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

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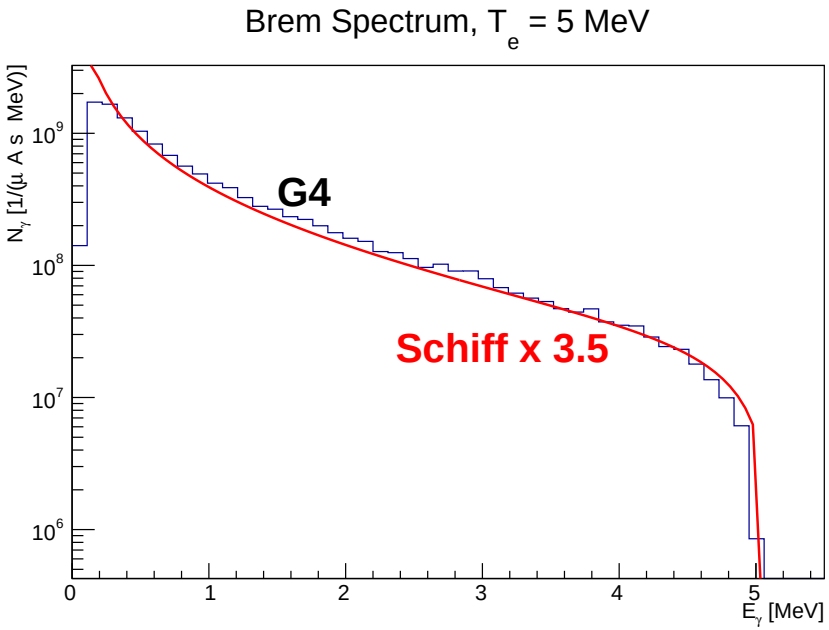
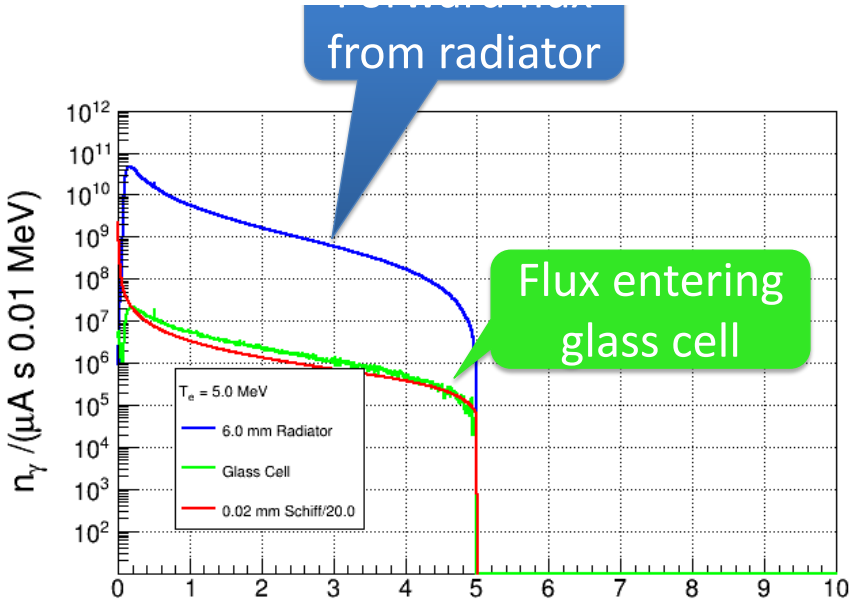
# Overview

- Developed new code to calcuate $^{19}\mathrm{F}(\gamma,\alpha)^{15}\mathrm{N}$ rates from scratch
- Comparing to presentation made in March 2016 with similar goals
- Geometry could be improved
- Have a bunch of questions - let me know where refinement can be done

