$^{19}\text{F}(\gamma, \alpha)^{15}\text{N}$ Measurement at JLab Injector

February 17, 2016

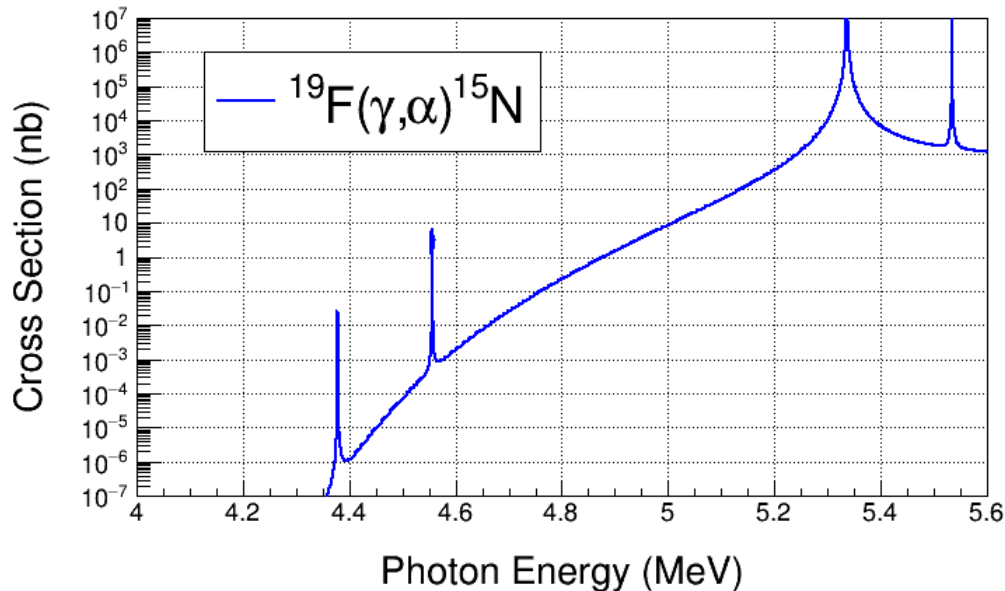
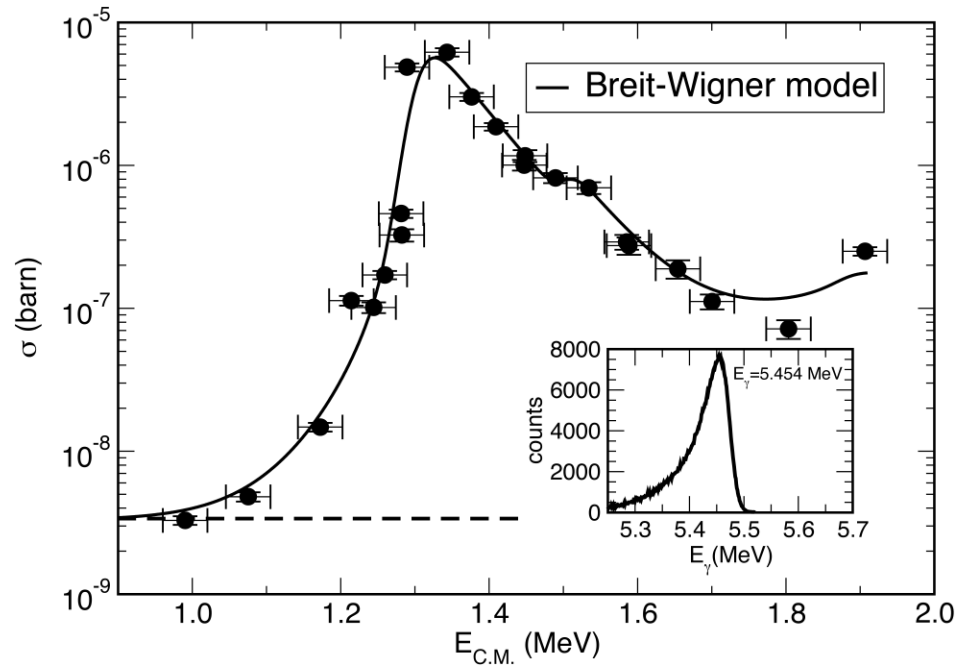
OUTLINE

