

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

March 9, 2016

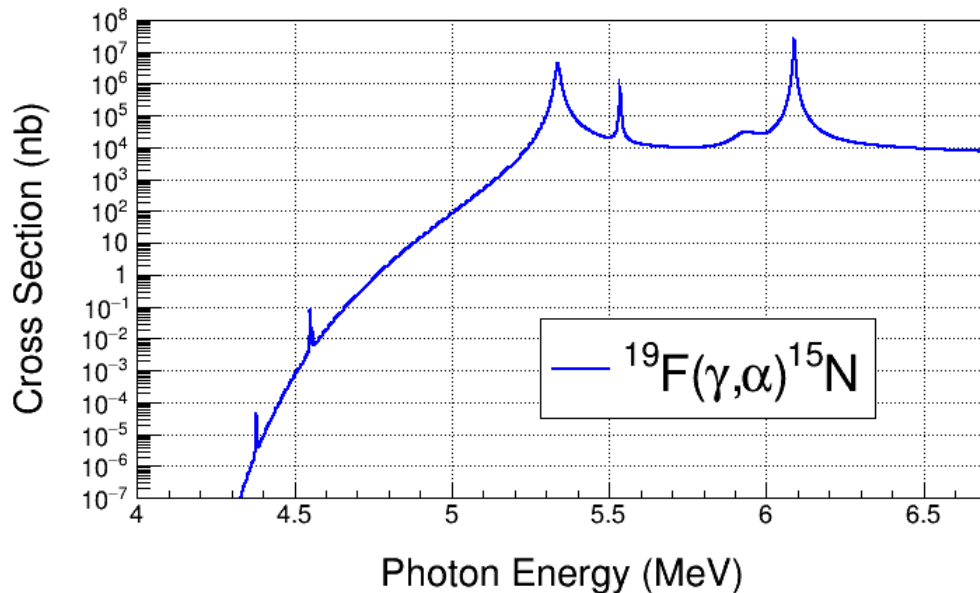
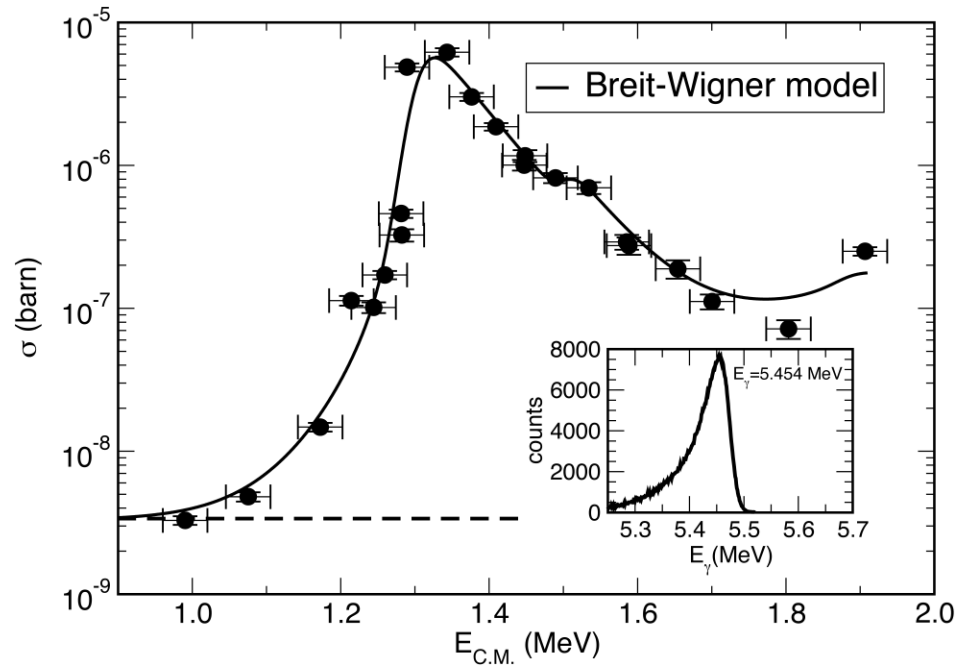
OUTLINE