# Simulation

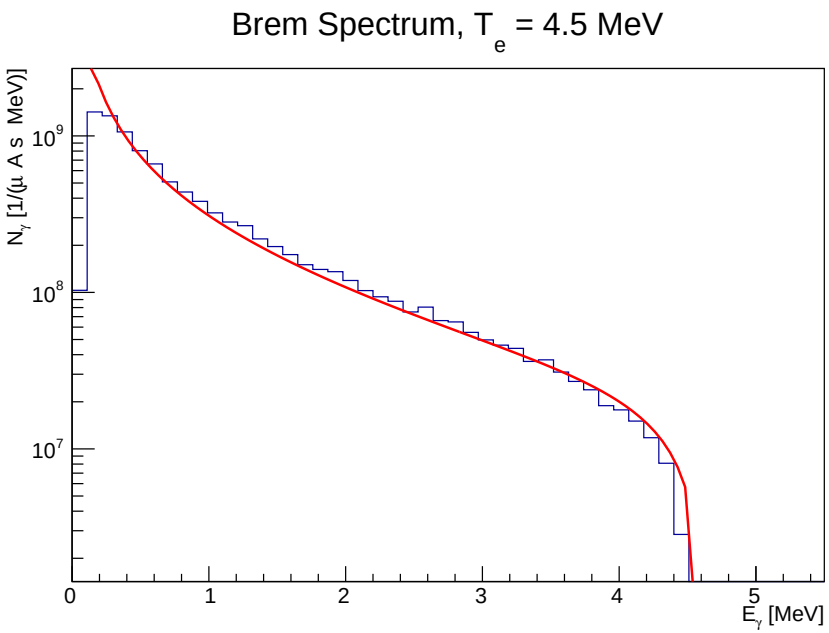
- Starting with very basic G4 from scratch based on geometry
- Just radiator and apertures
- Photons required to come from inside target - cutting everything else for simplicity



