Photon Strength Function of ^{58}Fe using the Oslo and Shape Methods

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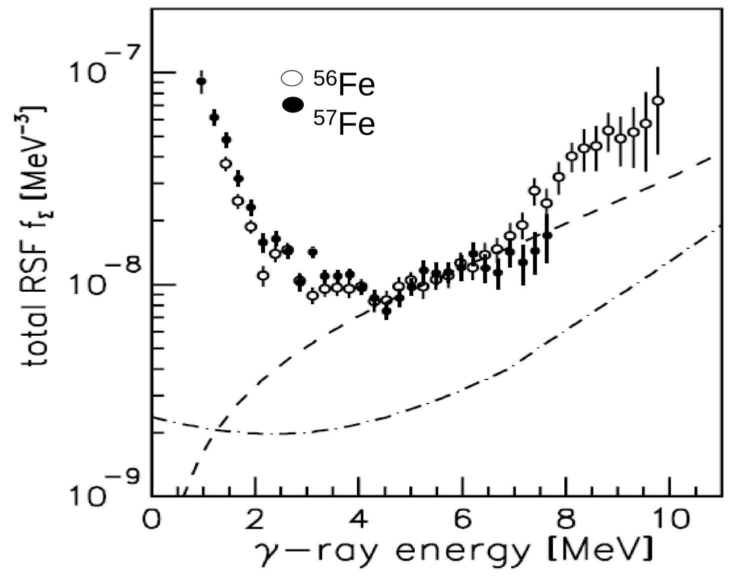
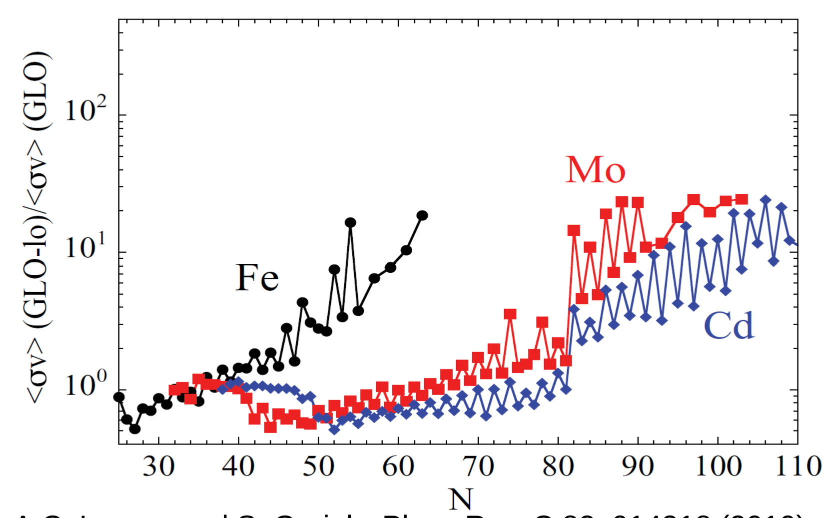
Introduction

- Neutron capture processes dominate production of Z > 26
- Models of stellar evolution require accurate cross-sections
- Photon strength functions often have the dominant uncertainty
- Low energy enhancement (LEE) first observed
- Reaction rates in r-process nucleosynthesis
- ^{60}Fe measurements on earth and space

