

Preliminary Analysis towards ^{55}Fe Photon Strength Function using $^{54}\text{Fe}(d, p)^{55}\text{Fe}$ reactions with DAPPER

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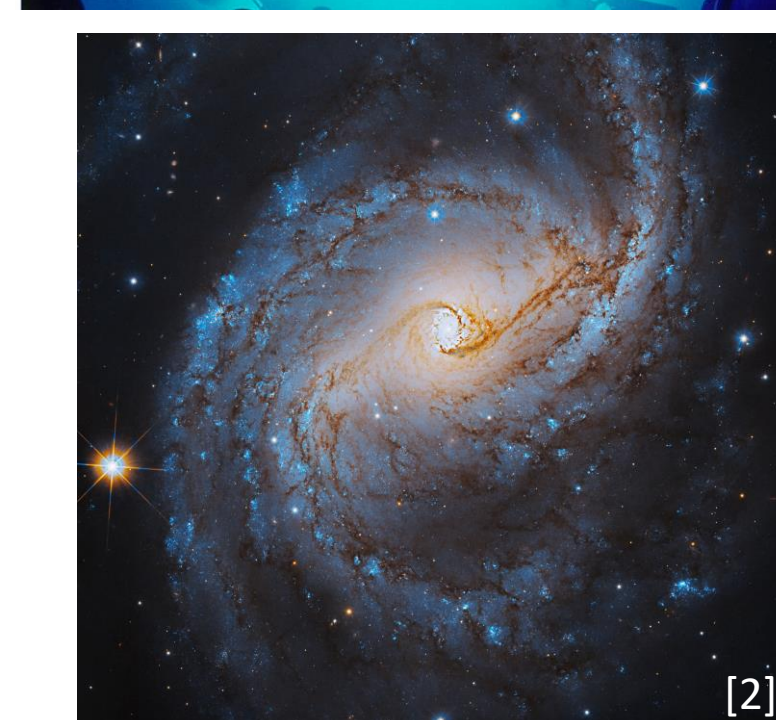