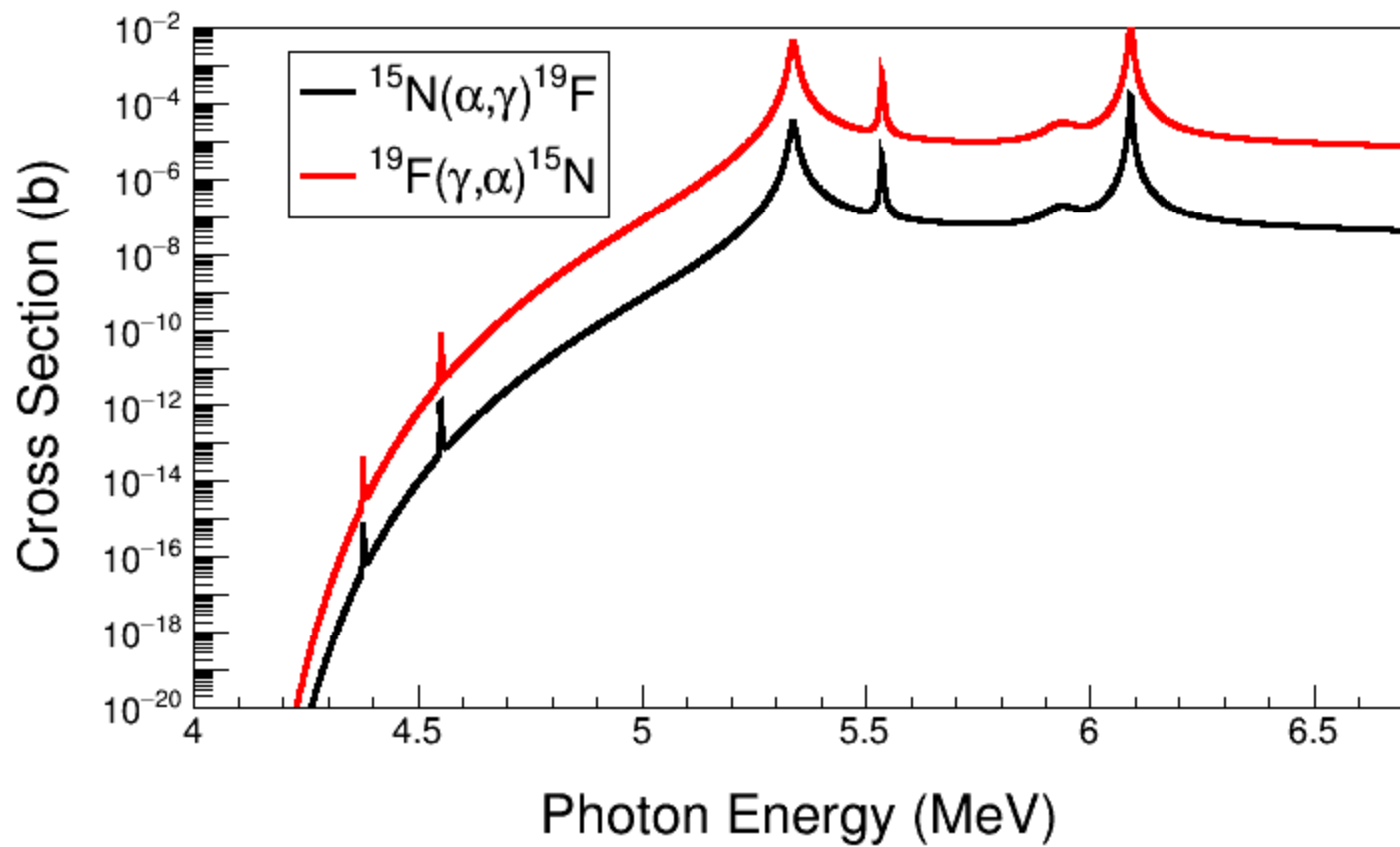
- Measuring $^{19}\text{F}(\gamma, \alpha)^{15}\text{N}$ at HIGS
- GEANT4 Model
- Gamma Flux
- Expected Rate for C_2F_6
- Expected Number of Bubbles
- Penfold-Leiss Unfolding
- Systematic Errors
- JLab Projected Data
- Remarks