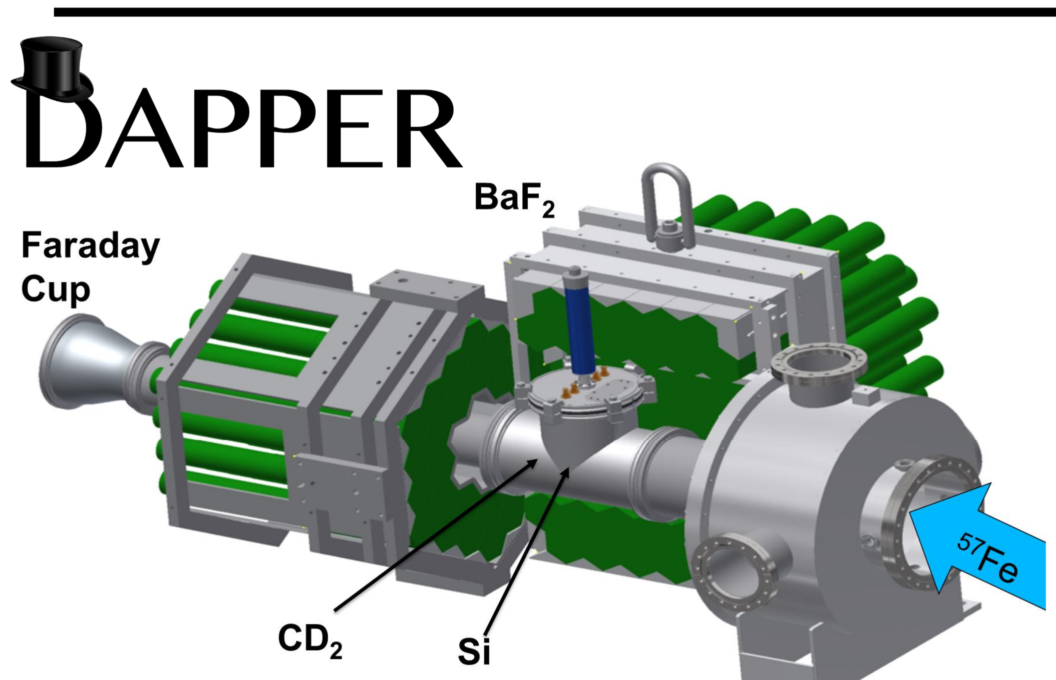


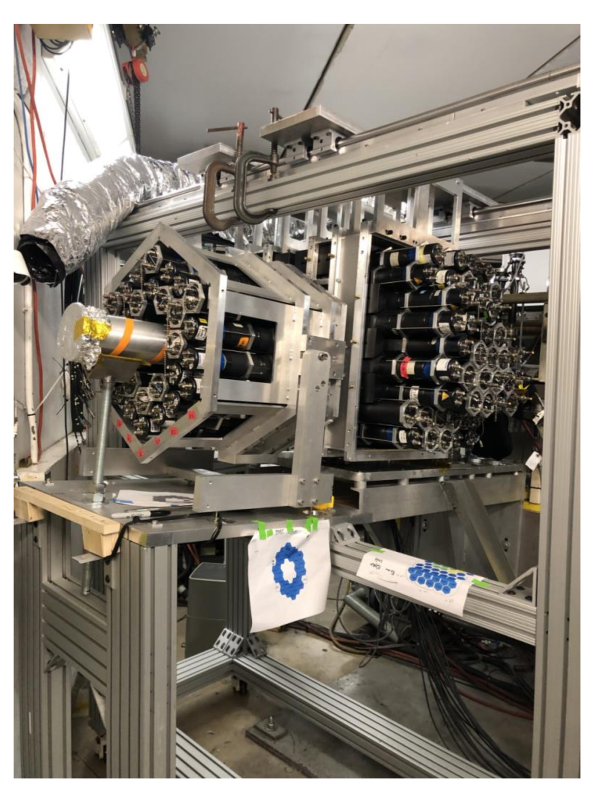
A. Voinov *et al.* Phys. Rev. Lett. Vol.93, 14 (2004)



A.C. Larsen and S. Goriely. Phys. Rev. C 82, 014318 (2010)

