

# BaF<sub>2</sub> Detector Characterization for Photon Strength Function of <sup>58</sup>Fe in Preparation for <sup>59</sup>Fe(d,p)<sup>60</sup>Fe Experiment



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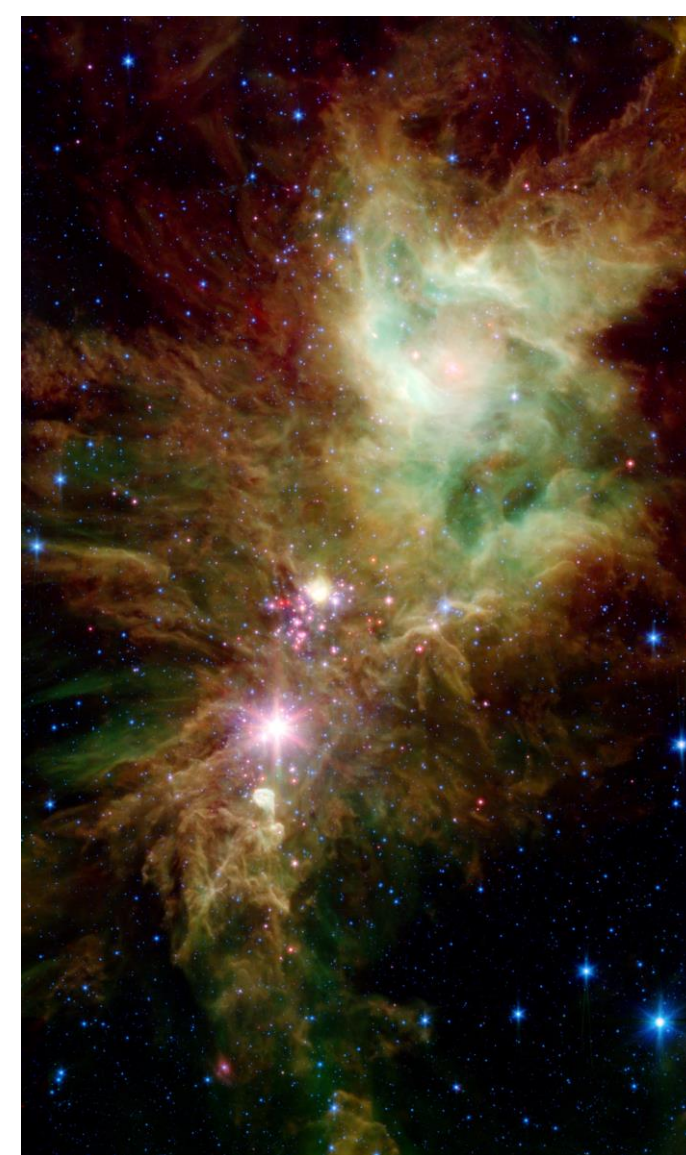
## Introduction

<sup>60</sup>Fe has been detected in space [1], on the moon [2], in Antarctic snow[3] and in earth's seabed [4].

Half-life and associated gamma rays make it potentially useful in tracking the evolution of certain stars[5].

