Preparations for Measuring the Gamma Ray Strength Function of $^{60}$Fe using $^{59}$Fe(d,p)$^{60}$Fe

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Introduction

- $^{60}$Fe has been observed nearby in the galaxy [1], in lunar soil samples [2], in oceans worldwide [3], and in Antarctic snow [4]
- Important isotope in nucleosynthesis; branch point in the s-process
- We will measure the gamma ray strength function in order to obtain a constraint for astrophysical models
- $^{59}$Fe beam, produced using the TAMU MARS line at the Cyclotron Institute, impinging on a CD$_2$ target
- Proton emitted at backward angles from $^{59}$Fe(d,p)$^{60}$Fe reaction will be detected in a silicon detector
- Gamma rays will be detected in packs of BaF$_2$ crystals coupled to photomultiplier tubes.

Experimental Setup

- CAD drawing of anticipated final experimental setup
- Coincidence of MCP and PPAC give TOF of residue
- Silicon rings give angular resolution for proton
- Purity detector for beam impurities event by event
- $\sim 10^5$ pps

Experimental Simulations

- $^{210}$Th alpha source and can achieve 53 keV (0.6%) resolution
- $\beta^+$ spectrum from $^{68}$Ge source
- $\gamma$ cascade

Silicon Testing

- 24 rings and 32 pies
- Currently triggering on the fast out of rings
- Tested with $^{232}$Th alpha source and can achieve 53 keV (0.6%) resolution
- Coincidence with Si

BaF$_2$ Resolution Improvement

- Decoupled to try RTV
- Initially successful but found degradation over time and uniformity issues
- Recover fast component of signal when recoupled with oil
- Resolution still between 15-25%
- New PMTs increase resolution of one detector from 17.7% to 11.6%

Coming This Fall

- Measure $^{57}$Fe(d,p)$^{58}$Fe reaction in order to characterize detector response
- Can check with known states of $^{57}$Fe

References


Acknowledgements

Special thanks to the Cyclotron Institute and the SJY group. This research is possible thanks to the NNSA Grant #DE-NA0003841, Robert A. Welch Foundation Grant #A-1266 and Department of Energy Grant #DE-FG03-93ER40773.