$^{19}\mathrm{F}(\gamma,\alpha)^{15}\mathrm{N}$ Rates

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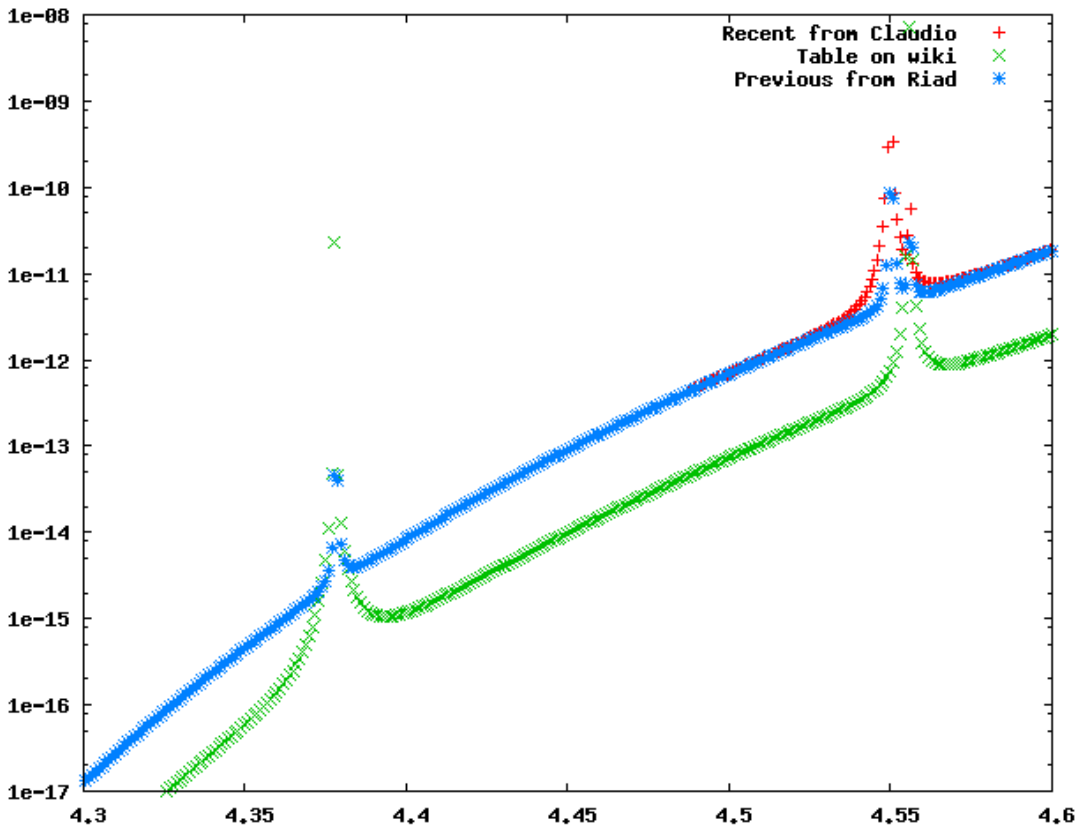
Overview