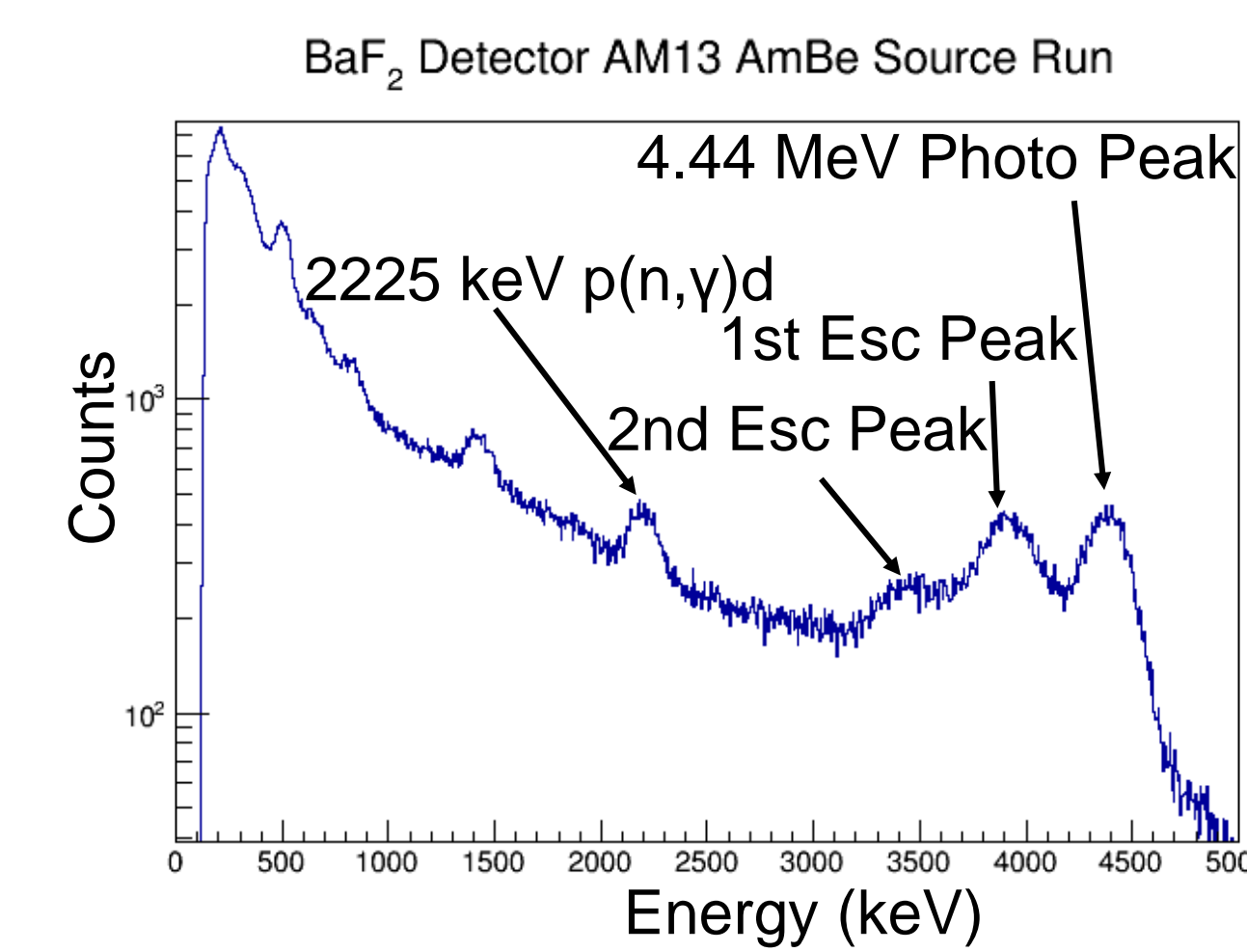
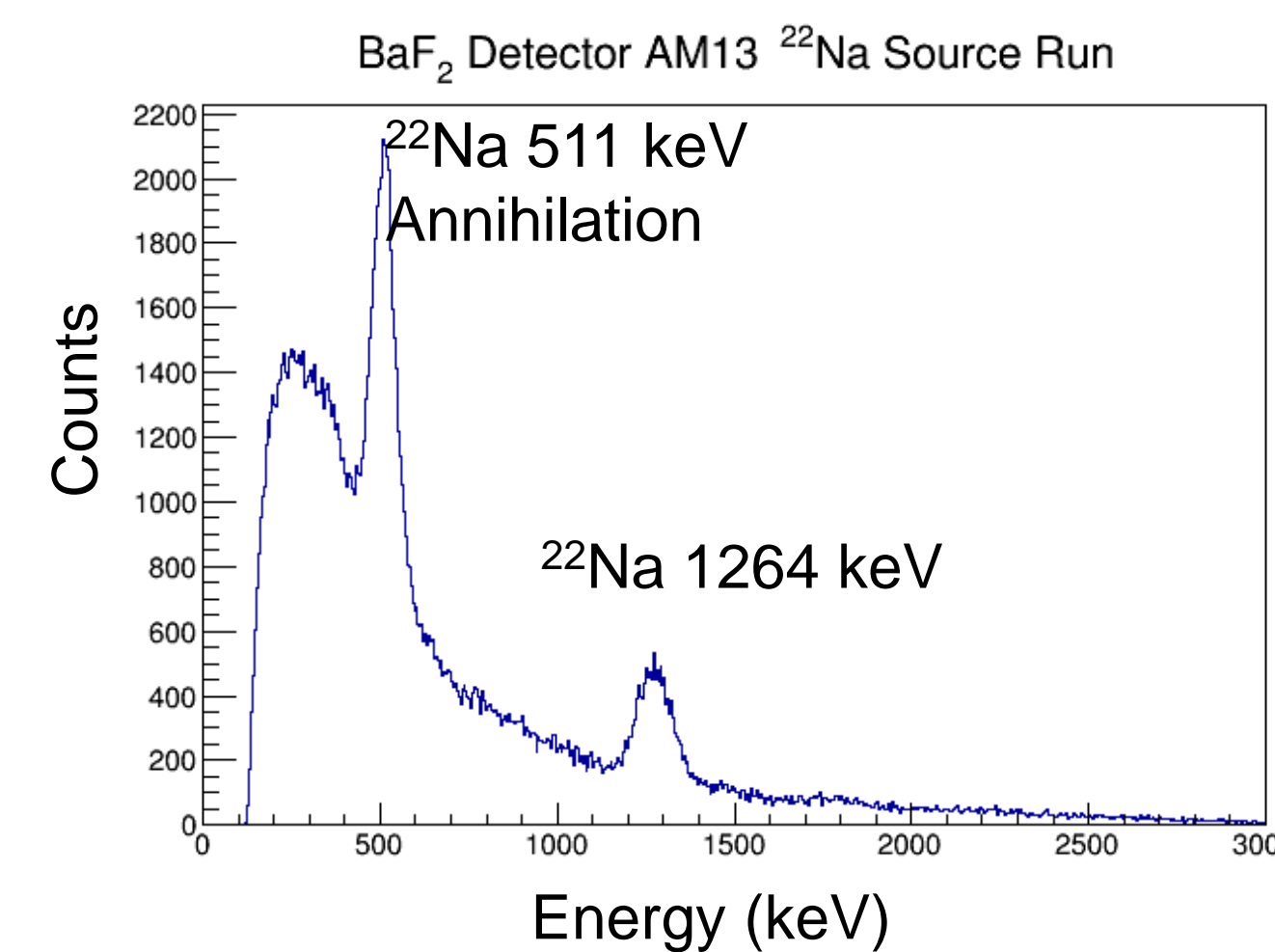
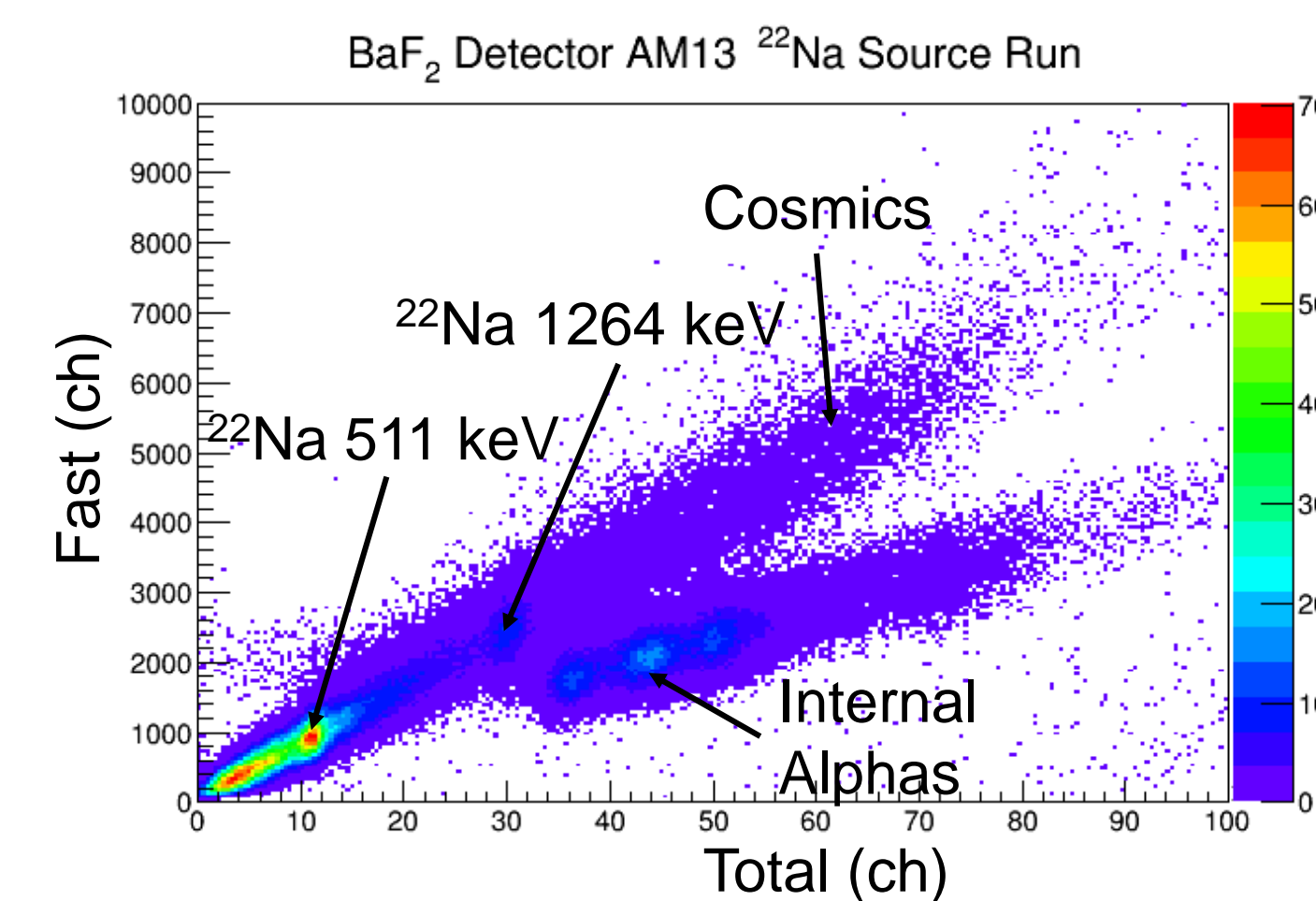
