The LBNL/UC-Berkeley Nuclear Data Program Experimental Activities

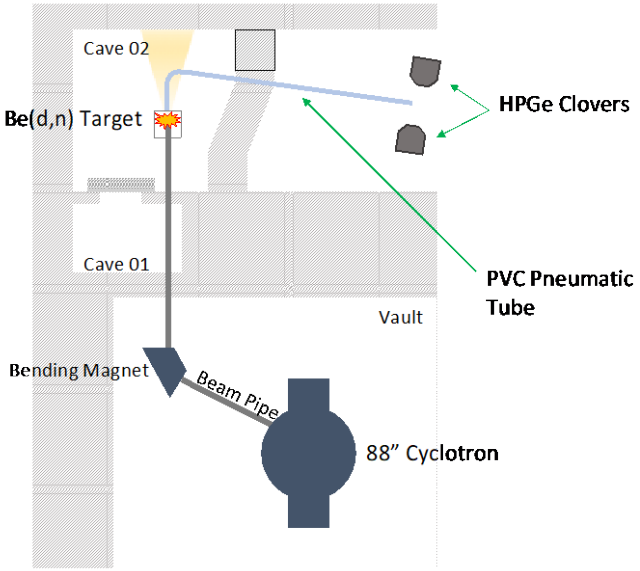
Josh A. Brown

Department of Nuclear Engineering
University of California – Berkeley

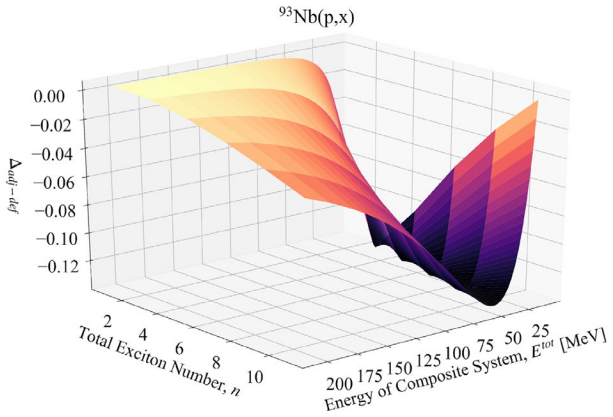
http://nucleardata.berkeley.edu

Experimental Activities

Fission Yields with FLUFFY

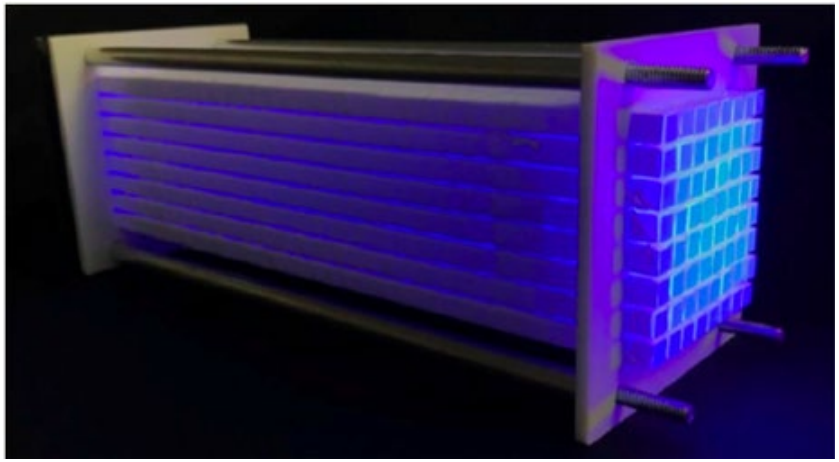


TREND'ing Isotopes



(n,n'γ) with GENESIS

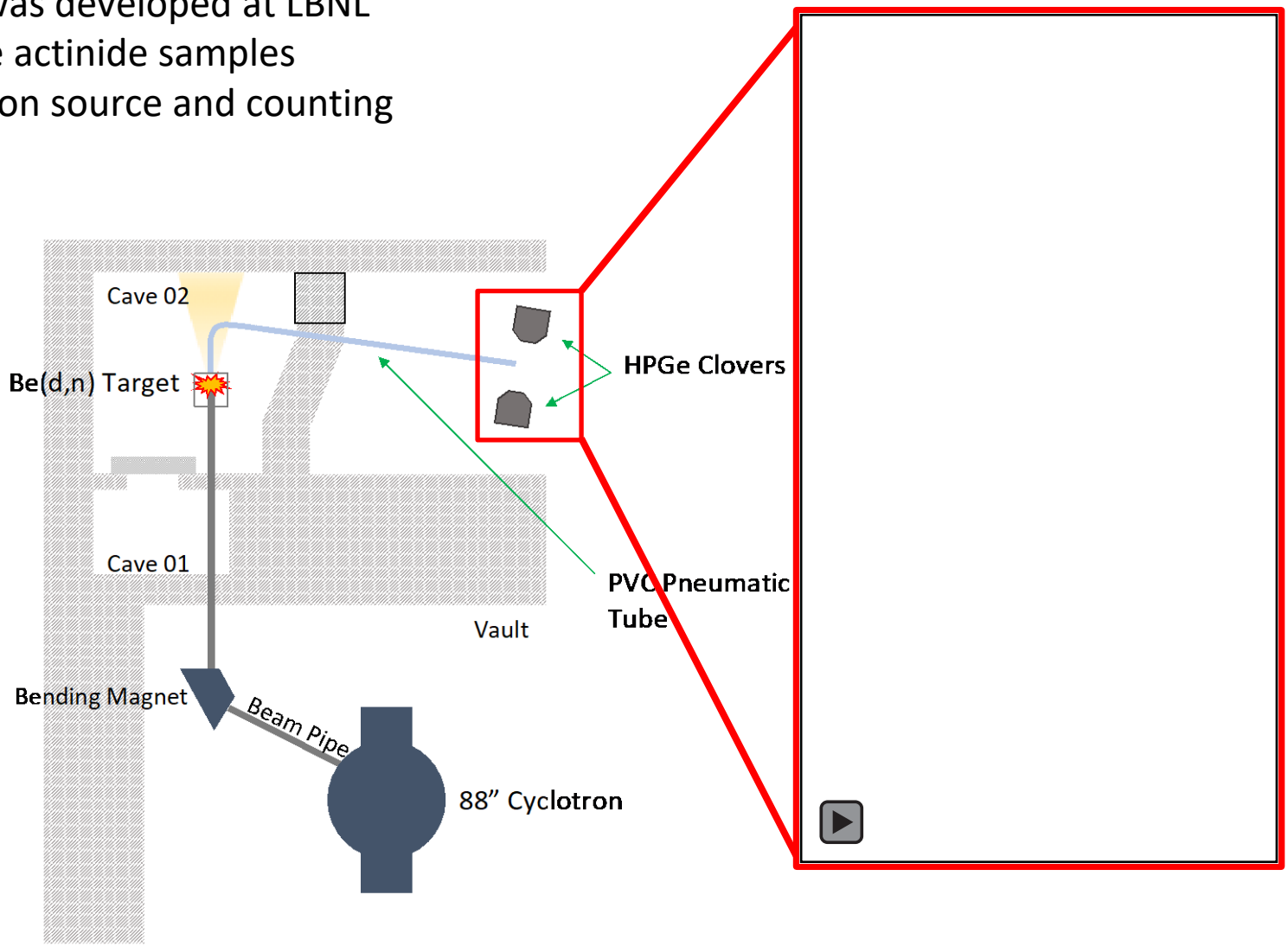
Scintillator Quenching



Fission Yields with FLUFFY

- The Fast Loading User Facility for Fission Yields (FLUFFY) was developed at LBNL to rapidly shuttle actinide samples between a neutron source and counting array.

- Transport times: **<1 s**
- Flux: **8.3 x 10^8 n/cm^2/s**
- This high flux along with the rapid transport time allows for the observation of 80+% of the yield in peak mass chains.

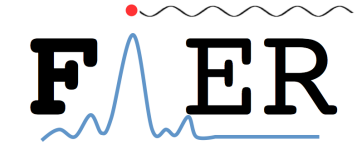


FIER Based Analysis

The Fission Induced Electromagnetic Response (FIER) code offers a model that produces analogous FPY γ emission data.