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

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

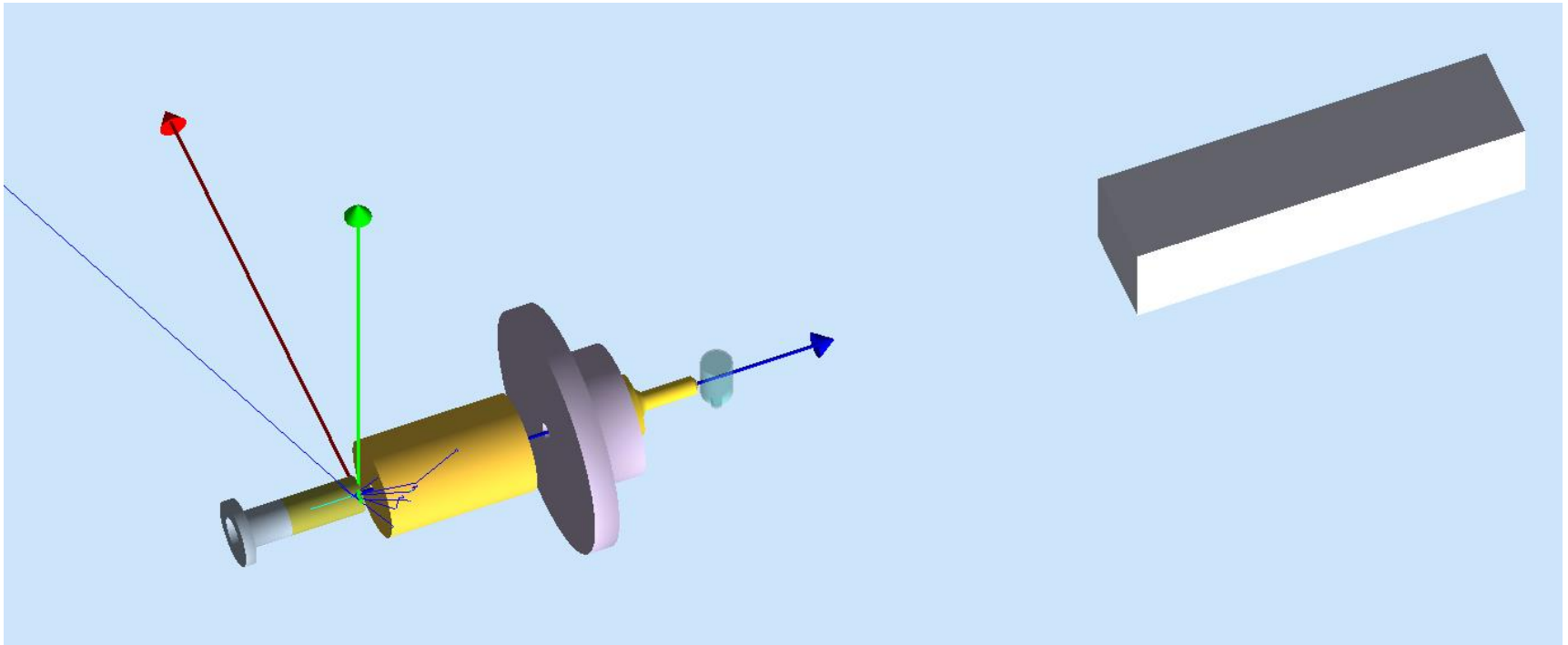
$$Q = +4.013 \text{ MeV}$$