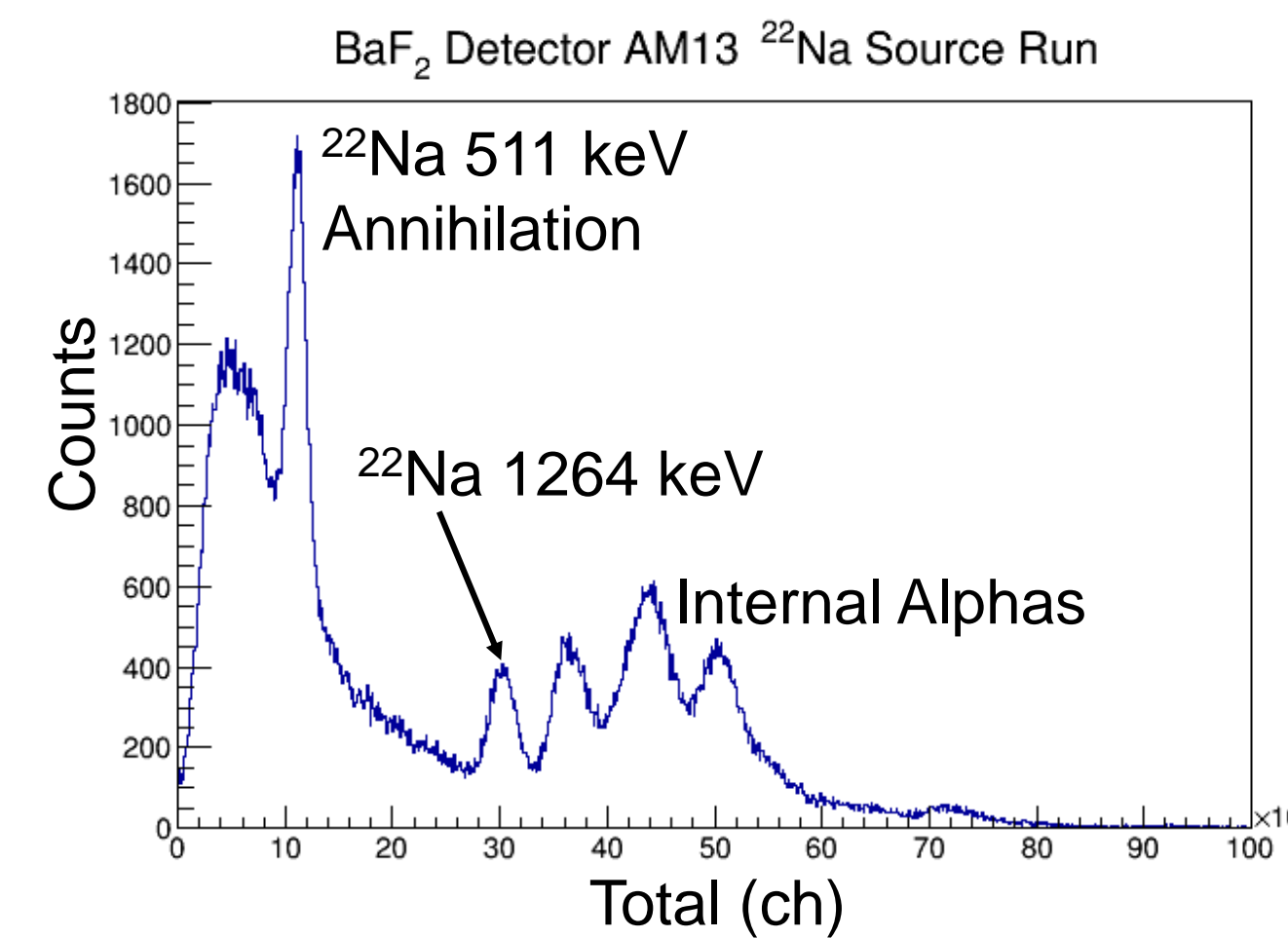
The photon strength function will be measured in order to obtain a constraint for astrophysical models.