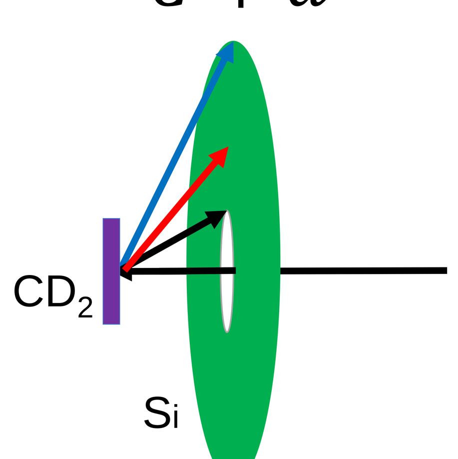
DAPPER





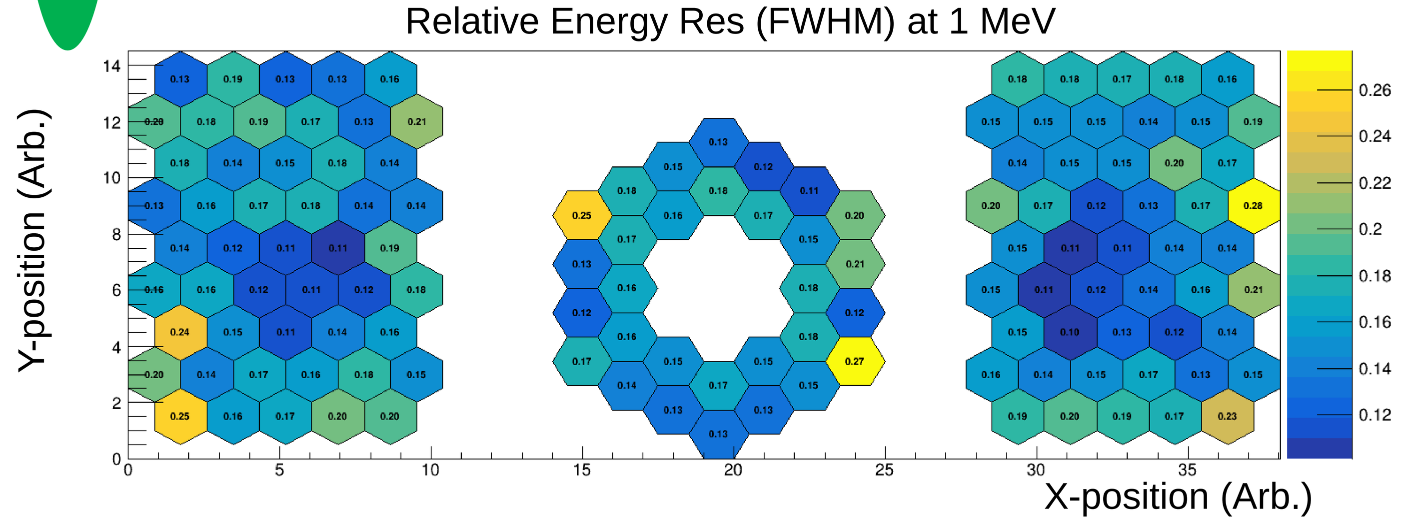
$$^{57}Fe + d \rightarrow {}^{58}Fe + p + \gamma$$

$$^{13}C + d \rightarrow {}^{14}C + p + \gamma$$



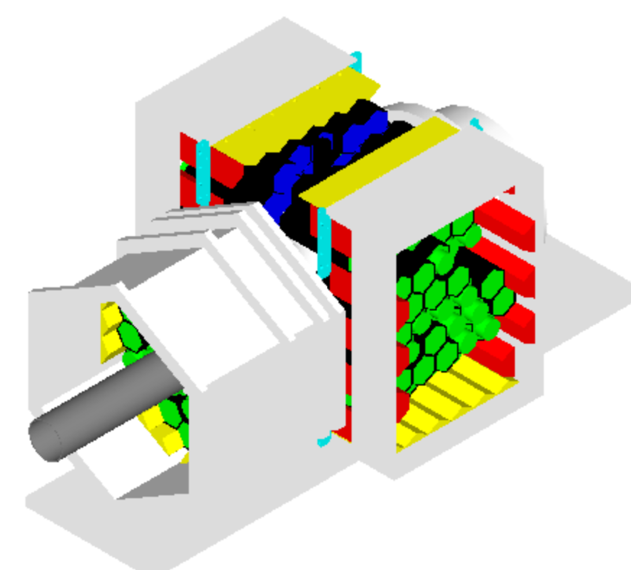
- Obtain PSF experimentally by measuring gamma-ray energies emitted from particular initial excited states
- Inverse kinematics opens possibilities of studying rare isotopes