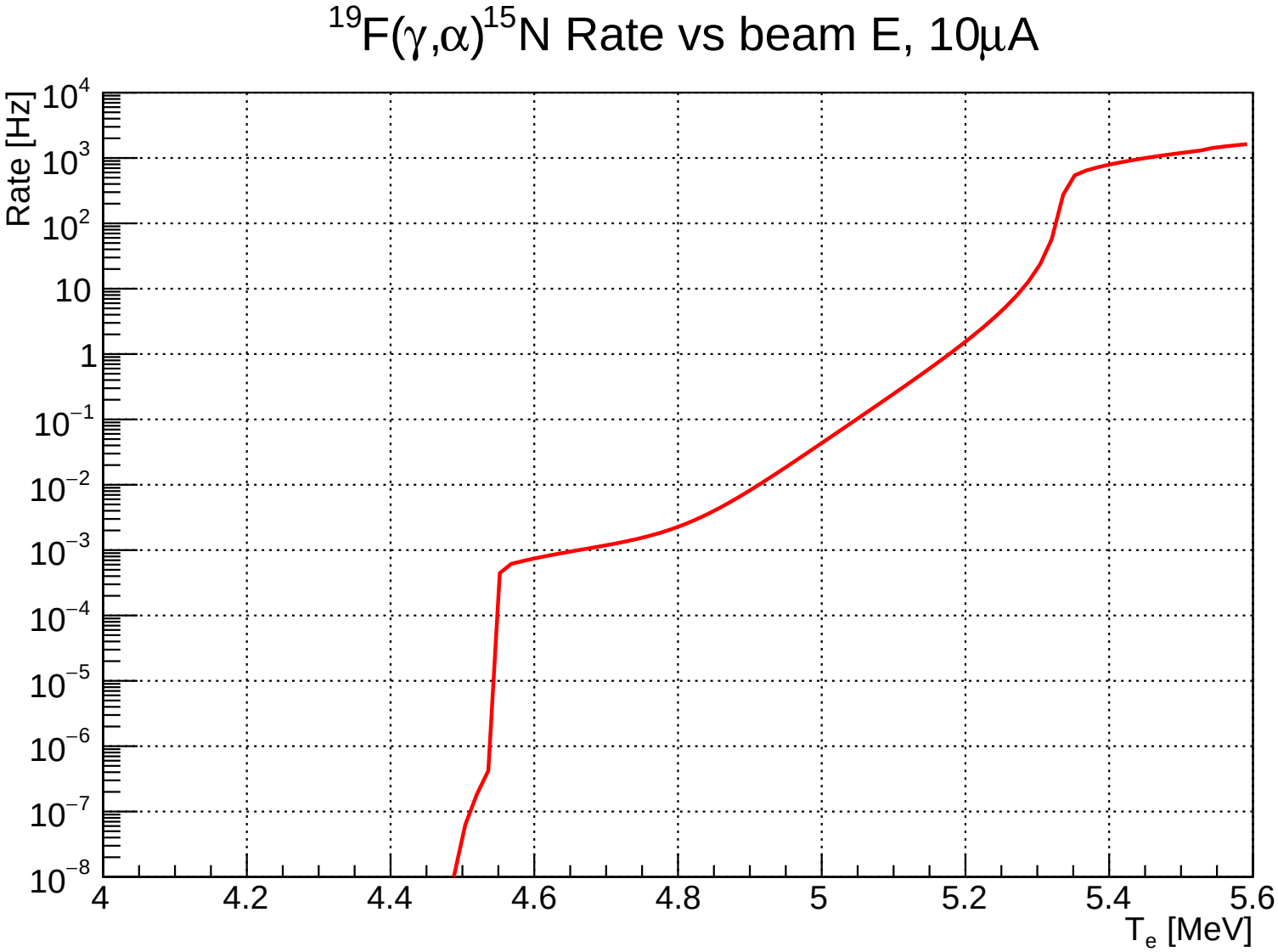
- Got updated $^{19}\mathrm{F}(\gamma,\alpha)^{15}\mathrm{N}$ rates
  - Cross section on wiki was low
- Have recalculated estimates for C_3F_8

Cross Section



- Cross section on wiki is significantly lower

Rates


$^{19}F(\gamma,\alpha)^{15}N$ Rate vs beam E, 10μA
Rate [Hz]
10^{4}
10^{3}
10^{2}
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
4
4.2
4.4
4.6
4.8
5
5.2
5.4
5.6
T_e [MeV]

Unfolding

- Assumptions made using simplest unfolding algorithm
- Electron energies evenly spaced by Δ
- Using bin centers as photon number calculation points

$$\begin{aligned} Y_i &\approx \sum_j N_\gamma(T_i^e, E_j^\gamma)\sigma(E_j^\gamma) \\ &= \sum_j N_{ij}\sigma_j \end{aligned}$$