Two test runs were performed using BaF<sub>2</sub> detectors in conjunction with a silicon detector.

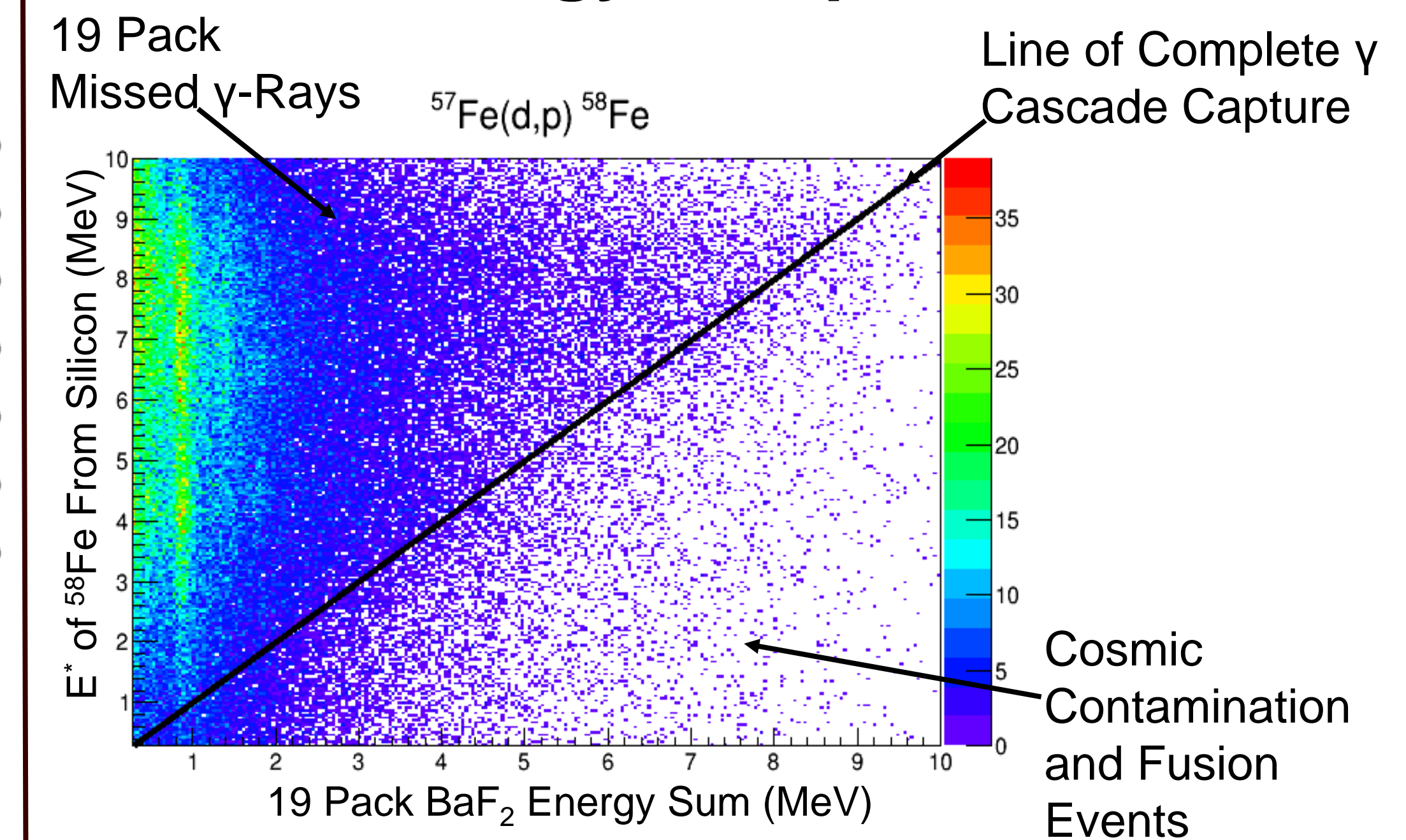


Stellar Snowflake Cluster from [6].