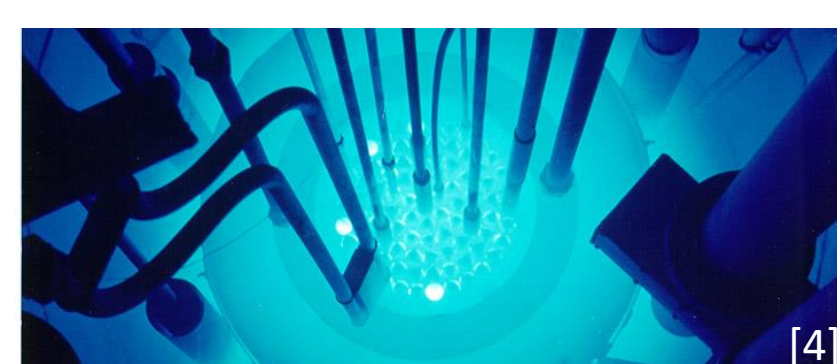
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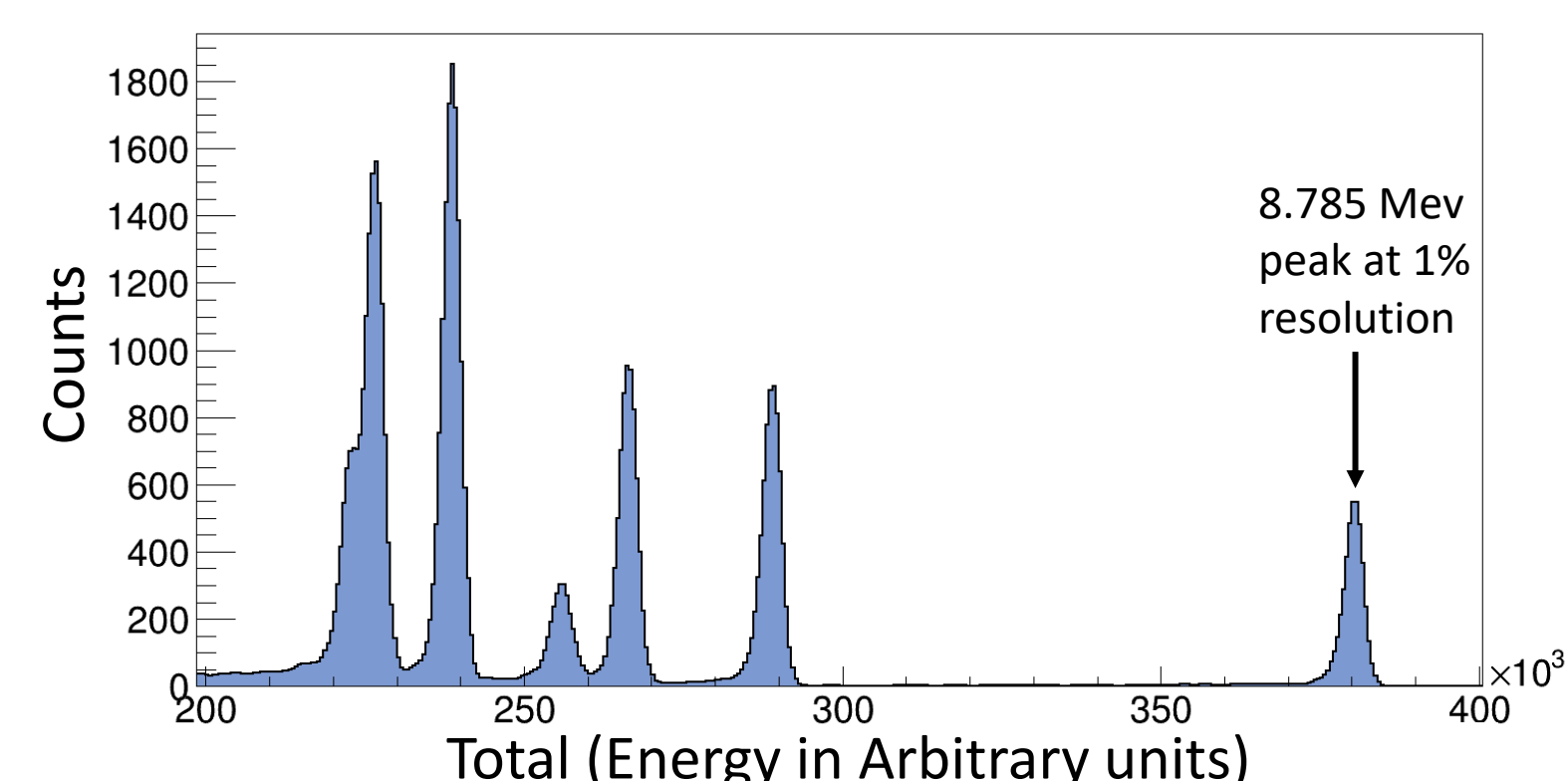
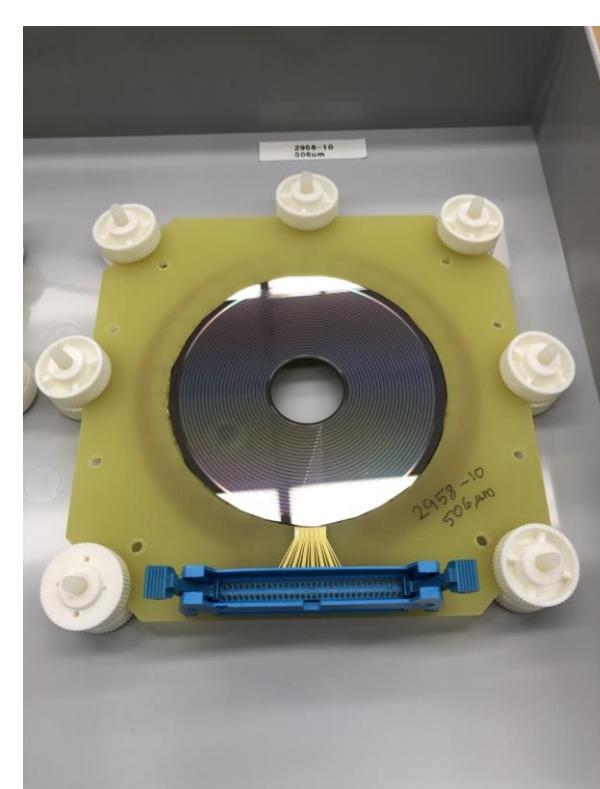