- Measuring $^{19}\text{F}(\gamma, \alpha)^{15}\text{N}$ at HIGS
- GEANT4 Model
- Gamma Flux
- Expected Rate with C_2F_6
- Expected Number of Bubbles
- Penfold-Leiss Unfolding
- Expected Cross Section Measurement
- Remarks

MEASURING $^{19}\text{F}(\gamma, \alpha)^{15}\text{N}$ AT HIGS

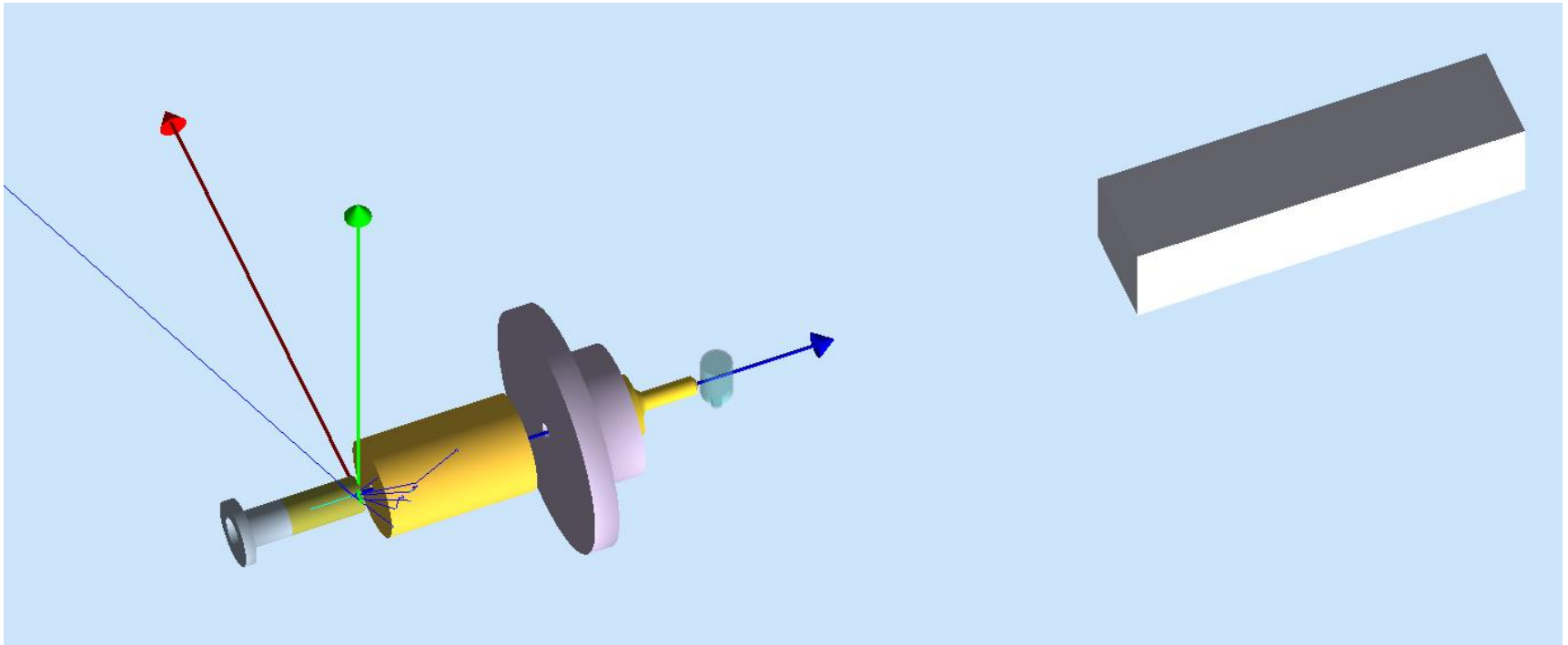
$$E_{\gamma} \cong E_{C.M.} + Q$$

$$Q = +4.013 \text{ MeV}$$