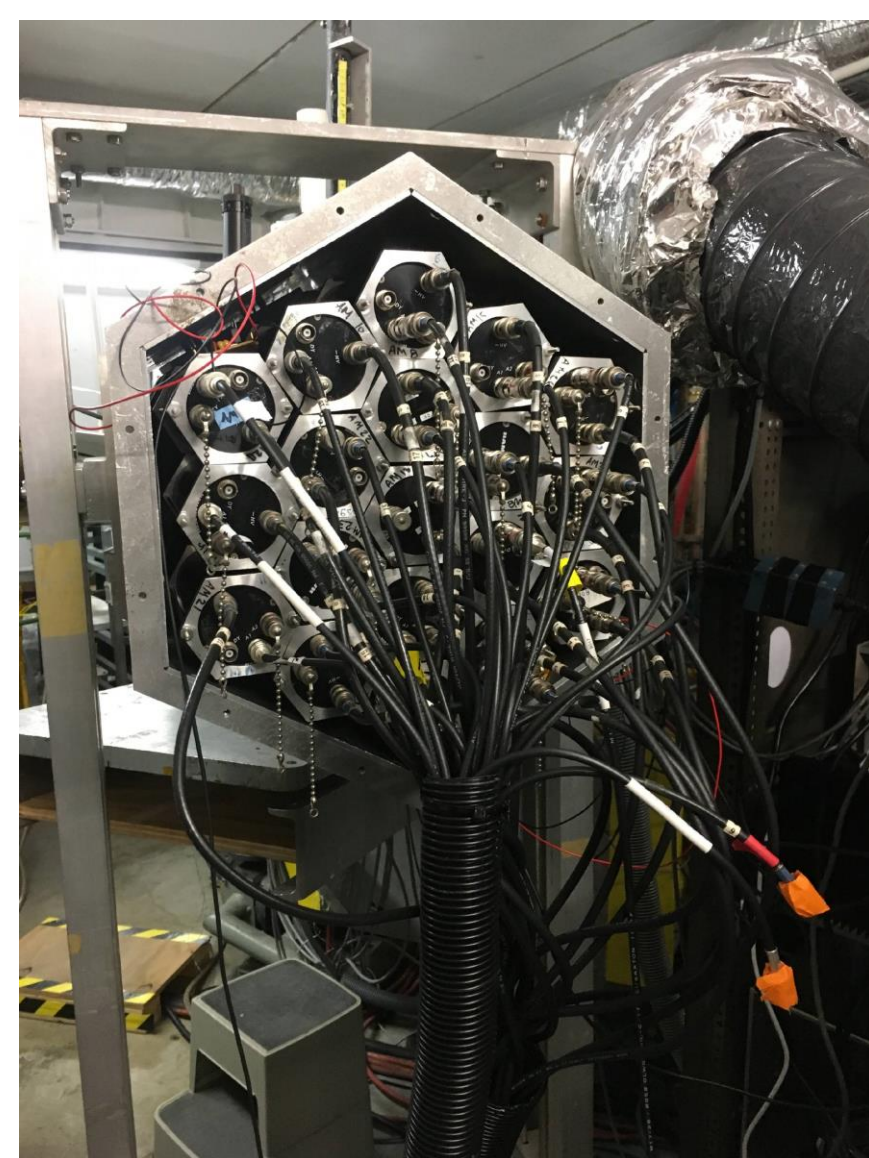
## BaF<sub>2</sub> Detector Energy Calibration and PID