Fission Yields

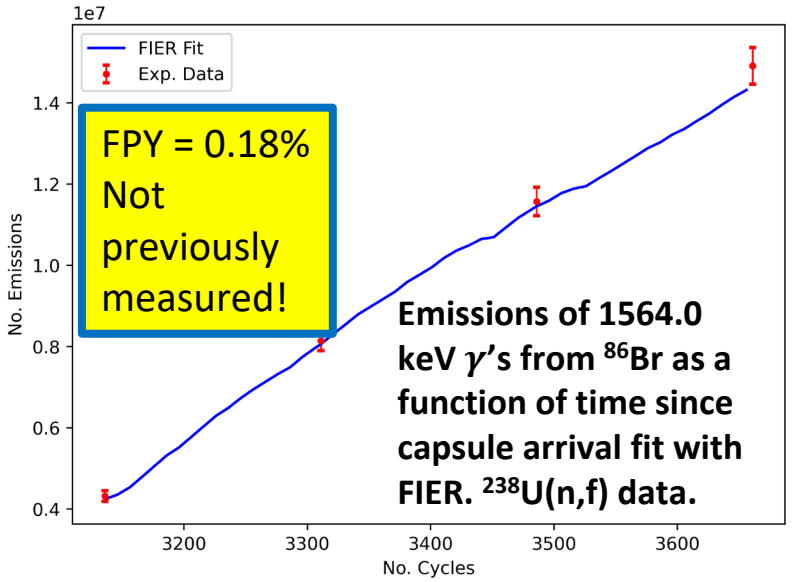
Pulsing Scheme



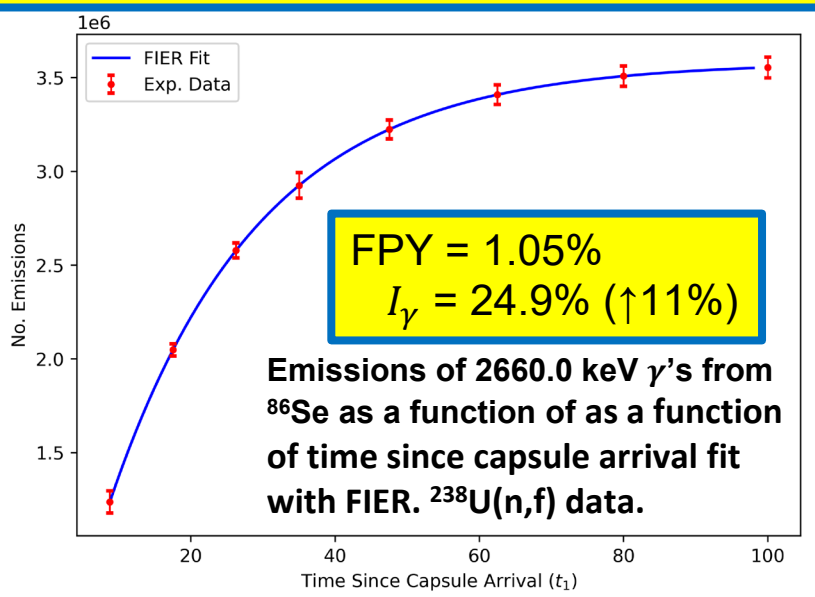
$$N_\gamma(Z, A, I, t_0, t_1, n_{cycles})$$

Chi-squared minimization between FIER and experimental data is used to determine fission yields and correct decay data

γ emission rates from the daughter FP simultaneously constrain the FPY and I_γ of the parent.

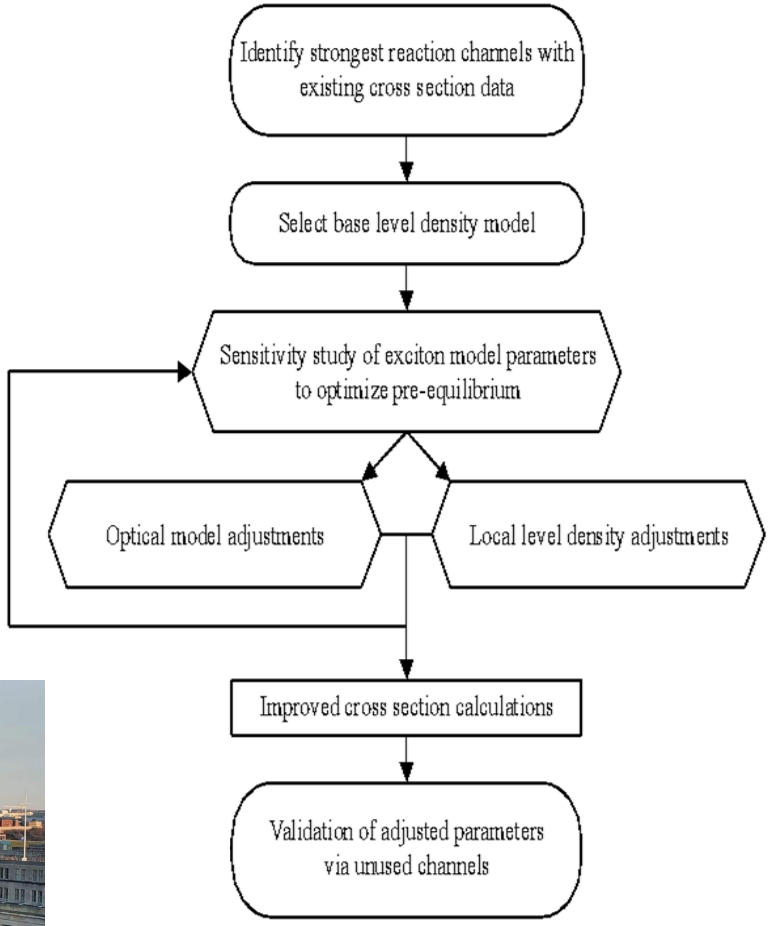


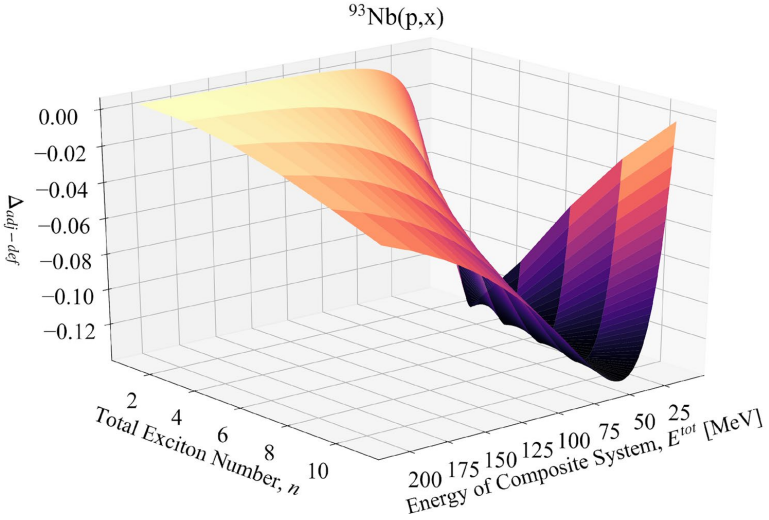
An example of results from the A = 86 mass chain