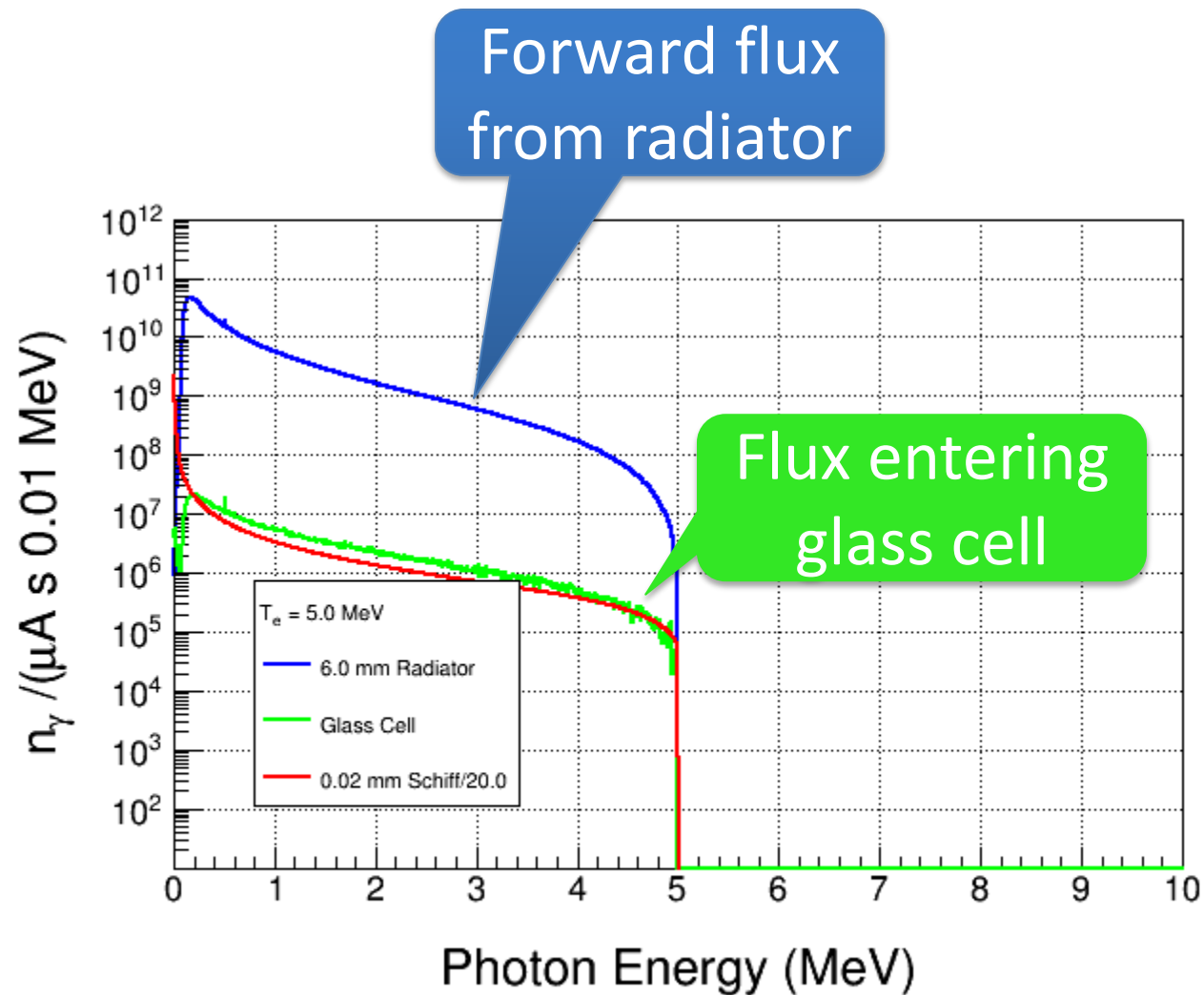


GEANT4 MODEL

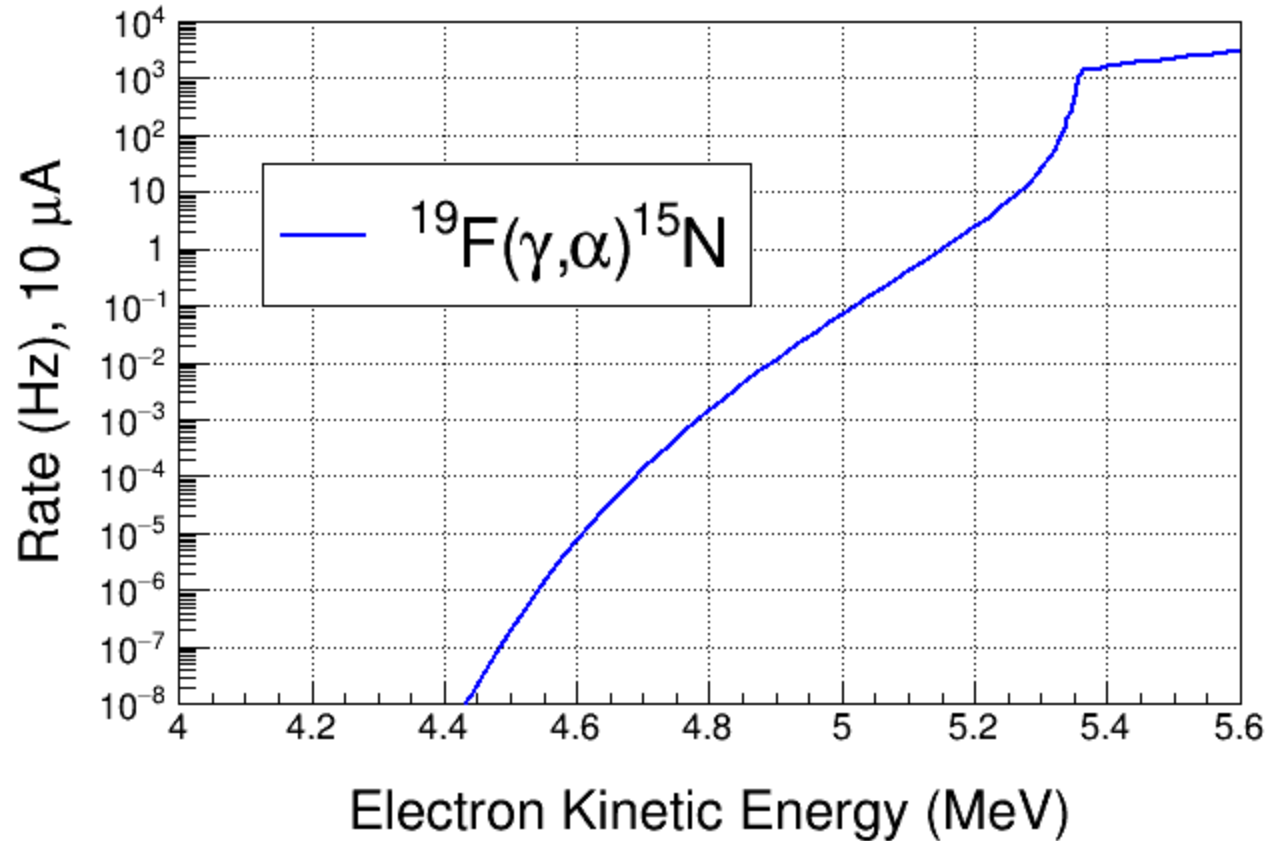
- Gap between radiator and collimator = 0.6 inches
- Distance between radiator and center of glass cell = 14.0 inches



GAMMA FLUX



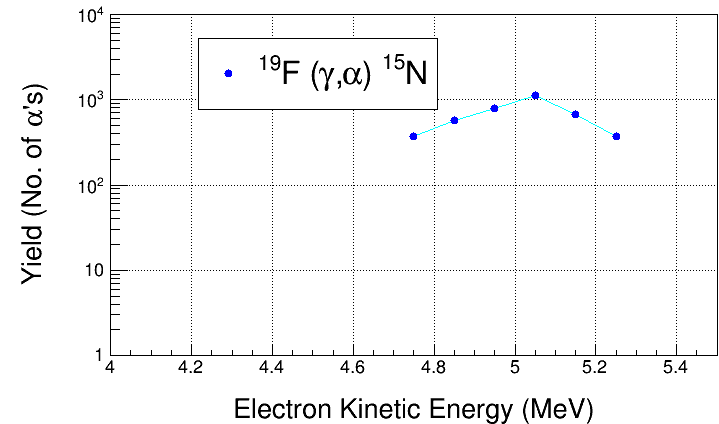
EXPECTED RATE FOR C₂F₆



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)