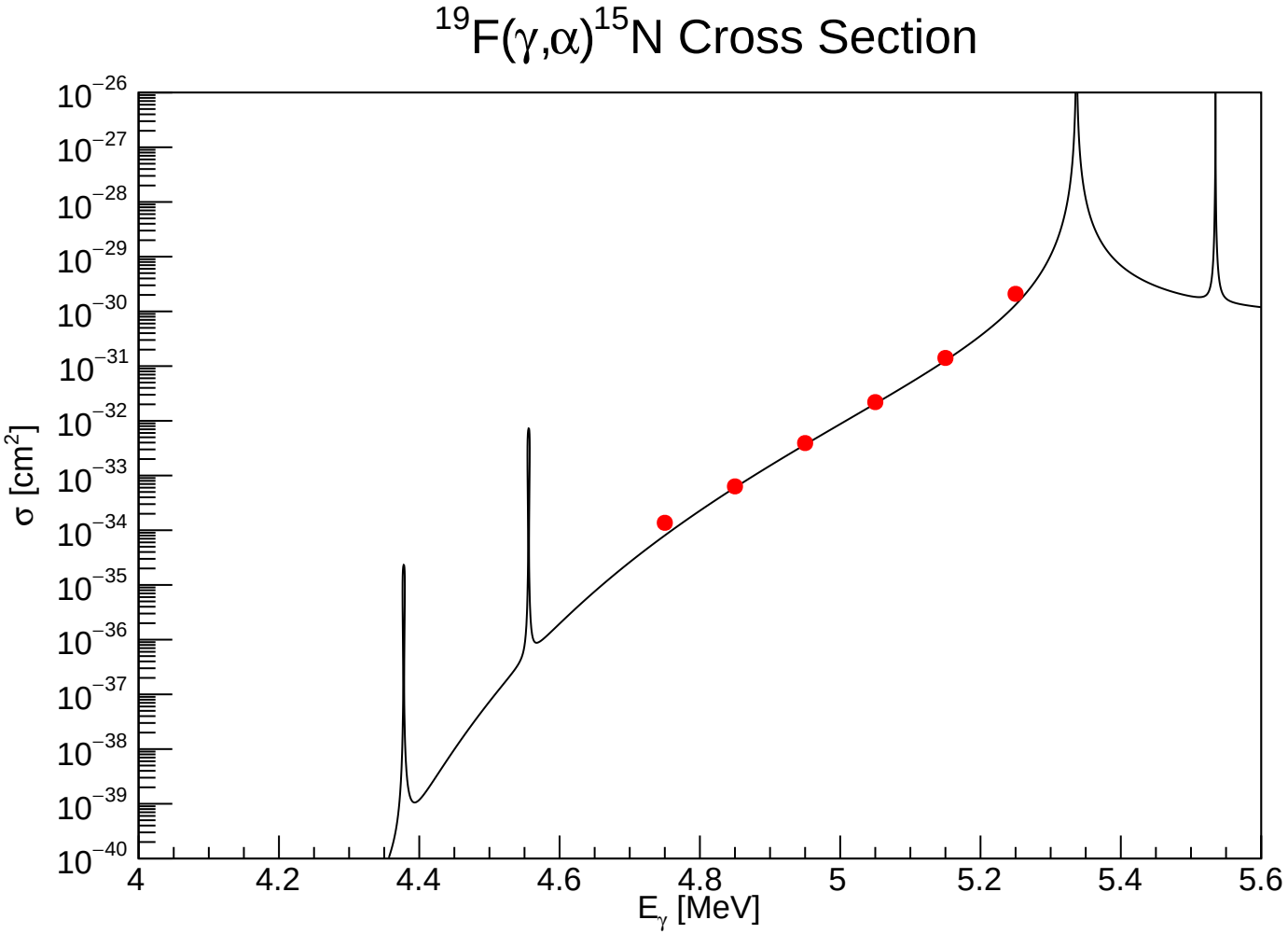

- Matching G4 $T_e$ =5 MeV to Schiff formula
- G4 visually agrees well with previous G4
- Overall scaling of my Schiff off by $\times 3 - 4$ - geometrical?
- Schiff used for remainder of calculations

# Simulation




- Also tracks with lower energy ($T = 4.5$ MeV)

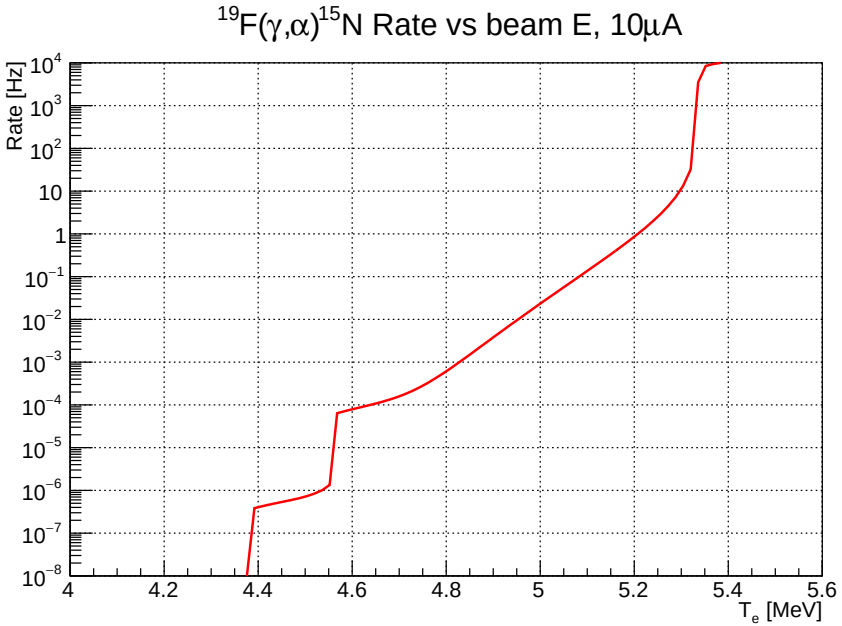
# Cross Section

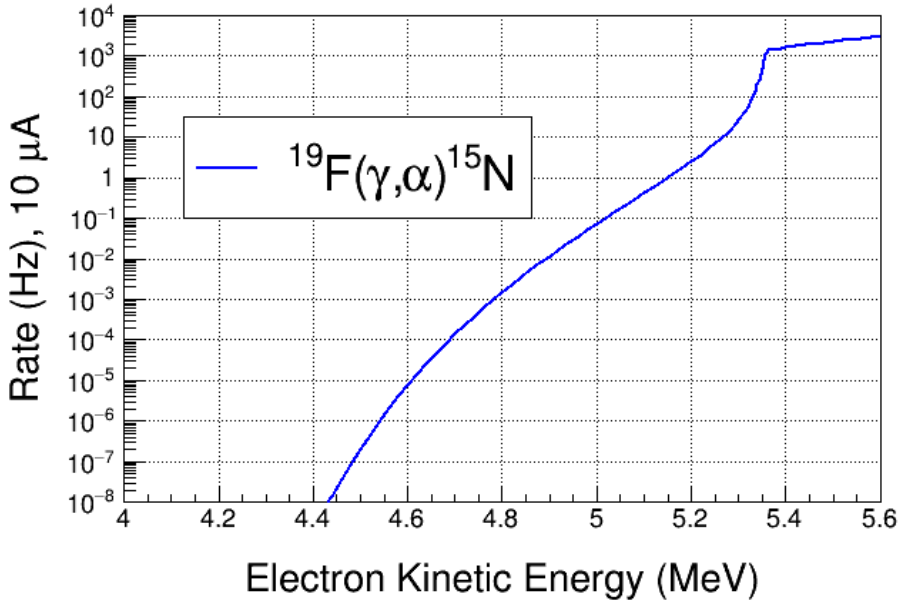



- Cross section used from table provided on wiki
- Using logarithmic-y linear-x interpolation due to extreme variation