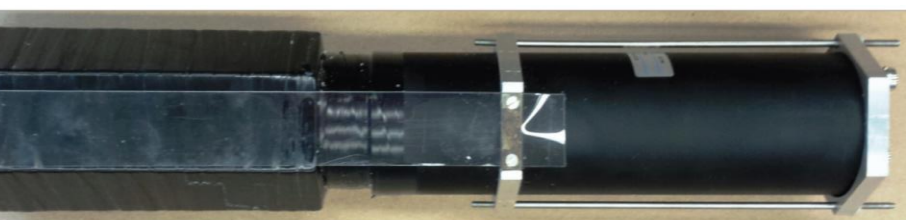
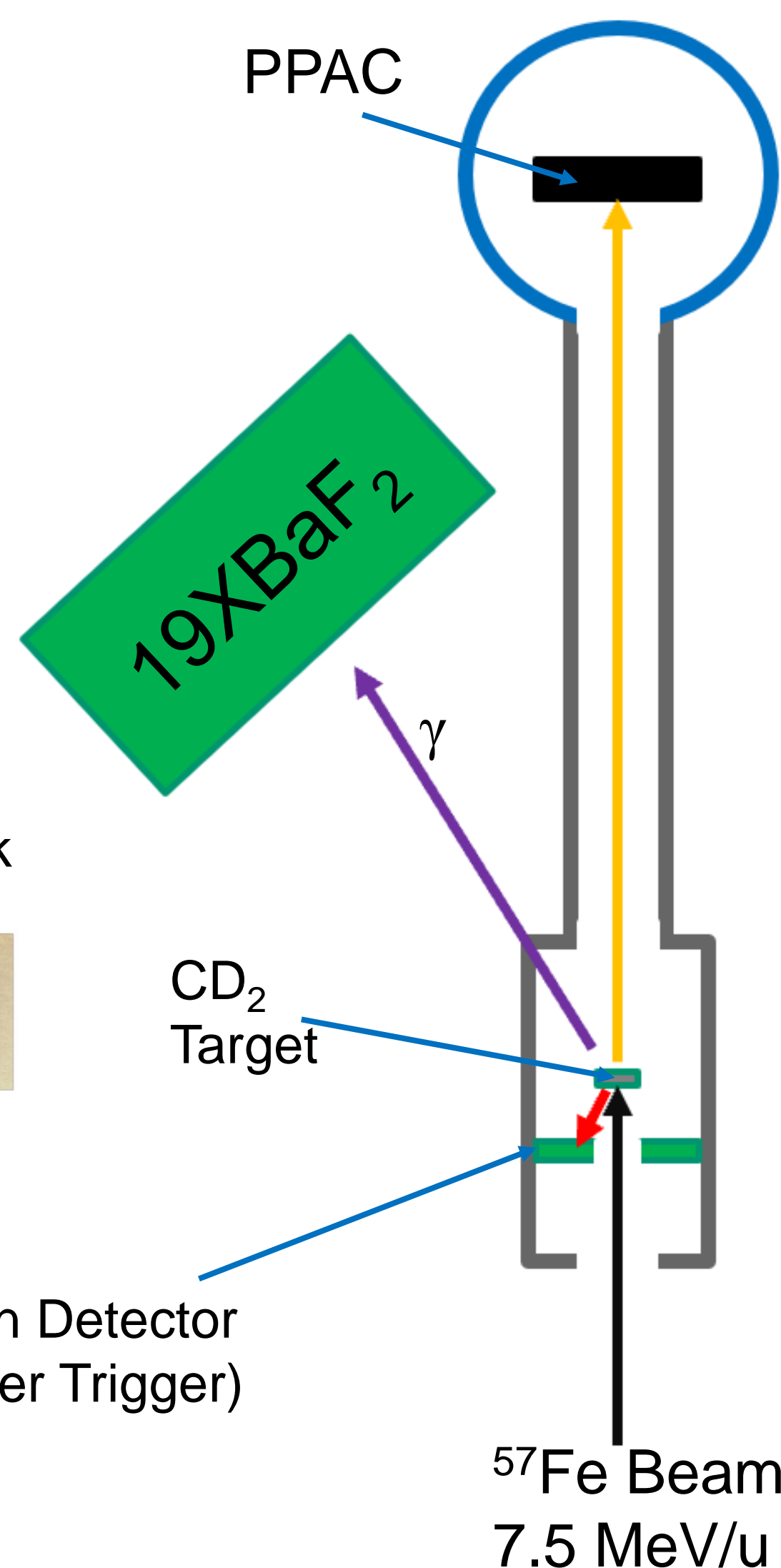
## Energy Comparison