Introduction

- Photon Strength Function is a key constraint on neutron capture reaction modeling
- Neutron capture reaction modeling develops nuclear science, nucleosynthesis, stockpile science, and reactor design.
- Test run was conducted to characterize the Ionization Chamber from the GODDESS array
- An experimental run on ^{55}Fe PSF was done in December similar to previous DAPPER campaigns.
- Latter part of the experiment was put in radioactive beam mode in preparation for ^{60}Fe

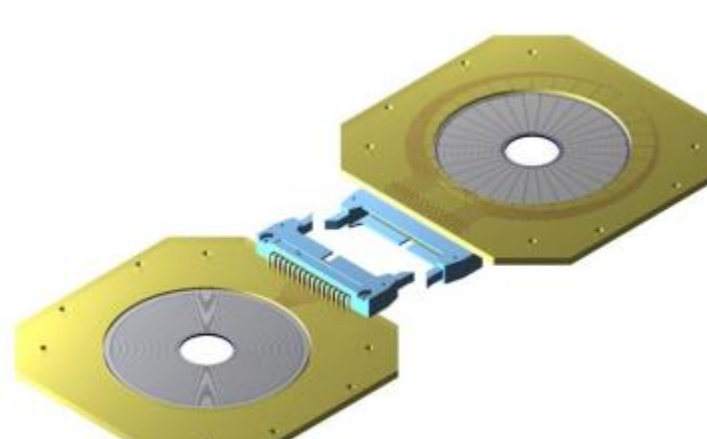


S3 Silicon

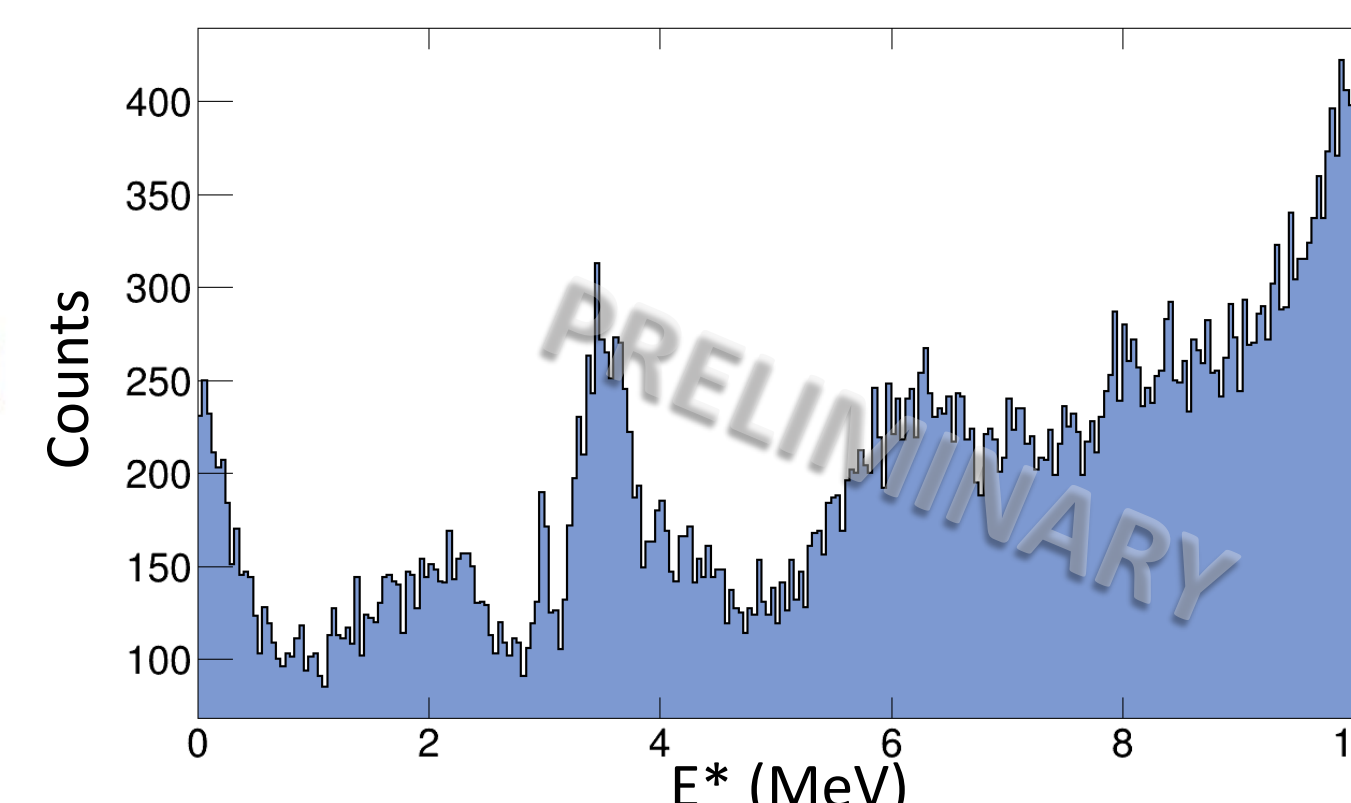


Shows ^{228}Th alpha spectrum measured on silicon detector

Annular design on the silicon detector

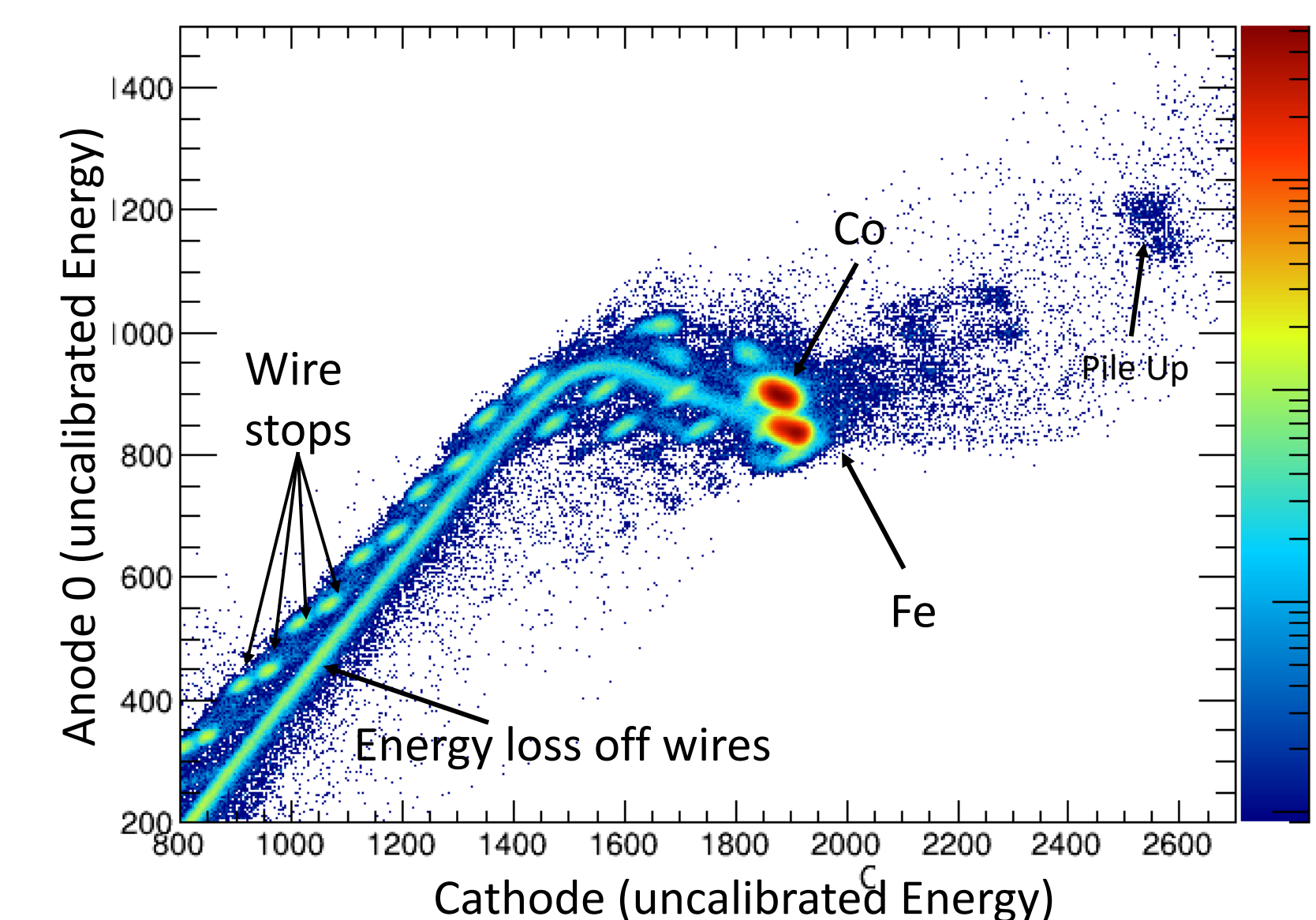


Schematic of both faces of silicon detector [5]