TREND (TRi-lab Effort in Nuclear Data)

- Targeted (p,x) stacked foil measurements for a variety of applications
- Development of a new analysis methodology for tuning model parameters in reaction codes
- Prompt-γ data collection being added to upcoming experiments



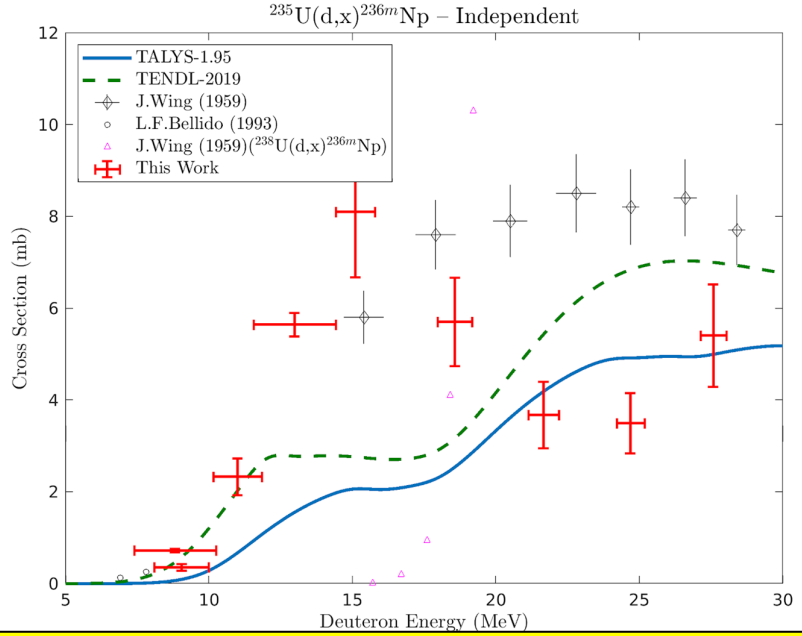


How do we improve modeling for high-energy proton-induced reactions?

R&D Supporting DoE Isotope Production

^{236}Np Production R&D

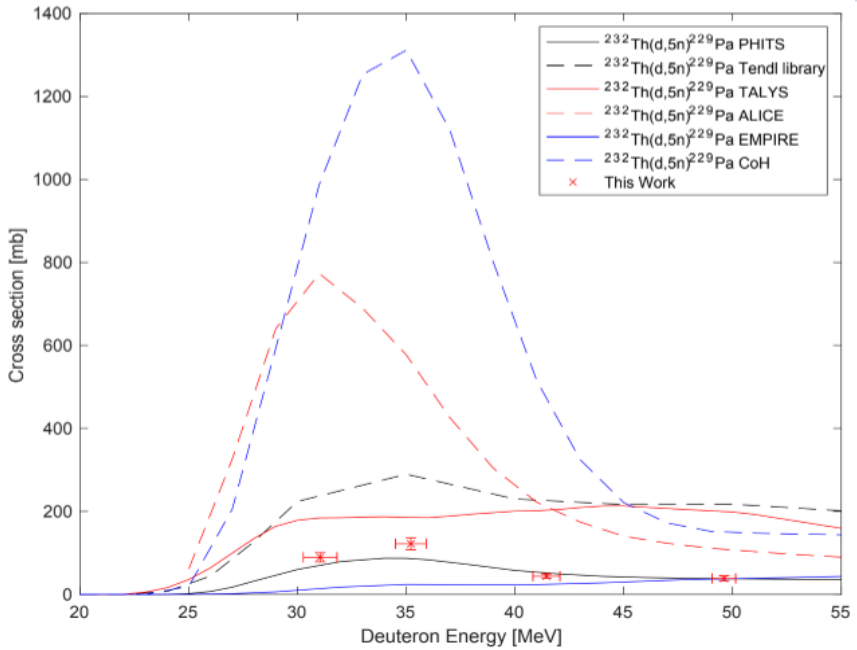
- Performed 3 target stack irradiations and γ-spec at LBNL
- ICP-MS & α-spec at LANL
- 16 MeV: 56.8(9) ng/mA•hr, 28 MeV: ≈200 ng/mA•hr
- ***12 targets (99.94% ^{235}U) made by LLNL with ρR_{areal} from 80-160 µg/cm^2***



We could meet the demand of 10-20 µg/yr ^{236}Np in a short time at I_d >100 µA.