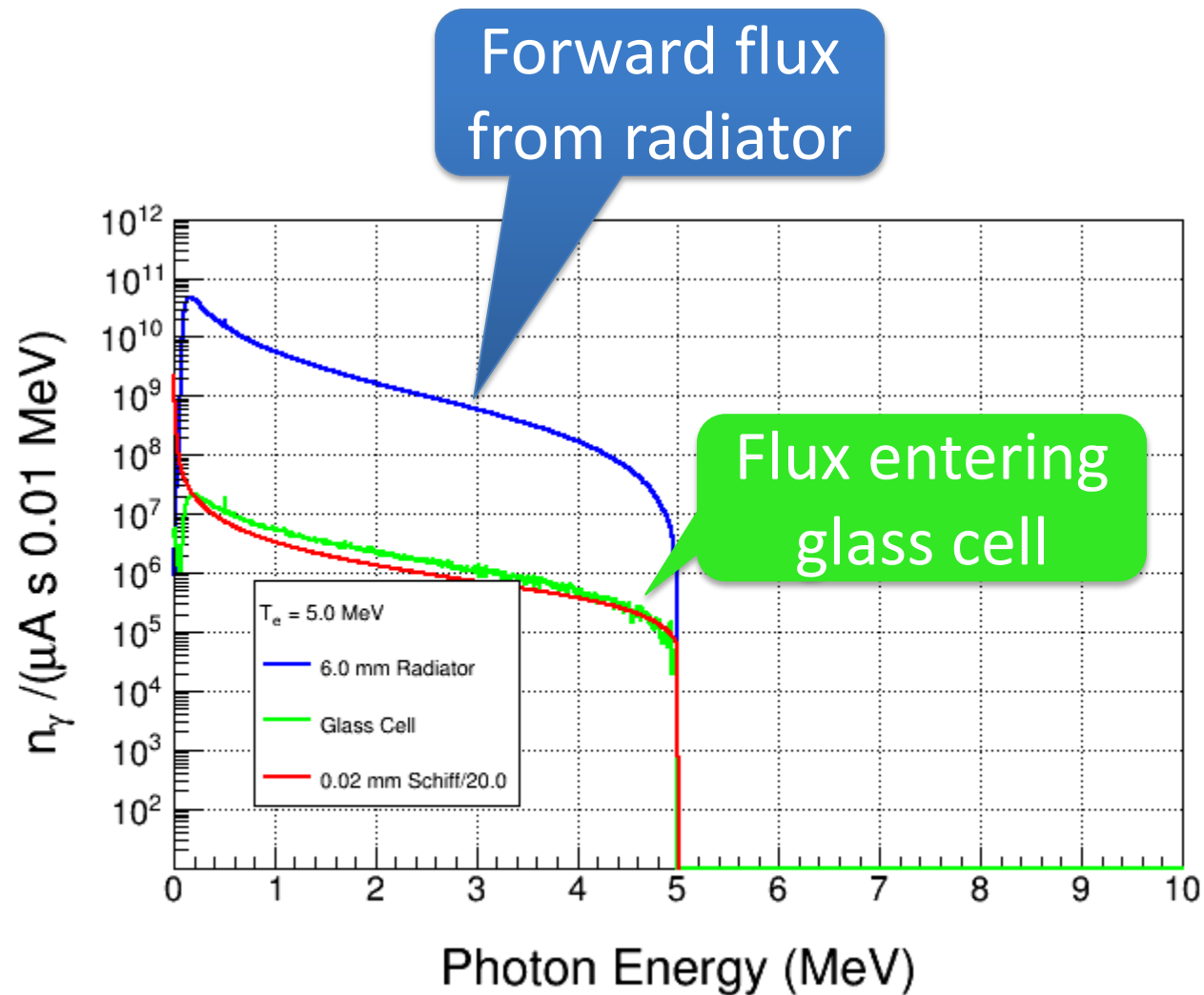


GEANT4 MODEL

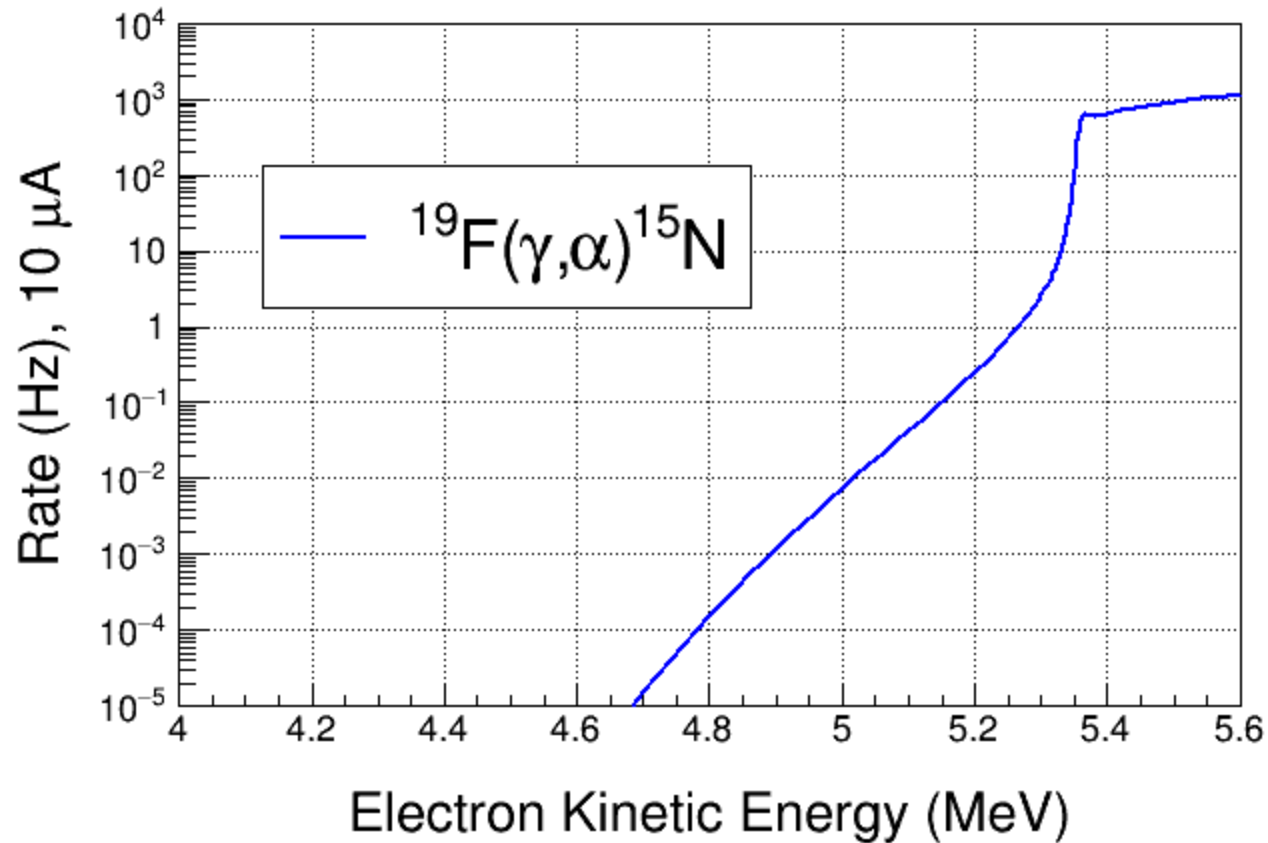
- Gap between radiator and collimator = 0.6 inches
- Distance between radiator and center of glass cell = 14.0 inches