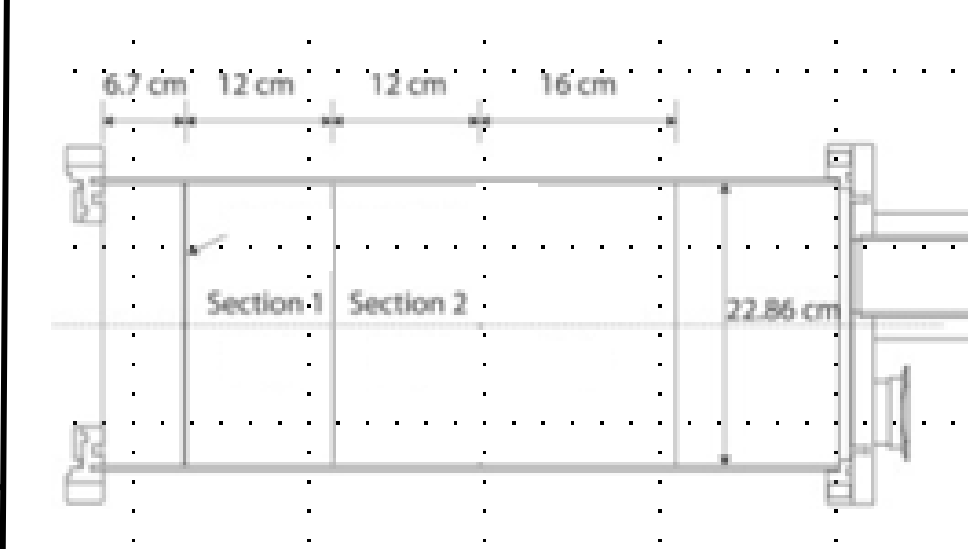


Plot showing Excitation Energy for ^{55}Fe

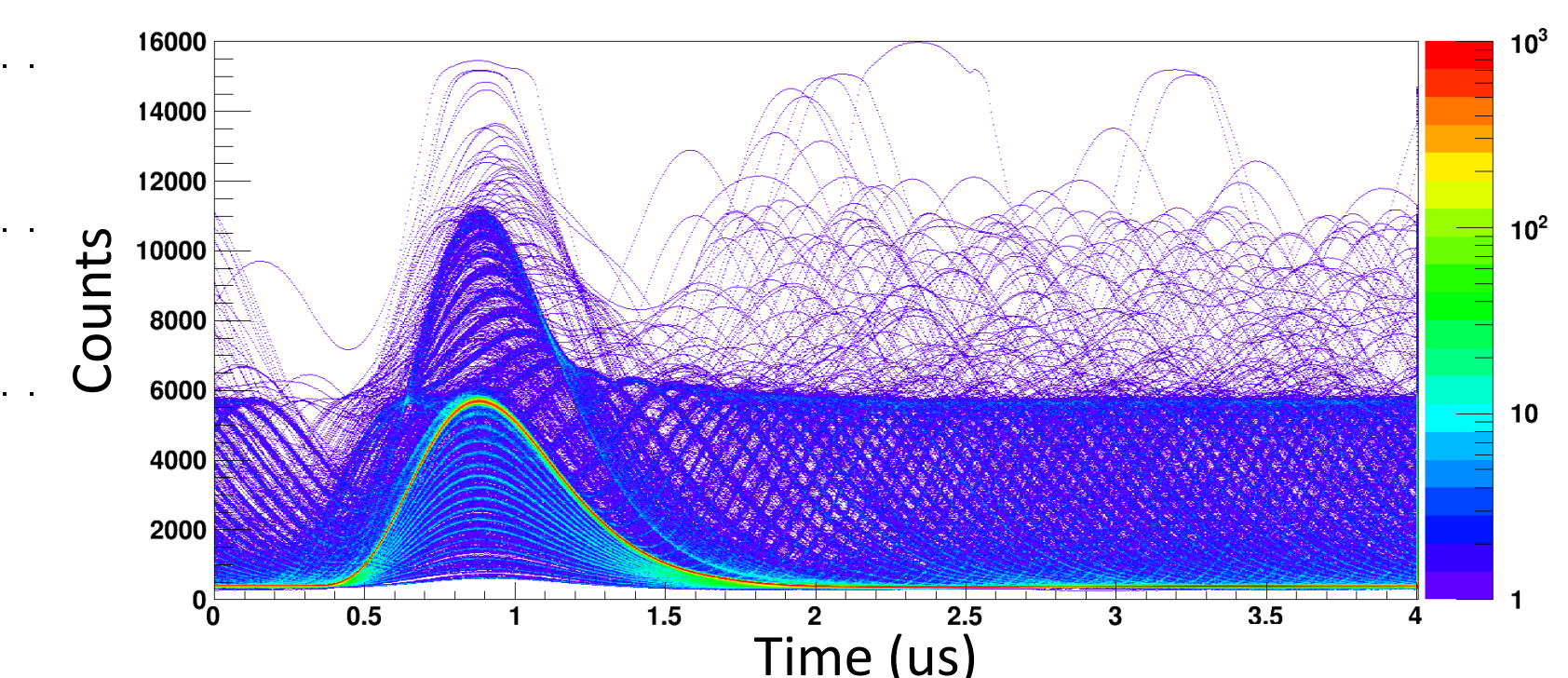
Ionization Chamber



Wire stops, pile up, energy loss by inelastic scattering off of wires of residuals, higher order pile up, separation of residues