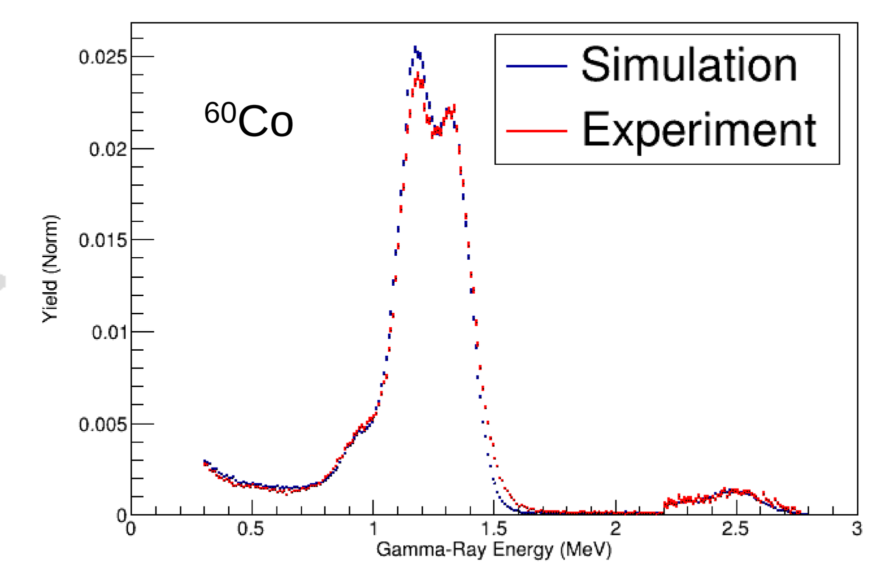
Relative Energy Res (FWHM) at 1 MeV



Simulation

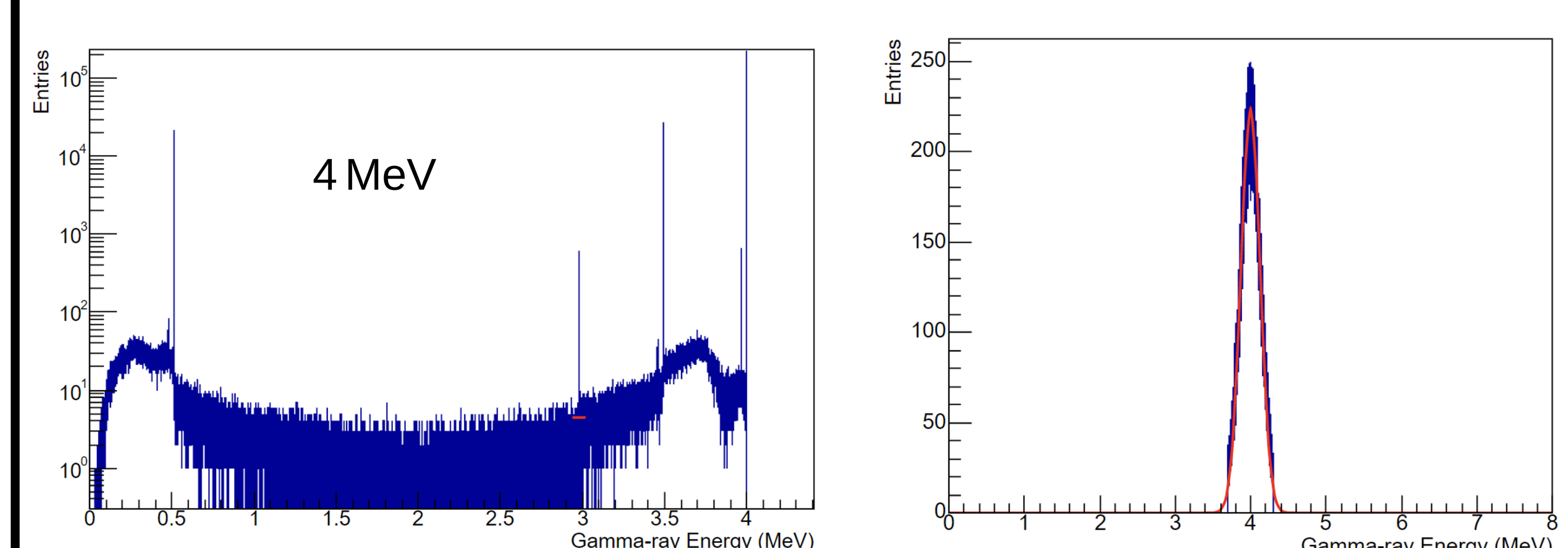
- GEANT4 simulation of DAPPER
- Accuracy tested with source data