# Rate vs $T_e$

- Convoluting cross section with Brem spectrum
- ROOT is doing numerical integration - defaults to adaptive QAG method




- Some differences in structure washed out in previous analysis?
- Absolute rates are a bit lower in mine

# Unfolding

- Using simplest unfolding algorithm
- Electron energies evenly spaced by $\Delta$
- Using bin centers as photon number calculation points

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

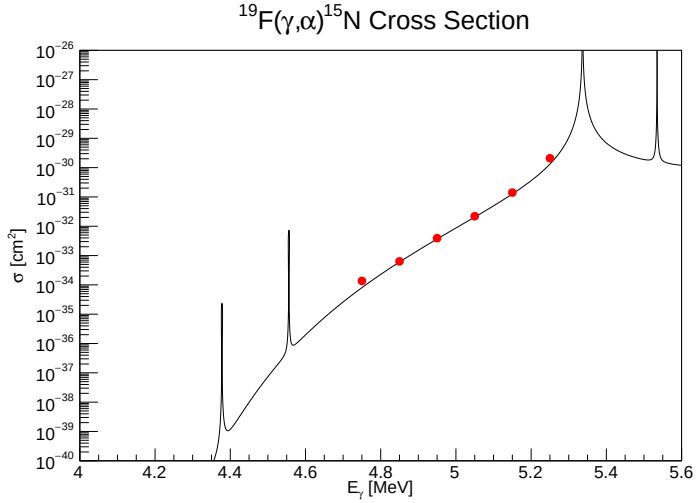
with $E_j^\gamma = T_i^e - (i - j + \frac{1}{2})\Delta$

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

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

# Trial Run Plan

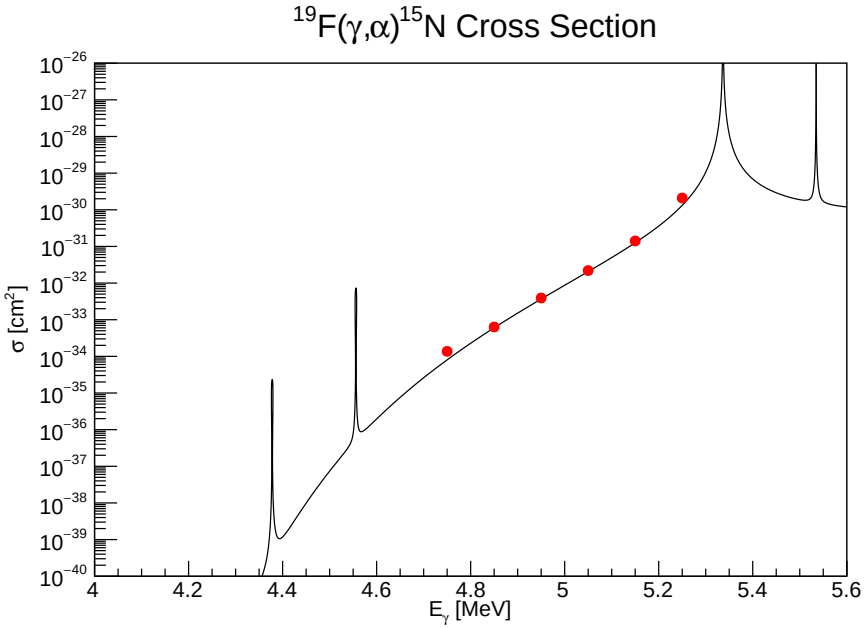
- Solved for constant $d\sigma/\sigma$, but assuming little cross section variation
- Plan can be tweaked given variation
- Total run time about 1 week
- Rates all less than 400 counts/hour
- Not including backgrounds yet