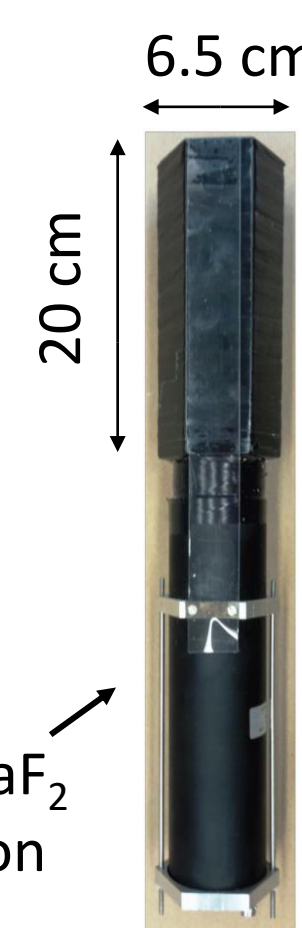
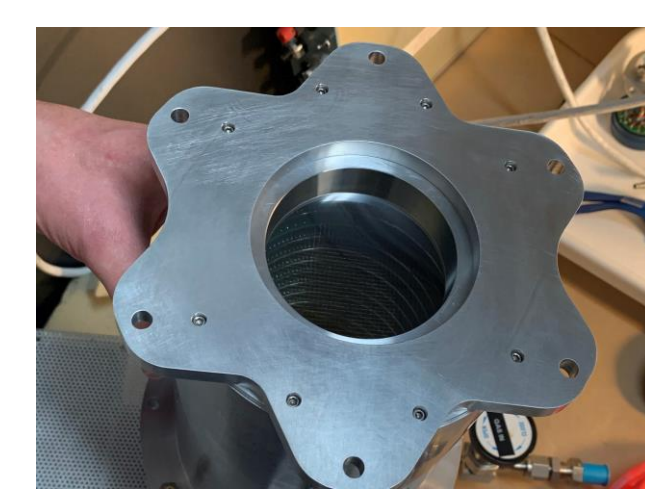
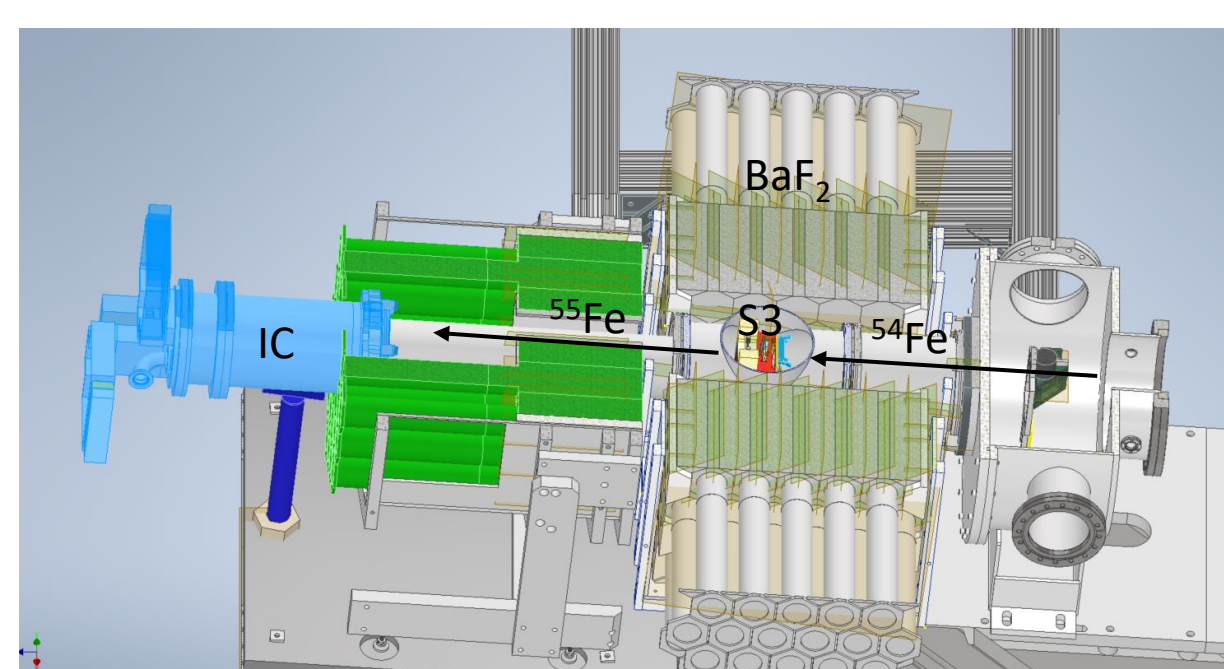
Schematic of the IC from the GODDESS array showing the anode sections [1]



Waveform pulses collected from multisampling ADC showing pile up

DAPPER+IC

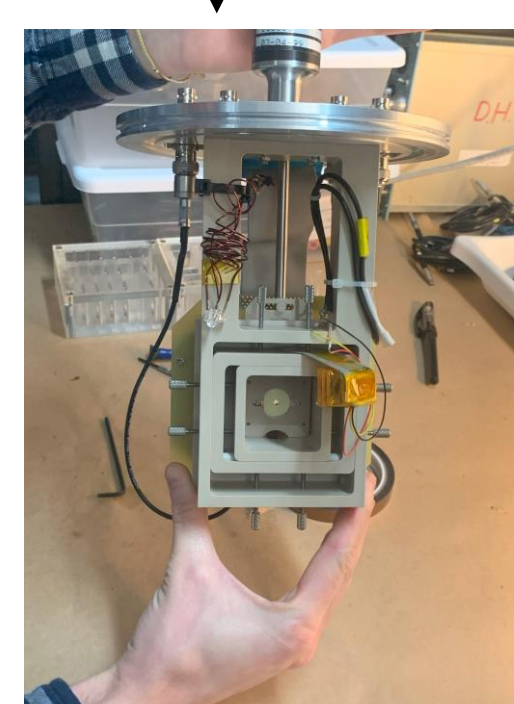
Detector Array for Photons Protons and Exotic Residues