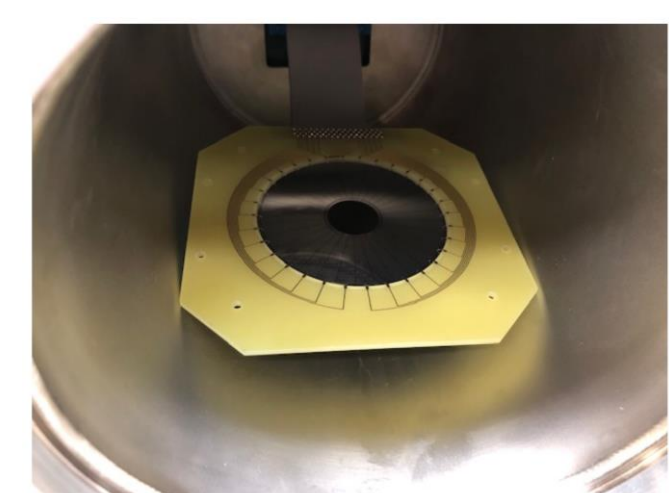
## Test Experiment Setup



Back view of BaF<sub>2</sub> 19 pack



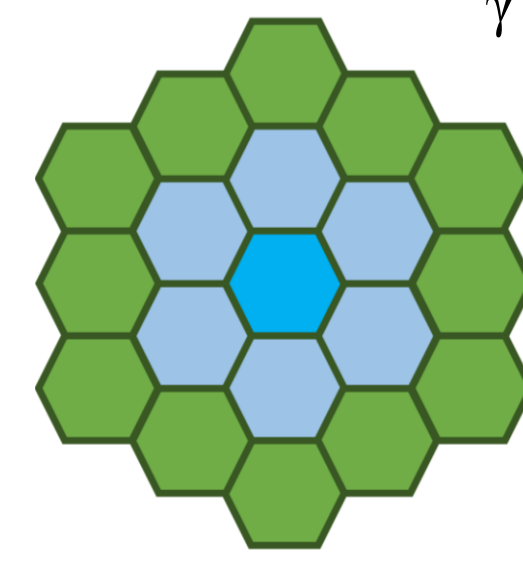
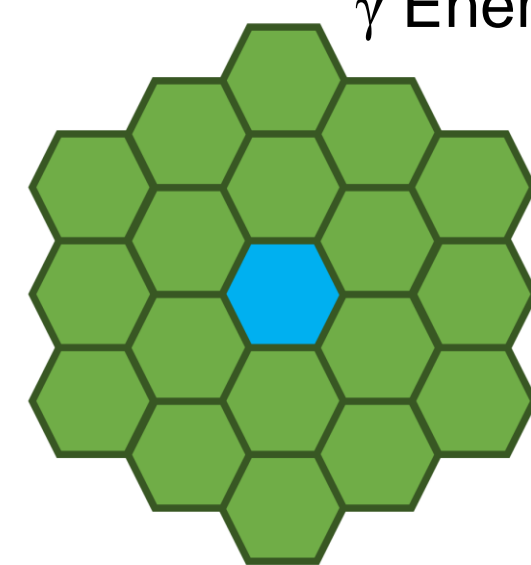
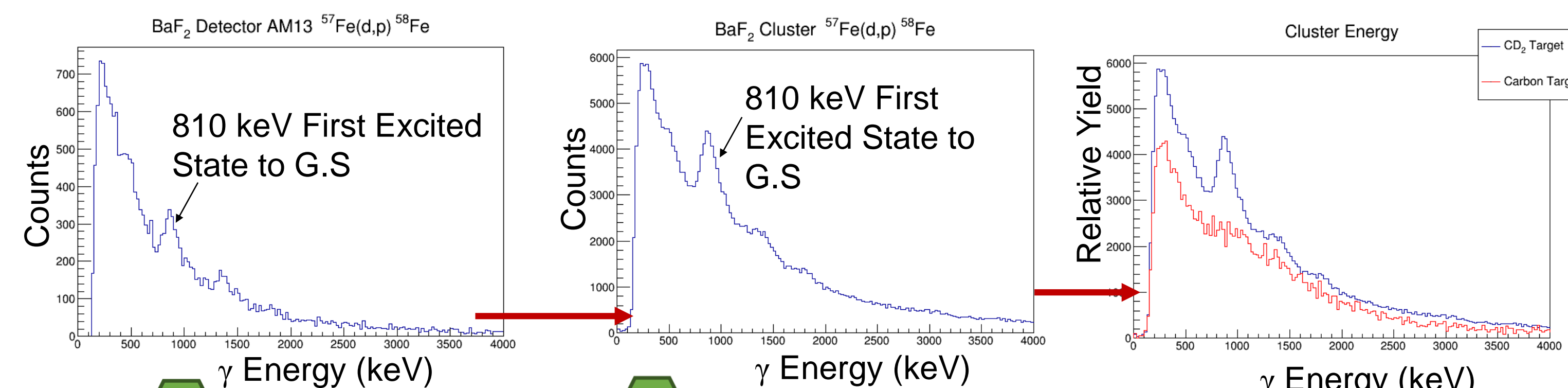
Side View of Single BaF<sub>2</sub> Detector



Silicon Detector (Master Trigger)