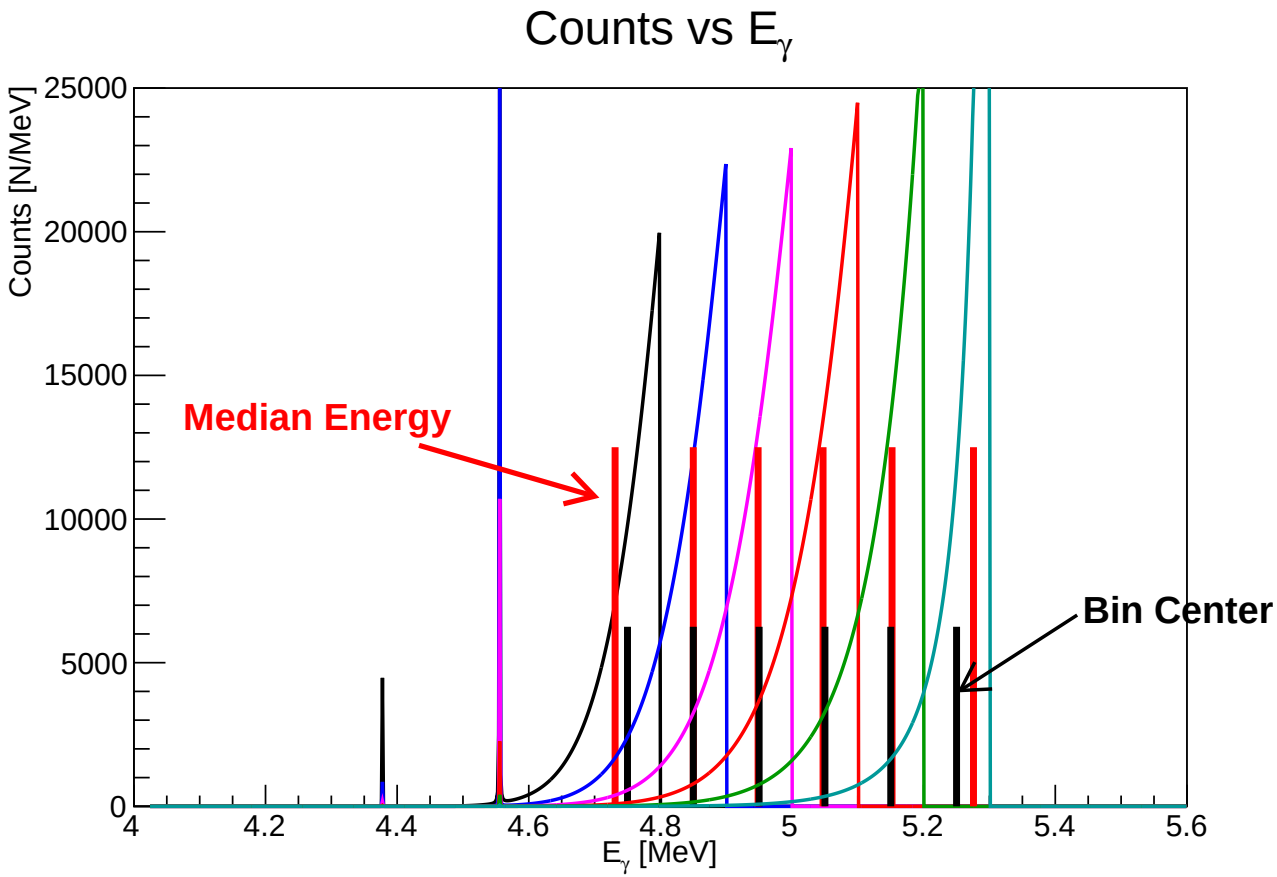

| $T$ | $E_\gamma$ | I ($\mu$A) | t (h) | Yield | $d\sigma/\sigma$ |
|---|---|---|---|---|---|
| 4.80 | 4.75 | 50.0 | 100 | 1641 | 3.7 |
| 4.90 | 4.85 | 20.3 | 40 | 1669 | 8.7 |
| 5.00 | 4.95 | 8.5 | 17 | 1834 | 8.1 |
| 5.10 | 5.05 | 3.7 | 7 | 1954 | 8.1 |
| 5.20 | 5.15 | 1.4 | 5 | 1935 | 8.1 |
| 5.30 | 5.25 | 0.4 | 5 | 2033 | 6.7 |
| | | | 174 | | |

# Quoted cross section concerns

- Cross section varies quickly - question about what cross section quoted means
- First and last bins are pulled by nearby resonance
- First and last have $\bar{\sigma}(E_i)$ 50-70% different from $\sigma(E_i)$
- Rest are $\sim 5 - 10\%$ level



# Quoted cross section concerns ii




- Median energy for convoluated rate about equal to bin center - evenly spaced

# Summary and To Do

- Put together machinery for calculating rates and doing unfolding
- Some differences from previous analysis need to be addressed
- Geometry should be finalized
- Photon spectrum from G4 should be compared over broader energy
- Question on cross section to quote and nearby resonance effects
- Backgrounds need to be included

# Running Pressures/Temperatures