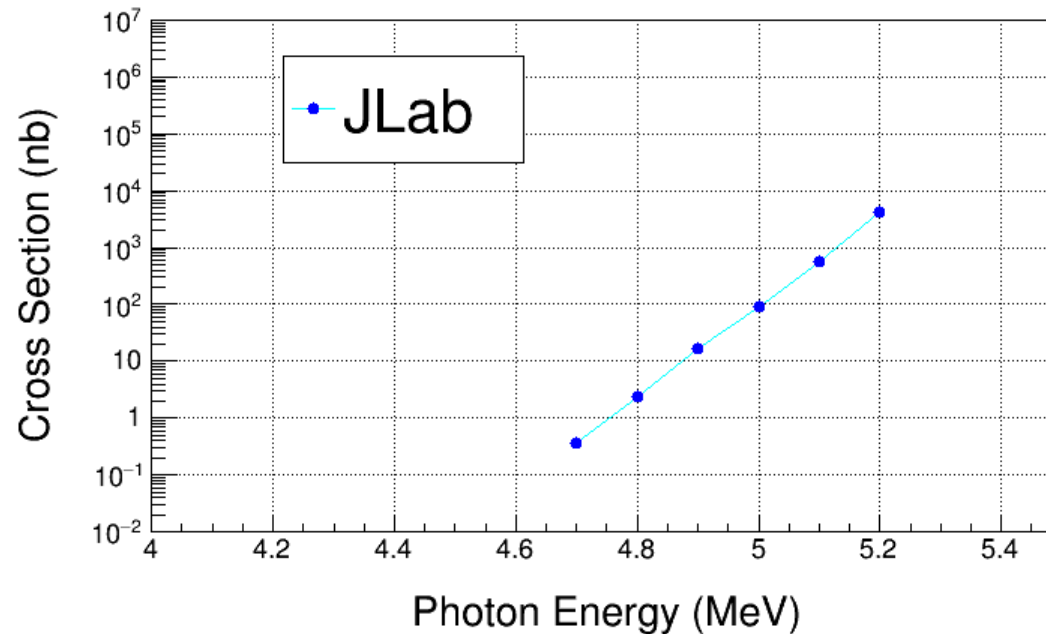
$$dy_i = \sqrt{y_i + 2y_i^{bg}}$$



Electron Beam K. E.	E_y (MeV)	Beam Current (μA)	Time (hour)	y_i	y_i (bg)	dy_i/y_i (with bg, %)
4.75	4.70	50	100	371	400	8.9
4.85	4.80	20	50	568	200	5.4
4.95	4.90	10	20	795	80	3.9
5.05	5.00	5	10	1124	40	3.1
5.15	5.10	1	5	662	20	4.0
5.25	5.20	0.2	2	374	8	5.3

PENFOLD-LEISS UNFOLDING

E_γ (MeV)	Cross Section (nb)	Stat Error (with bg, %)
4.7	0.37	8.9
4.8	2.35	6.3
4.9	16.6	4.6
5.0	91	3.9
5.1	555	5.1
5.2	4217	6.5



ENERGY SYSTEMATIC ERROR

- For absolute beam energy uncertainty of δE (= 0.1%) and zero relative beam energy uncertainty:

$$\frac{dy_i}{y_i} = \frac{y_i(E_i + \delta E) - y_i(E_i)}{y_i(E_i)}$$

$$\frac{dN_{ij}}{N_{ij}} = \frac{N_{ij}(E_i + \delta E) - N_{ij}(E_i)}{N_{ij}(E_i)}$$

$$E_0 = 4.75 \pm \delta E$$

$$E_i = E_0 + i\Delta$$

E_i (MeV)	dy_i/y_i (%)	$d\sigma_i/\sigma_i$ (%)
4.75	11.1	11.7
4.85	9.8	10.1
4.95	8.8	9.2
5.05	8.4	9.0
5.15	8.7	9.6
5.25	11.7	12.7