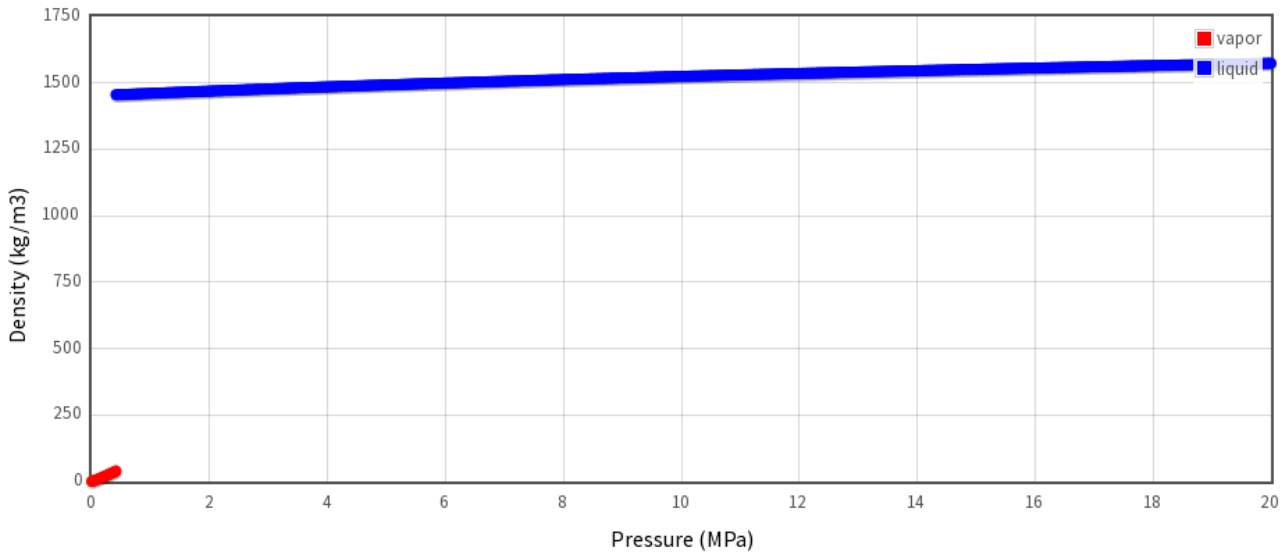
with $E_j^\gamma = T_i^e - (i - j + \frac{1}{2})\Delta$

- Measured cross section $\bar{\sigma}_j$ for E_j^γ

$$\bar{\sigma}_j = B_{ji} Y_i = N_{ji}^{-1} Y_i$$

Input Parameters

- C_3F_8 density from NIST



- 0.06% T_e resolution
- 3 cm long bubble chamber target
- 0.6 cm copper radiator
  (compared brem spectrum to G4, see prior talks)