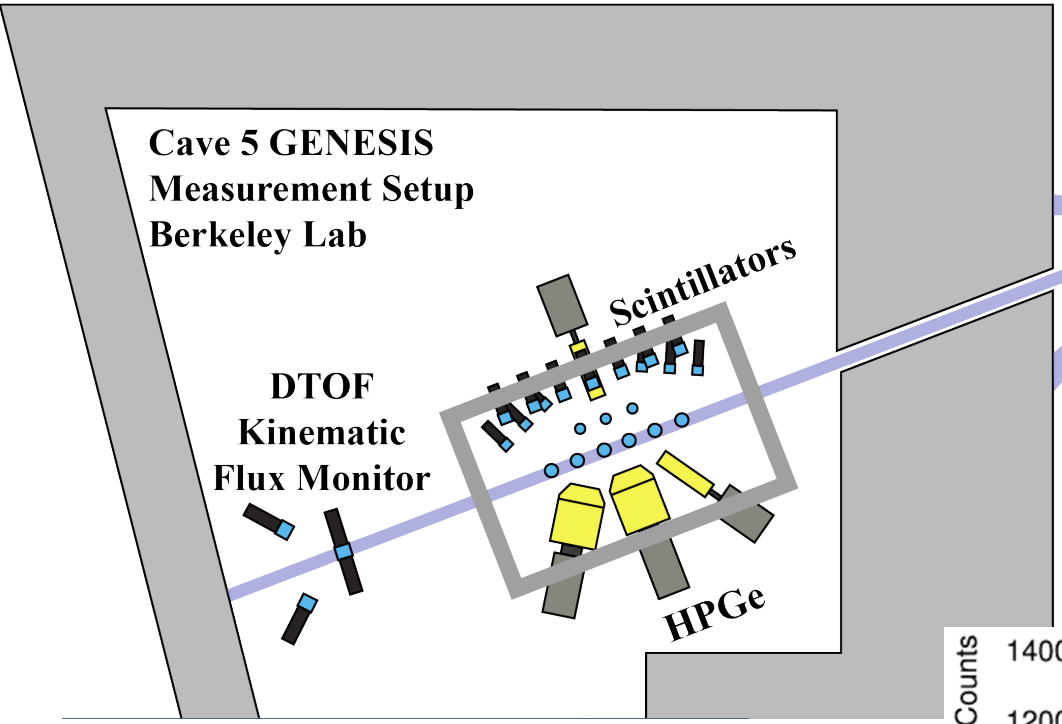
Novel Methods for Producing ^{229}Th

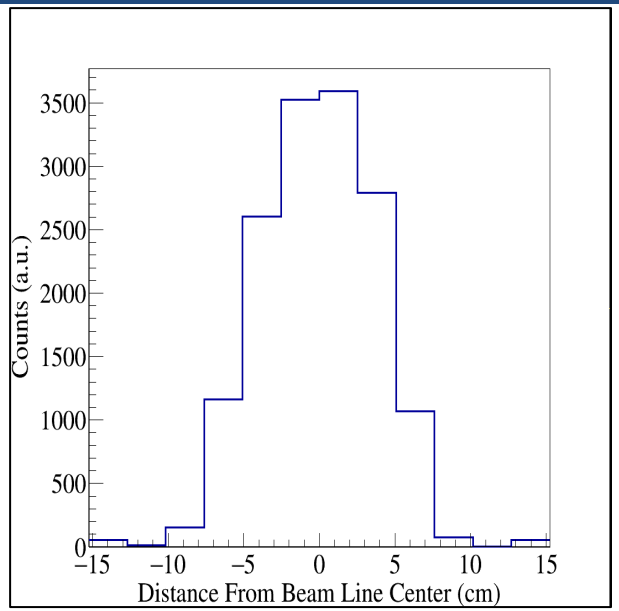
^{230}Th(n,2n)	^{232}Th(p,4n) ^{229}Pa	^{232}Th(d,5n)	^{230}Th(p,2n) ^{229}Pa
11/2019	07/2020	05/2021	Spring 2022