GAMMA FLUX



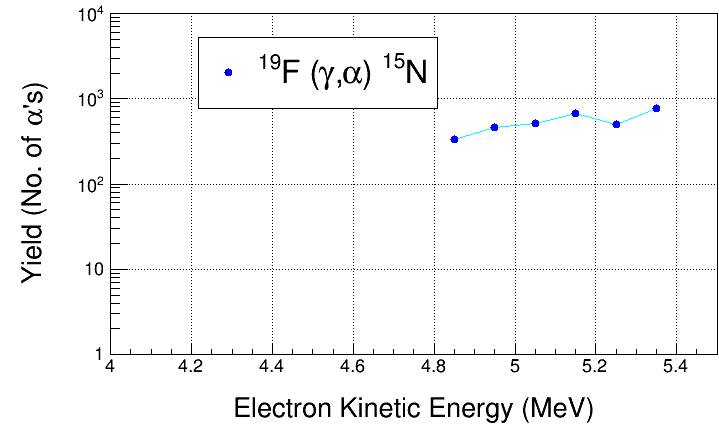
EXPECTED RATE FOR C₂F₆



EXPECTED NUMBER OF BUBBLES

- Cosmic background rate in chamber fiducial volume at JLab Injector is about 10^{-3} Hz (or 1 event every 15 minutes)

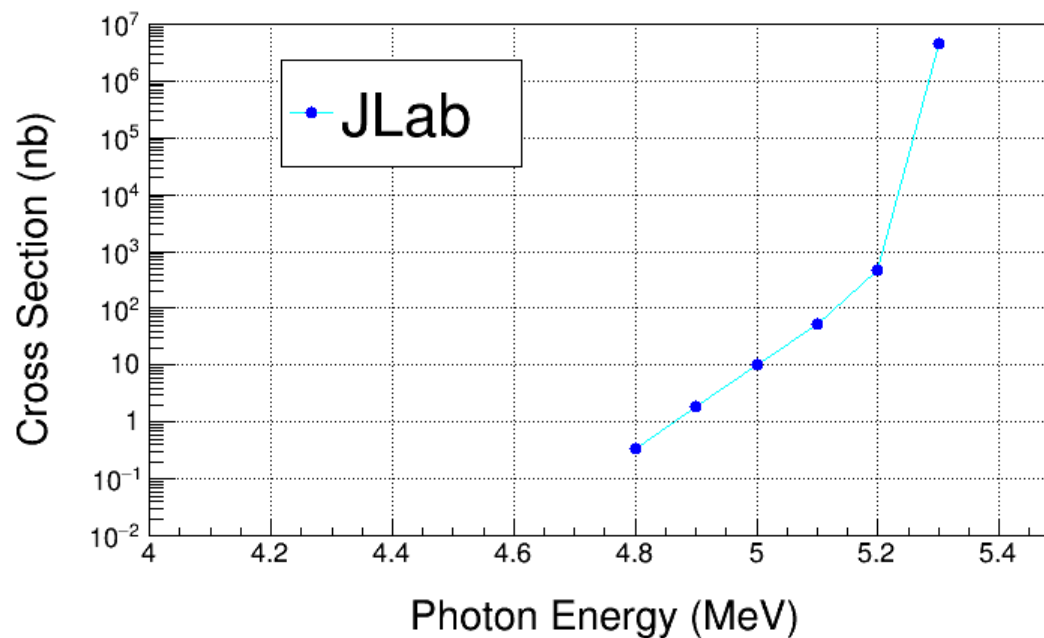
$$dy_i = \sqrt{y_i + 2y_i^{bg}}$$



Electron Beam K. E.	E_y (MeV)	Beam Current (μ A)	Time (hour)	y_i	y_i (bg)	dy_i/y_i (with bg, %)
4.85	4.80	50	100	333	400	9.7
4.95	4.90	20	50	454	200	6.3
5.05	5.00	10	20	509	80	5.0
5.15	5.10	5	10	667	40	4.1
5.25	5.20	1	5	502	20	4.6
5.35	5.30	0.001	1	768	4	3.6

PENFOLD-LEISS UNFOLDING

E_γ (MeV)	Cross Section (nb)	Stat Error (with bg, %)
4.8	0.34	9.7
4.9	1.87	7.5
5.0	10.2	6.4
5.1	54	5.3
5.2	460	5.6
5.3	4.42e+06	3.6



REMARKS

- Calculate systematic error: energy, ...

Beam Current, $\delta I/I$	3%
Photon Flux, $\delta\varphi/\varphi$	5%
Radiator Thickness, $\delta R/R$	3%
Bubble Chamber Thickness, $\delta T/T$	3%
Bubble Chamber Efficiency, ε	5%

- For 1nA, use Hall B beam
- We are only approved to 10 μA , we will need 50 μA .