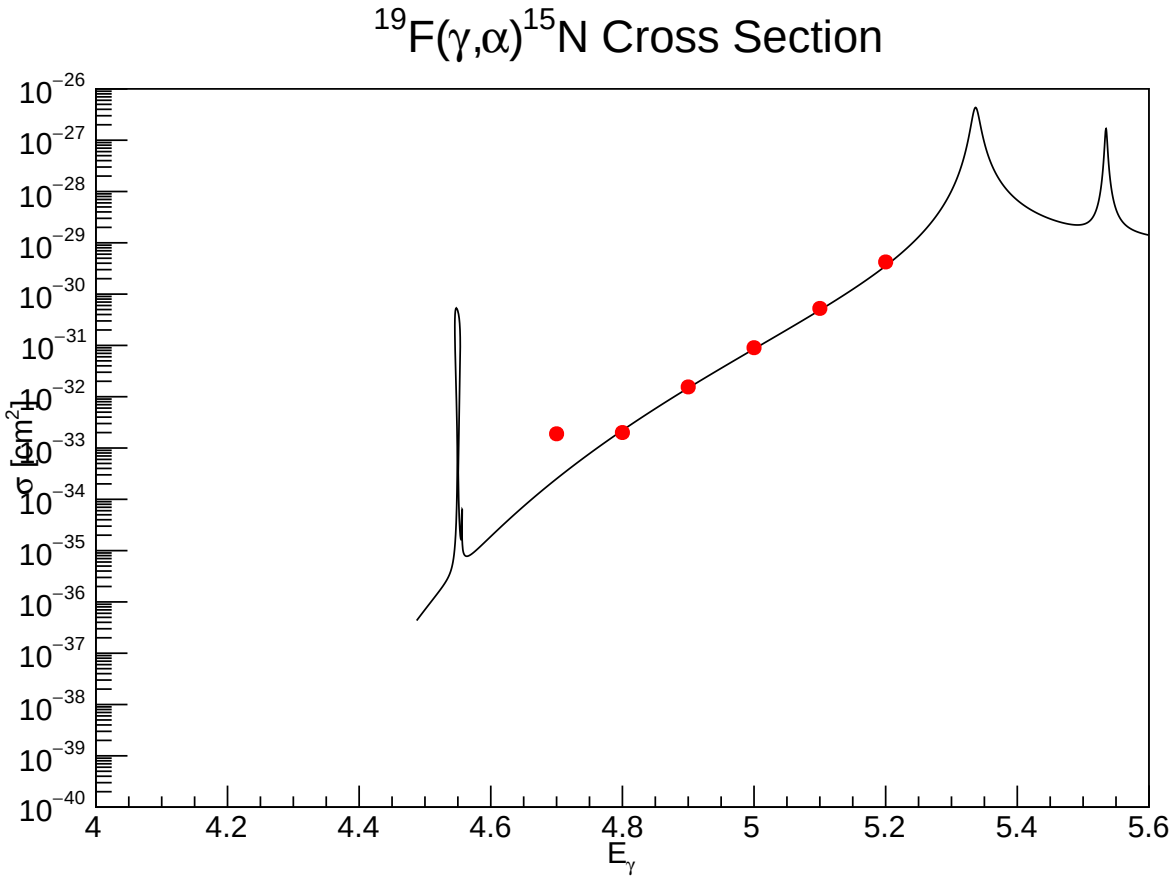
Trial Run Plan

- Solved for constant $d\sigma/\sigma$, but assuming little cross section variation
- Assumed total run time about 1 week
- Rates all less than 400 counts/hour

T	E_γ	I (μA)	t (h)	Yield	Back	Recon. $d\sigma/\sigma$ (%)
4.75	4.70	50.0	83	2319	333	2.2
4.85	4.80	36.8	61	3235	245	5.4
4.95	4.90	9.1	15	913	60	5.0
5.05	5.00	3.2	5	616	21	5.7
5.15	5.10	1.3	2	627	9	5.5
5.25	5.20	0.2	2	596	3	5.2
			169			

- Lowest point picks up resonances, but gets subtracted off for higher points

Unfolded σ



- Lowest point picks up resonance, but gets subtracted off for higher points
- Shifting T_e by 0.5 MeV goes to $\sim$10% uncertainties

To Do and Concerns

- Need to include G4 rates from Whit
- Point-to-point systematics in unfolding?
  - Leading point unfolding

$$\sigma(4.8\ \mathrm{MeV}) \propto \frac{Y(4.8\ \mathrm{MeV})}{\int L(4.8\ \mathrm{MeV})dt} - 1.5\frac{Y(4.7\ \mathrm{MeV})}{\int L(4.7\ \mathrm{MeV})dt}$$

- Absolute and step-relative uncertainties should be redone?