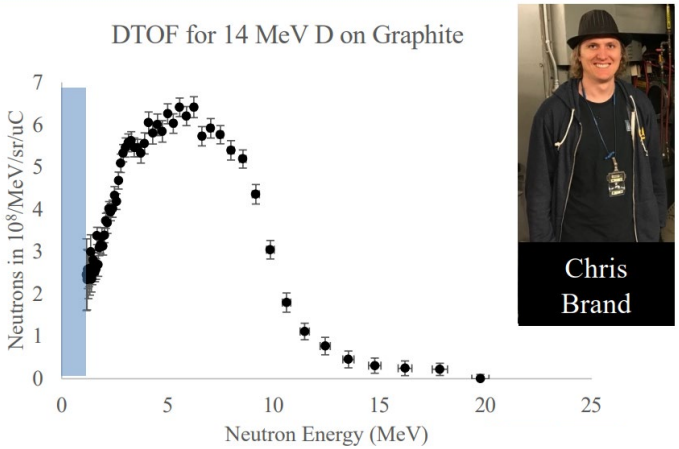


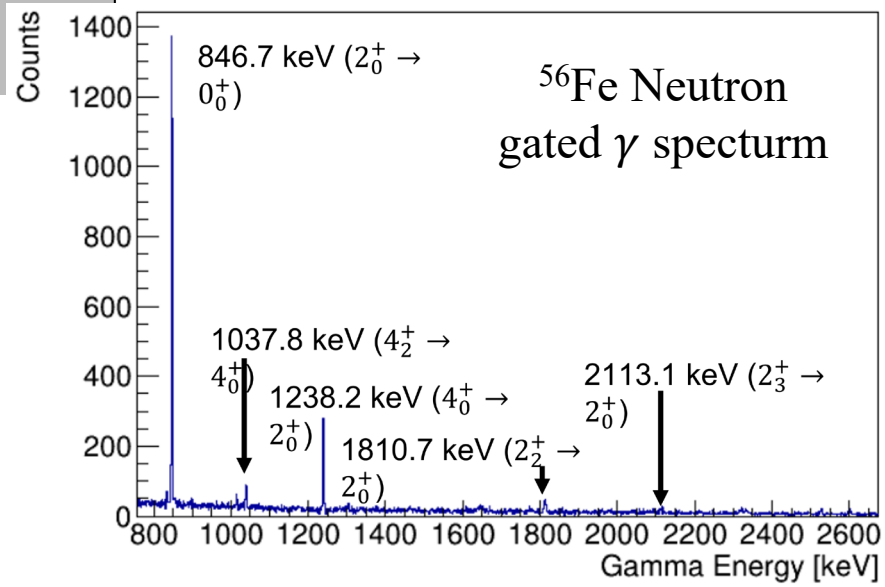
New methods for production of ^{225}Ac have been identified