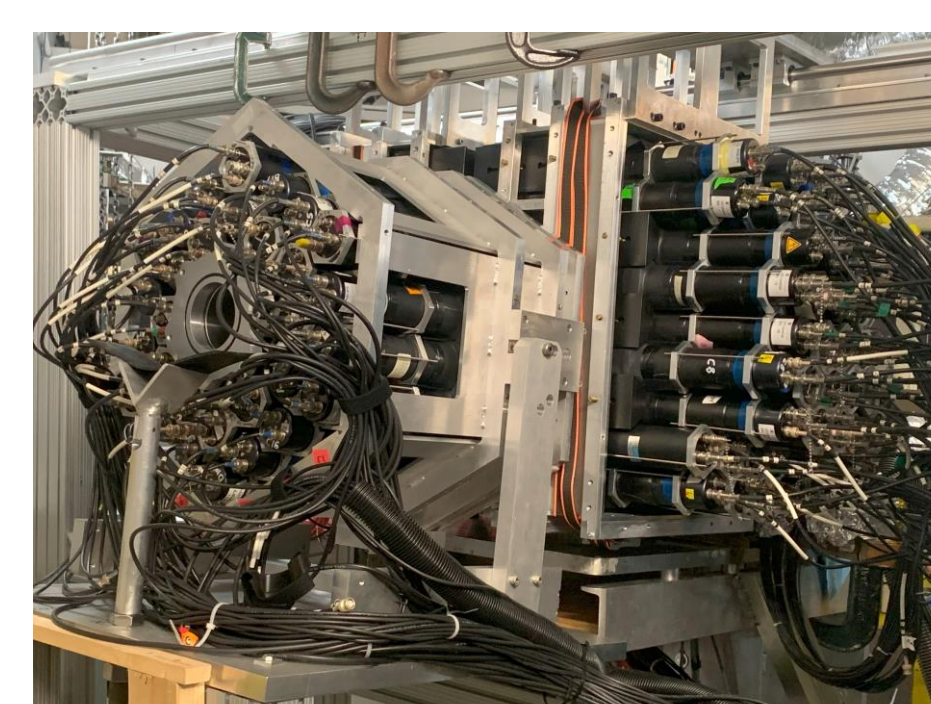
Silicon (S3): Protons are emitted at a backwards angle towards the S3 after (d, p) reaction where the annular and pie faces allow for measurement of proton energy, and angle(θ , ϕ)

BaF₂: All 128 detectors measure gamma ray energy from de-excitation of residue.

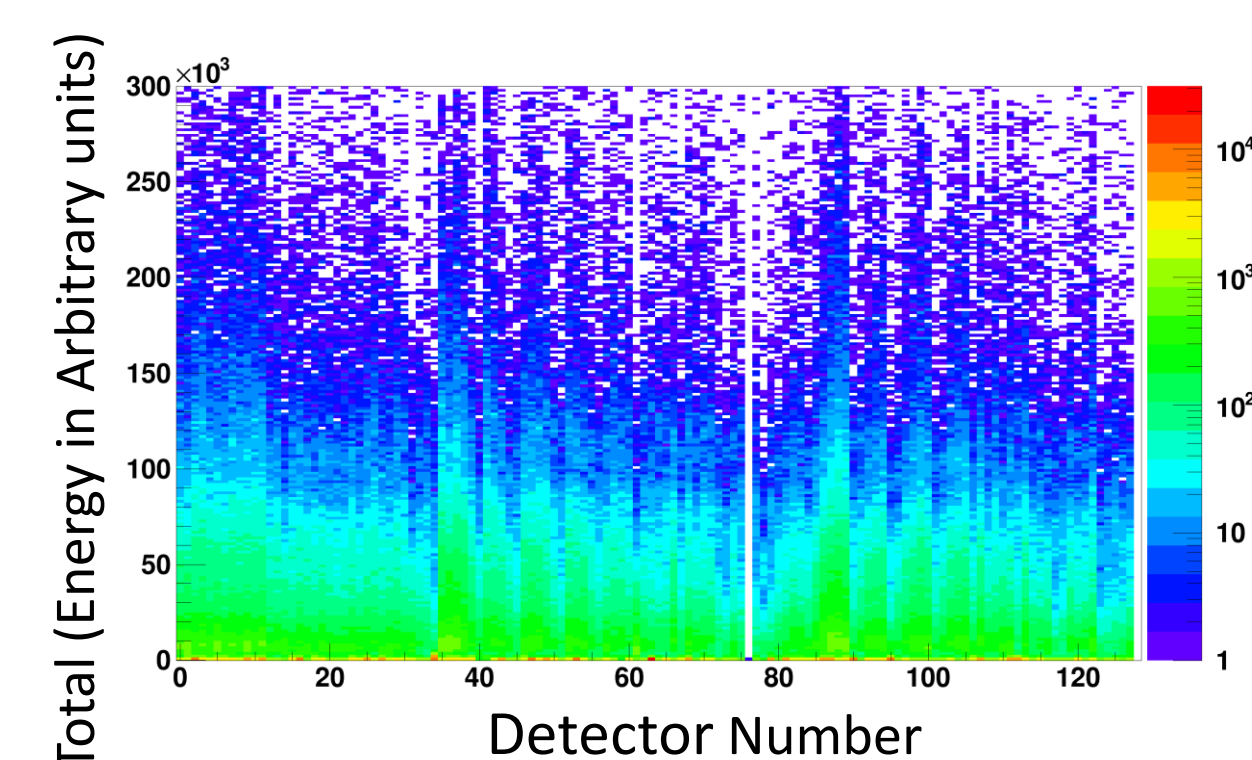
IC: Ionized gas collects on anode and cathode giving measurements for E-Loss and dE of the beam and contaminants .