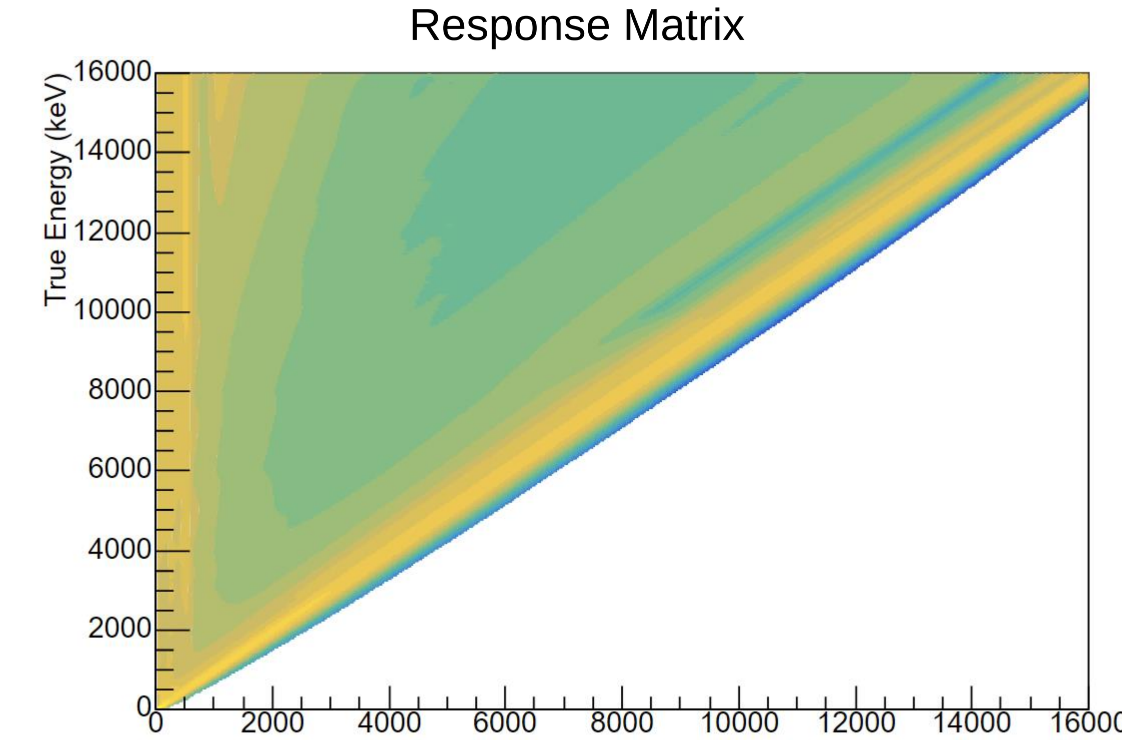
Response Function

- Simulate gamma-rays of various energies

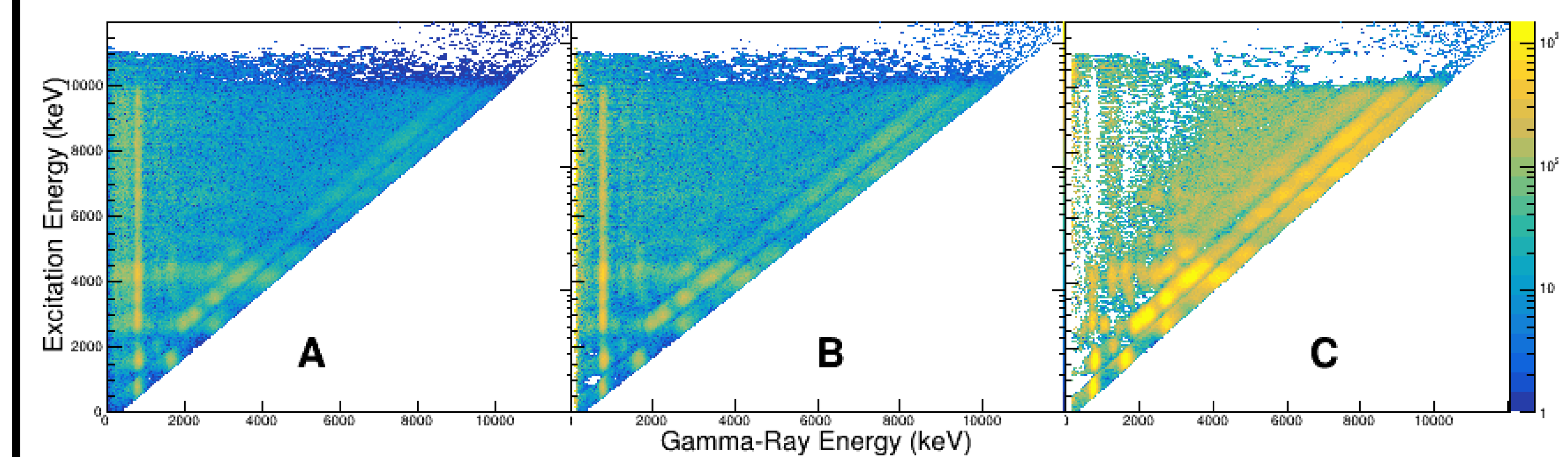


- Determine efficiencies, resolution and relative entries of various peaks
- Energy dependent shape of Compton background
- Interpolated for all energies