(n,n'γ) with GENESIS

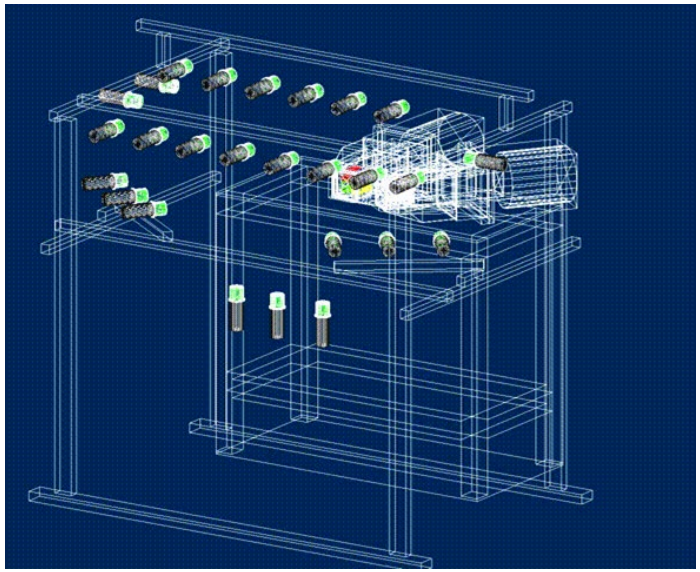


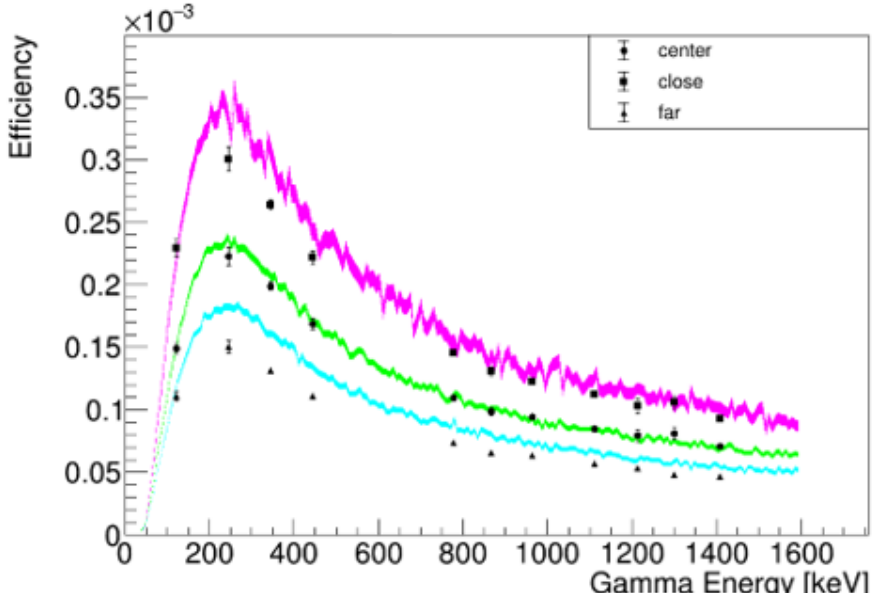




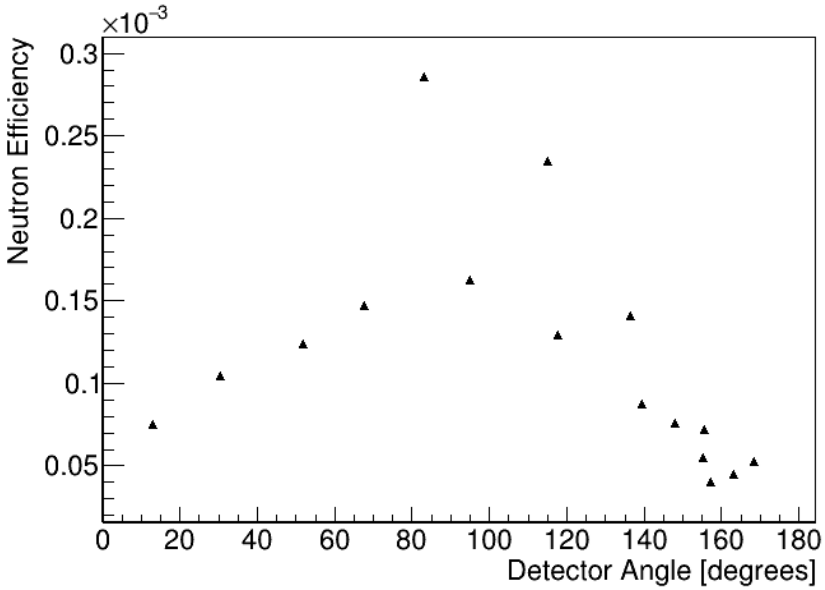


GENESIS Array Characterization

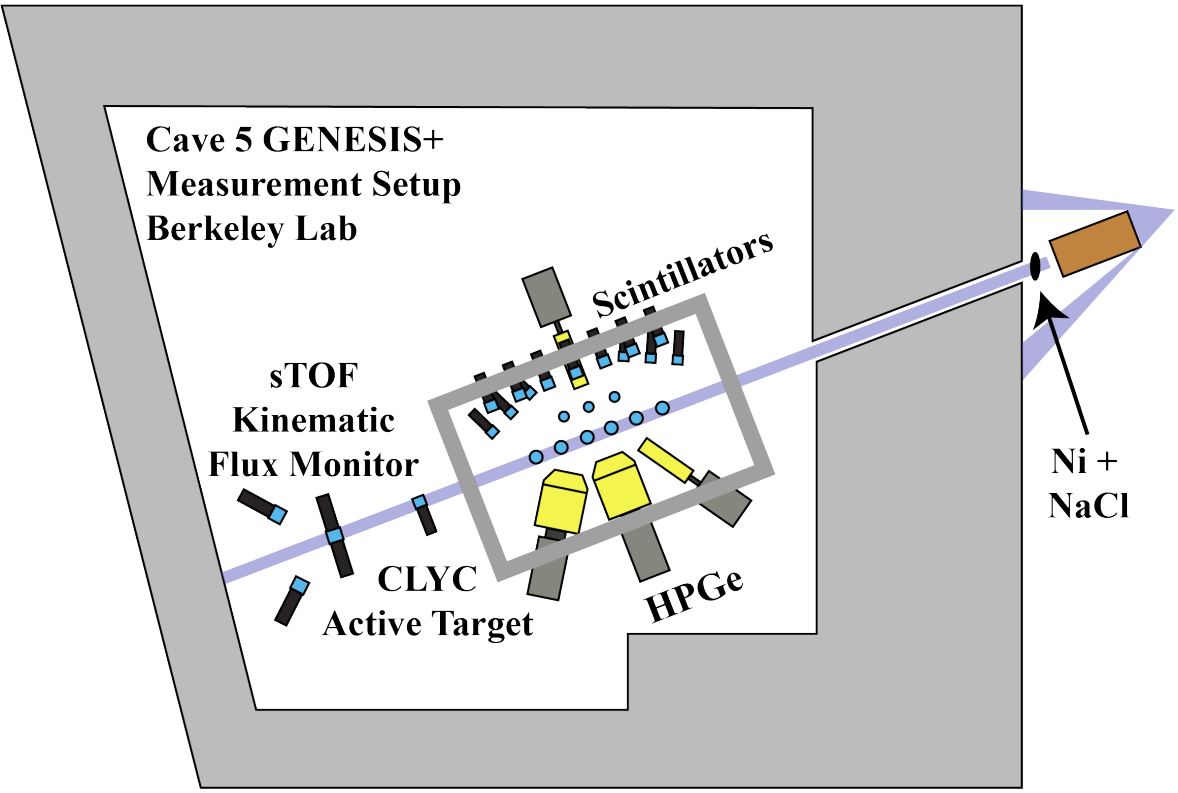


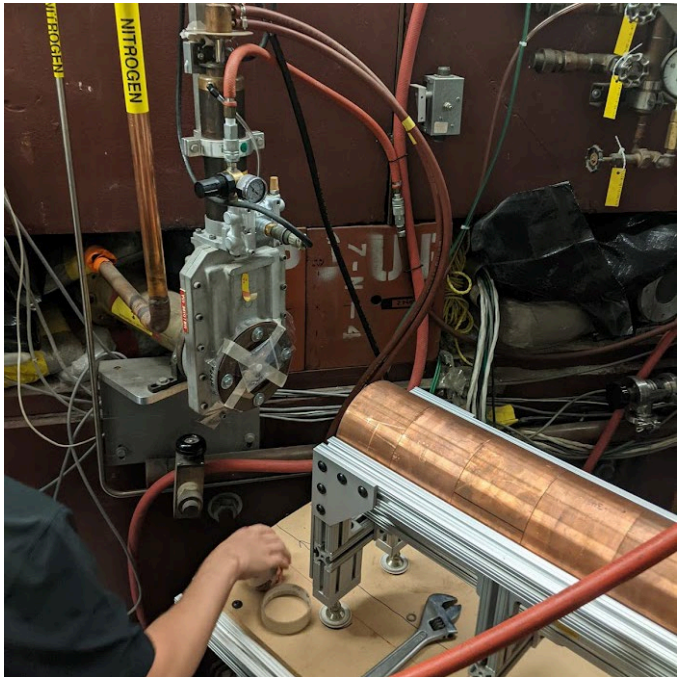


- Absolute efficiencies established using a combination of gamma ray and neutron sources
- Long dwell time ^{252}Cf measurements enabling model tuning, detection efficiency calculations, and time calibrations
- Three experiments conducted in 2021:
  - ^{238}U March
  - ^{56}Fe July
  - ^{35}Cl Aug



GENESIS+ for Cl Measurements