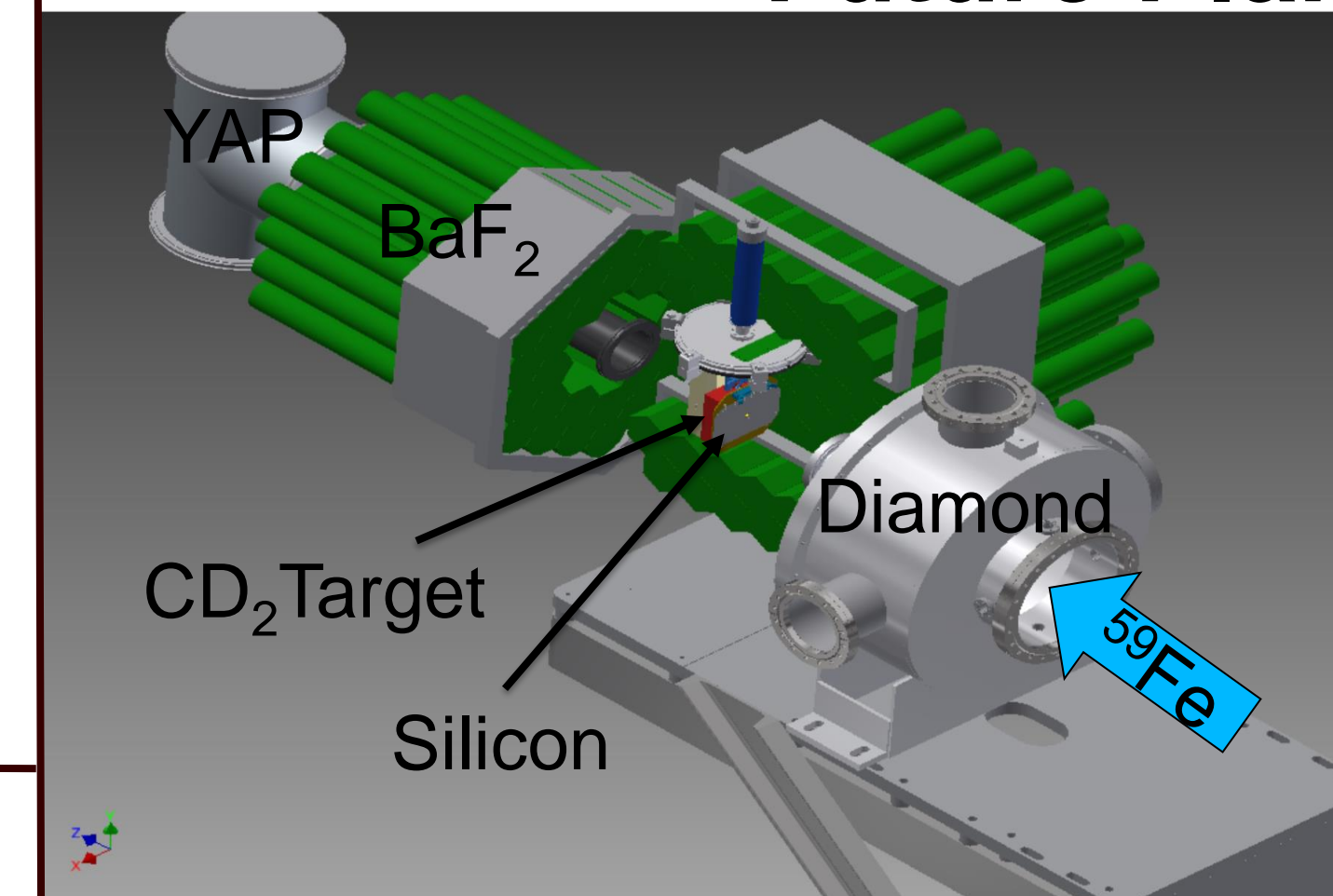
<sup>57</sup>Fe Beam  
7.5 MeV/u

## Experiment Gamma Ray Reconstruction

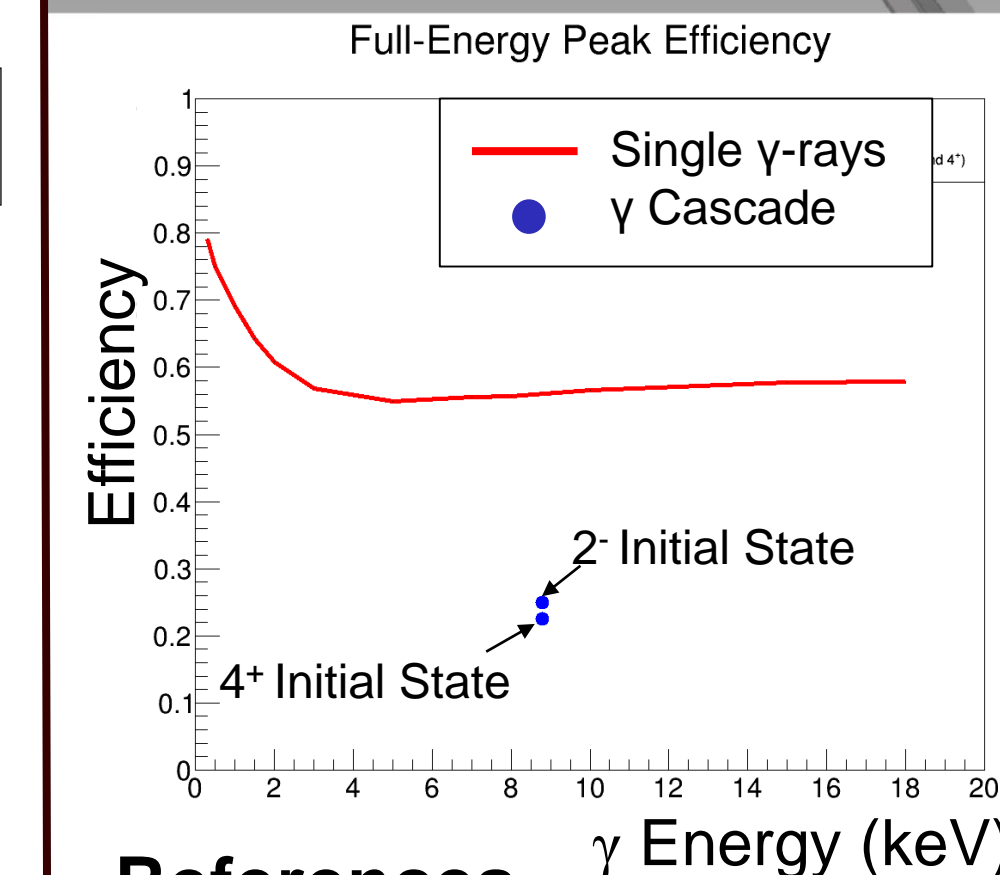


**Top Left Figure:** Gamma rays measured with a single detector (central detector).  
**Top Center Figure:** Gamma rays reconstructed when adding neighboring detectors that fired.  
**Top Right Figure:** Comparison of the gamma spectra obtained with CD<sub>2</sub> target (blue) and the carbon target (red).

## Future Plans



- Add more BaF<sub>2</sub> detectors to increase coverage.
- Implement a diamond beam purity detector and a  $\Theta=0^\circ$  YAP timing detector.



**Top:** CAD drawing of anticipated final experimental setup.  
**Bottom:** GEANT simulation for BaF<sub>2</sub> array efficiency for single photons and gamma cascades.

## References

- [1] R. Diehl, *New Astronomy Reviews* 50 (2006) 534-539
- [2] L. Fimiani, *et al. Phys. Rev. Lett.* 116, 151104 (2016)
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- [4] A. Wallner, *et al. Nature* 532 (2016) 69-72
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- [6] NASA/JPL-Caltech/P.S. Teixeira (Center for Astrophysics). Snowflake Cluster. <https://www.nasa.gov/multimedia/imagegallery/iotd.html> (accessed Feb 20,2020).

## Acknowledgments

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