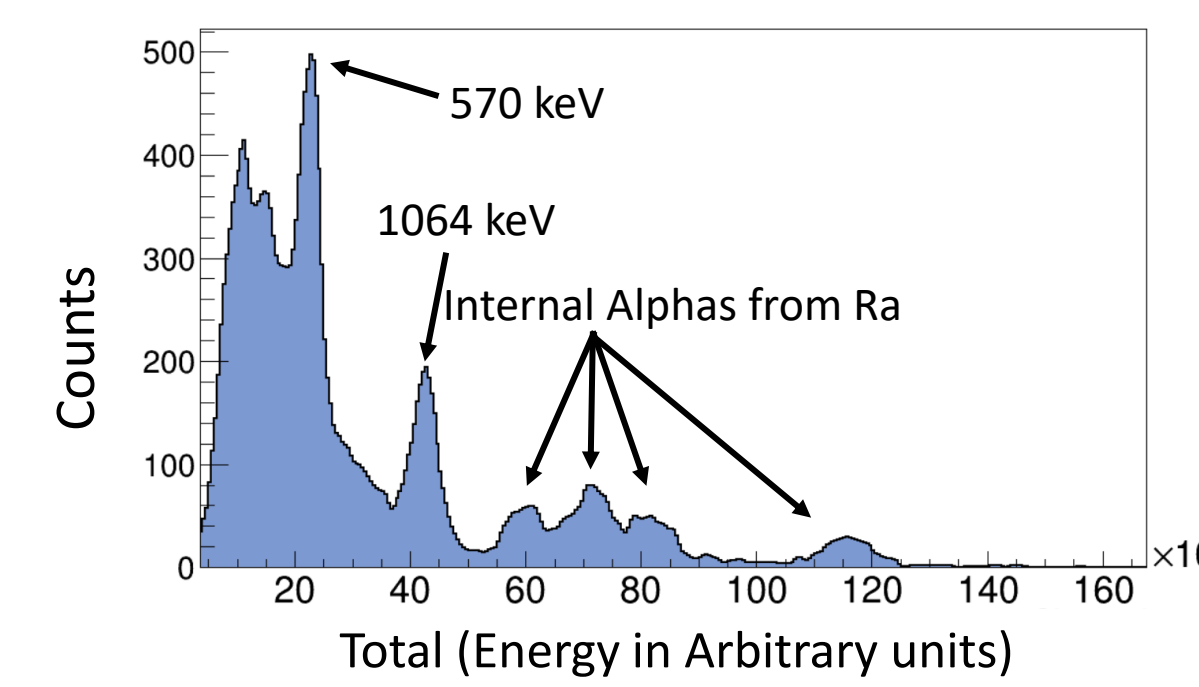
BaF₂ Detectors



All 128 BaF₂ Detectors in full array setup



All 128 BaF₂ working together measuring gammas from ^{55}Fe



^{207}Bi Spectrum taken during experiment

Future Work

- Calculate E* of proton measured in silicon
- Energy calibration of BaF₂
- Identify residues in IC
- Demonstrate suitability of IC and DAPPER with RIBs
- Disentangle pile up
- Verify detector response function
- Extract PSF for ^{55}Fe



References

- [1]. Lai et al., *Position-Sensitive, Fast Ionization Chambers*, Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment **890**, 119 (2018).
- [2]. N. H. S. Telescope, *Spiral Galaxy NGC 6951*, <https://www.flickr.com/photos/nasahubble/5323368647/in/album-72157695205167691/>.
- [3]. says, *Nuclear Forensics: Reading Nuclear Fingerprints*, <https://geoscienceforthefuture.com/nuclear-forensics/>.
- [4] TRIGA Nuclear Reactors, <https://www.ga.com/triga/>.
- [5] S3, <https://www.micronsemiconductor.co.uk/product/s3/>.

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