Response Matrix

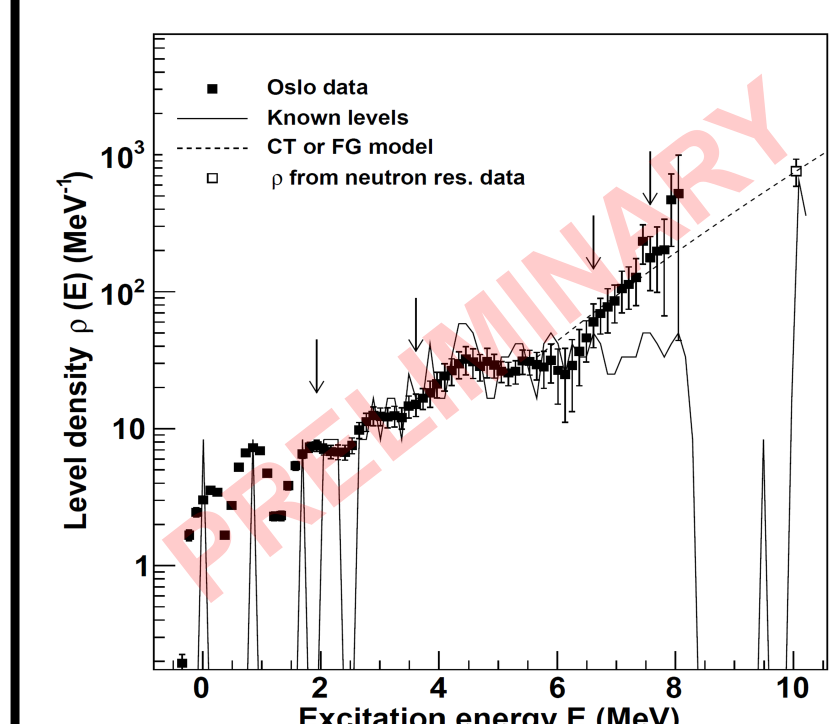


Oslo and Shape



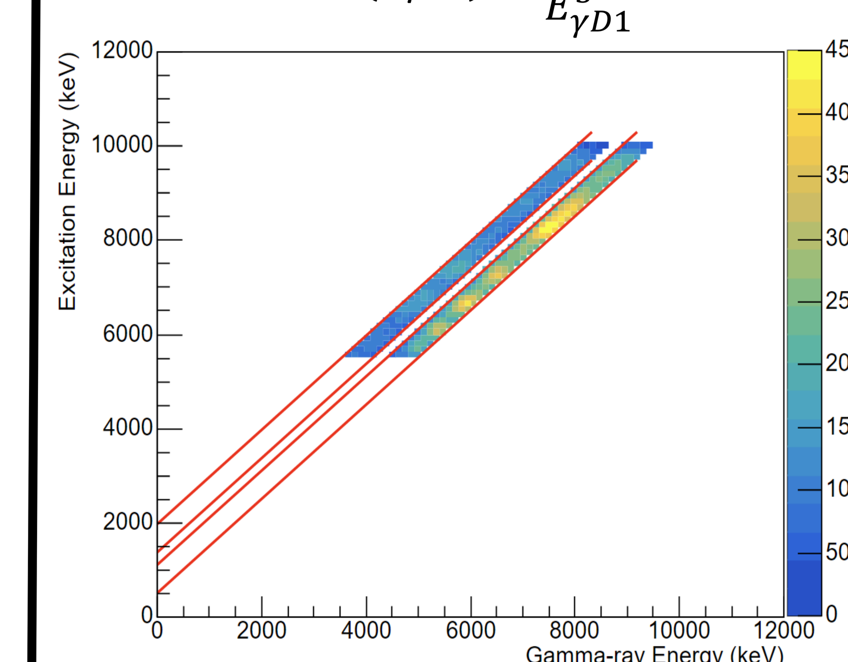
- A: Raw experimental matrix
- B : Unfolded matrix – utilizes the response matrix
- C: Primary matrix - $P(E_\gamma, E_x) \propto \rho(E_x - E_\gamma)T(E_\gamma)$