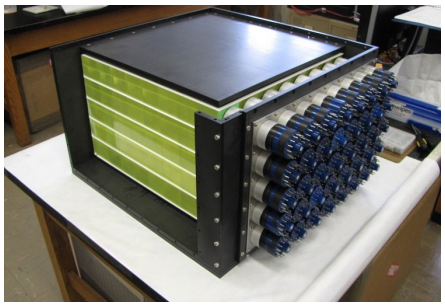


- Additionally targeting (n,p) and (n,α) during Cl measurement
- Inclusion of an active target CLYC for $\sigma(E_n)$
- NaCl salt co-located with Ni foil to provide integral σ for the experiment

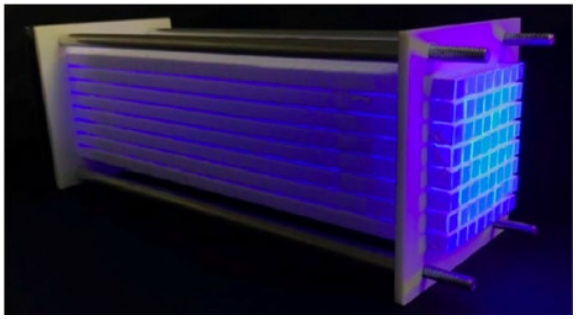
Neutron response of organic scintillators

- Scattering experiment using active “target” scintillator
- Map light vs nuclear recoil energy (highly non-linear)
- Kinematically over-constrained system allowing rejection of multiple scatters
- Continuous measurement using broad energy neutron source

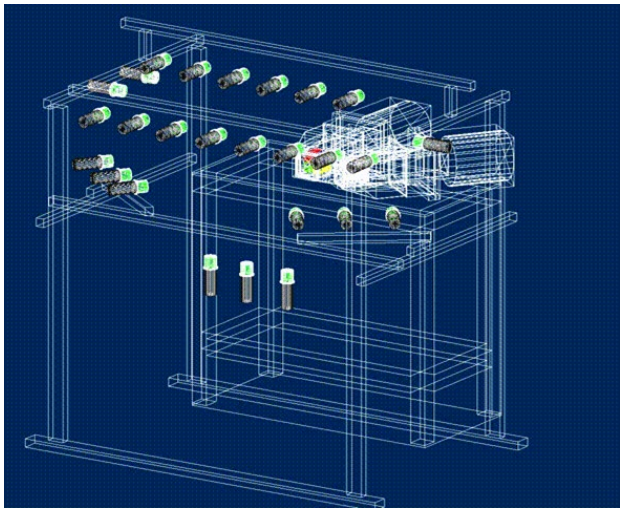