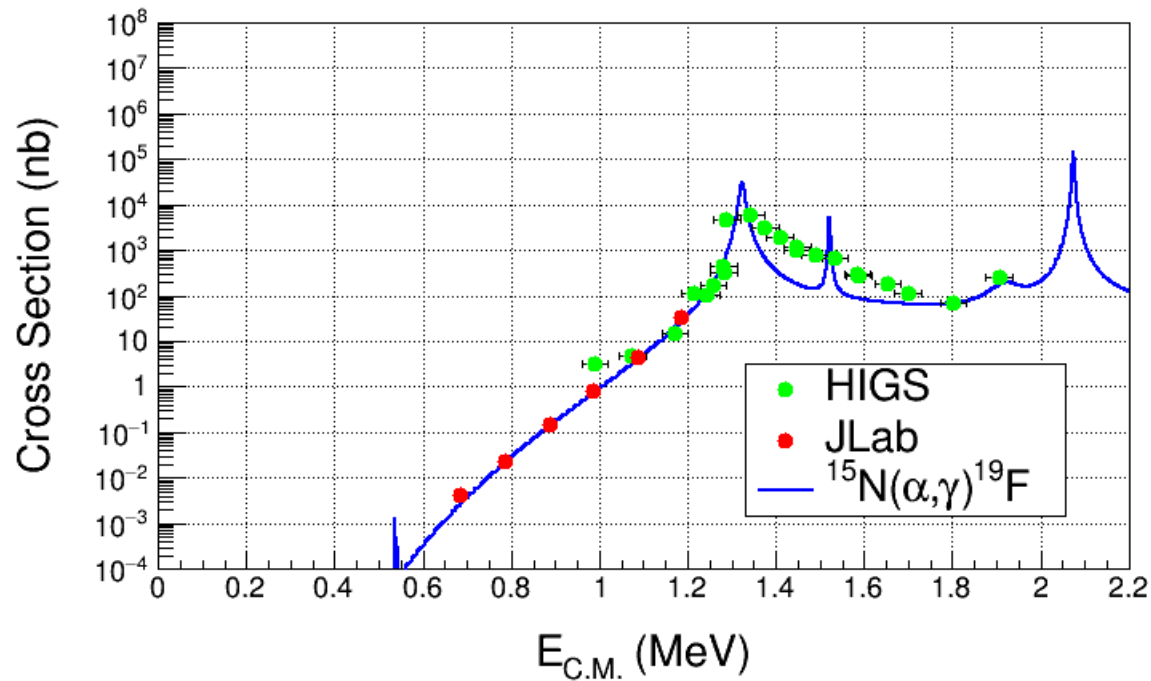
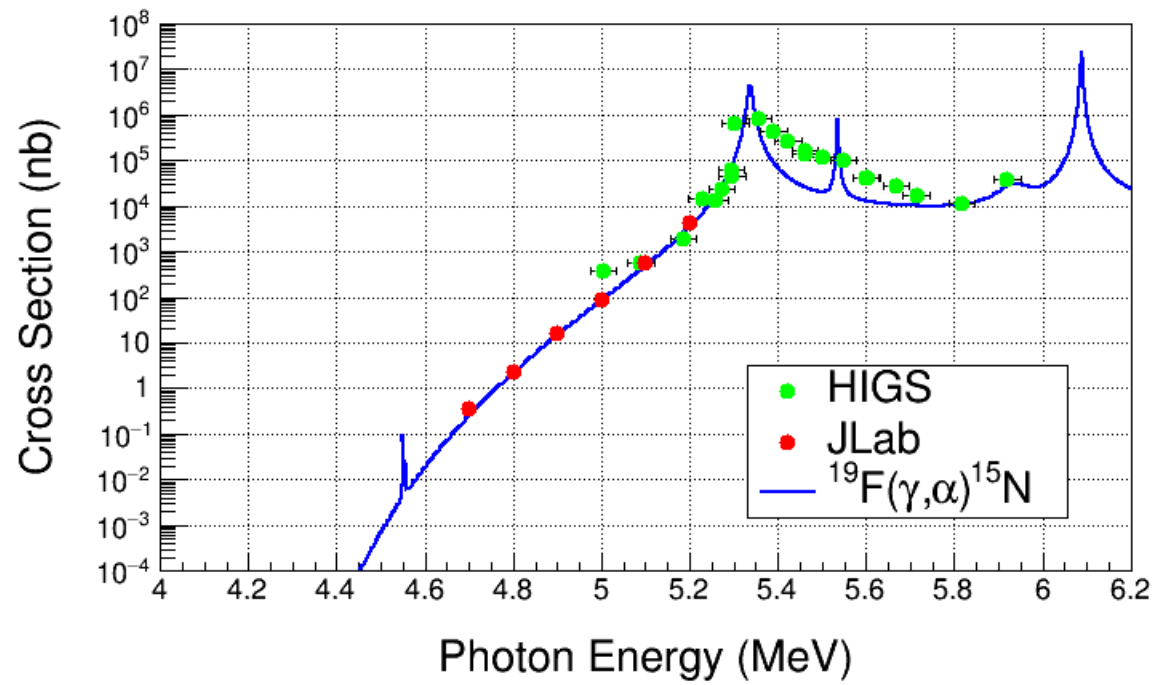
This is the cross section dependence on energy

- Accounted for dN_{ij} due to energy error when calculating dy_i

OTHER SYSTEMATIC ERRORS

Electron Beam K. E.	Cross Section (nb)	Sys Error (Energy, %)	Sys Error (Total, %)
4.75	0.37	11.1	14.2
4.85	2.35	9.5	13.0
4.95	16.6	8.6	12.3
5.05	91	8.3	12.1
5.15	555	8.8	12.5
5.25	4217	12.5	15.2

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%



REMARKS

- We are only approved to 10 μA , we will need 50 μA .