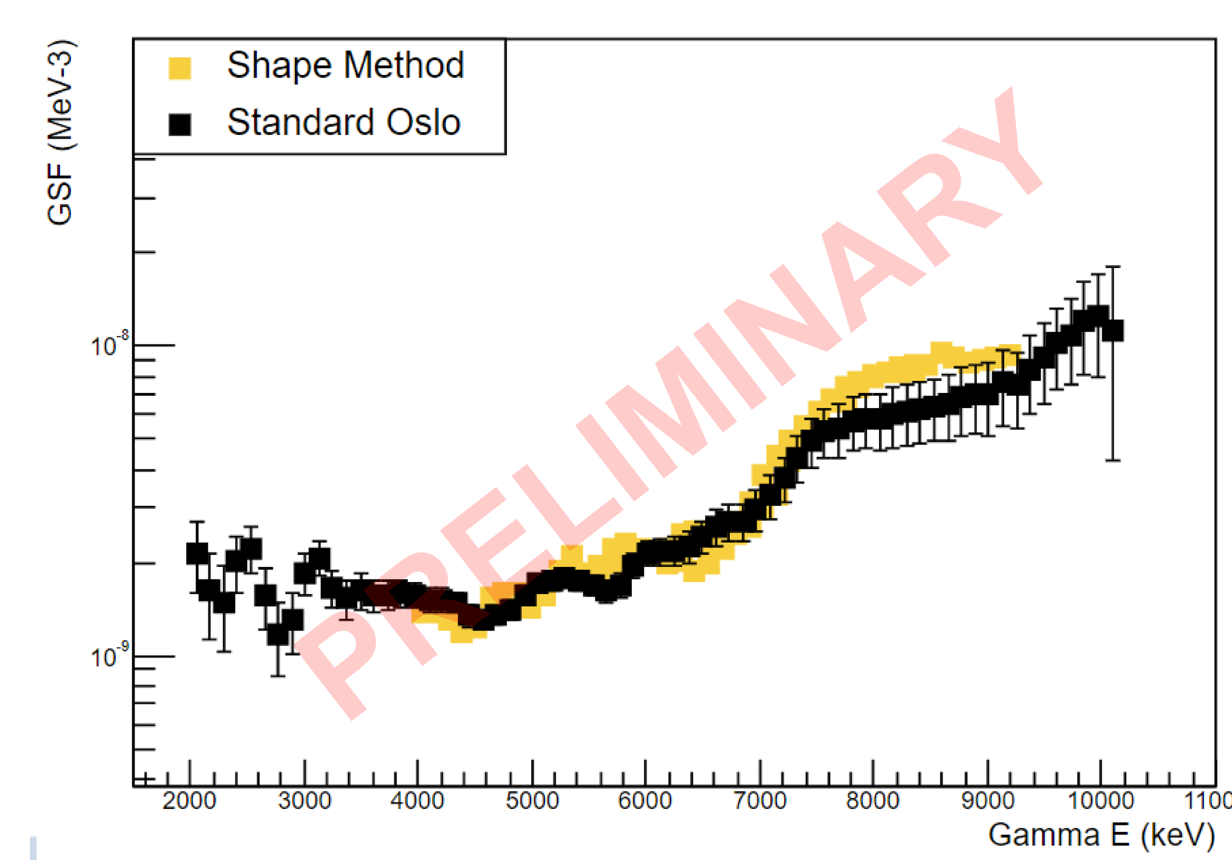
- Absolute normalization: requires external data
  - NLD: D_0, known levels
  - PSF: $\langle\Gamma_\gamma\rangle$ at S_n



- Utilize relative entries in final states
  - Obtain functional form of PSF; no NLD

$$f_{D1}(E_{\gamma D1}) \propto \frac{N_{D1}}{E^3_{\gamma D1}}$$





Acknowledgments: Special thanks to the Cyclotron Institute, the SJY group, and collaborators. This research is possible thanks to the NNSA Grant #DE-NA0003841 and Department of Energy Grant #DE-FG02-93ER40773.