Neutron response of organic scintillators



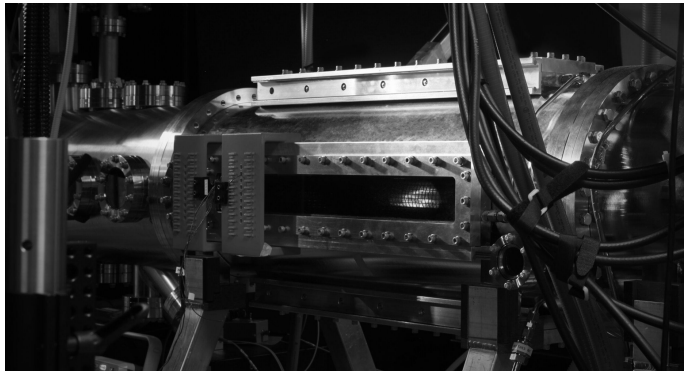
Neutrino detection (background identification in IBD detectors see WoNDRAM report)
WbLS, Gd doped WbLS, Li-loaded plastics



Nuclear security & non-proliferation (kinematic reconstruction for imaging)
Commercial fast plastic scintillators (EJ-20X, EJ-23X) and custom organic glass



Nuclear physics experiments(threshold estimation and forward modeling approach)
Commercial PSD liquids (EJ-301, EJ-309)



Nuclear fusion (diagnostics of plasma instabilities for Z-Pinch device)
Commercial fast plastics(EJ-204)

Thanks For Your Time!