LA-UR-21-31468

Los Alamos NATIONAL LABORATORY

LANL experimental updates on LENZ, SPIDER and SREFT in FY21

Hye Young Lee for LENZ

Jack Winkelbauer for SPIDER

Christopher Prokop for SREFT

Los Alamos National Laboratory

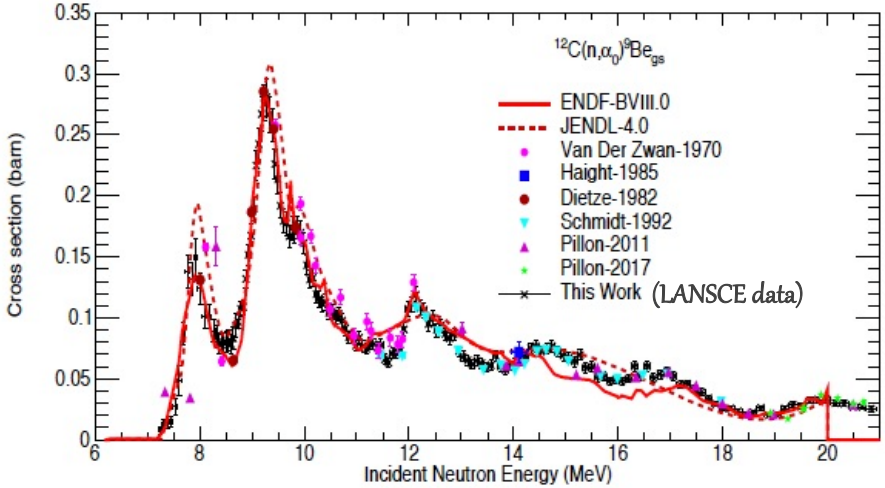
Nuclear Data Week 2021

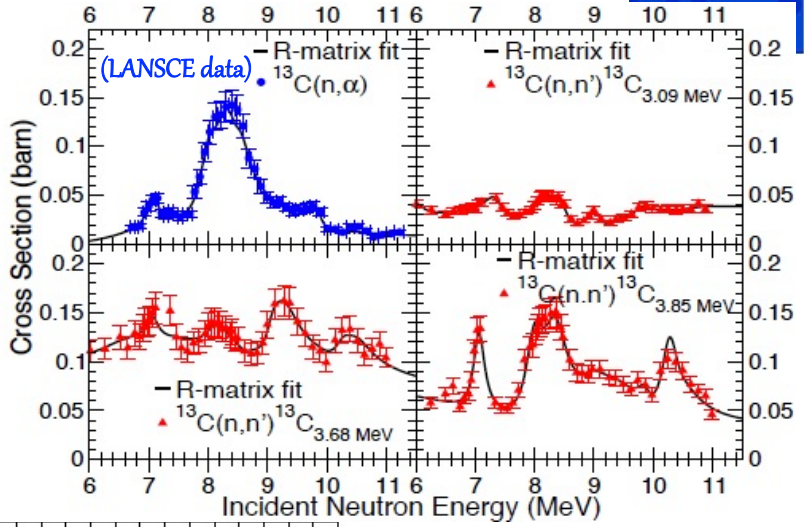
Cross Section Evaluation Working Group session

Nov. 8-19, 2021

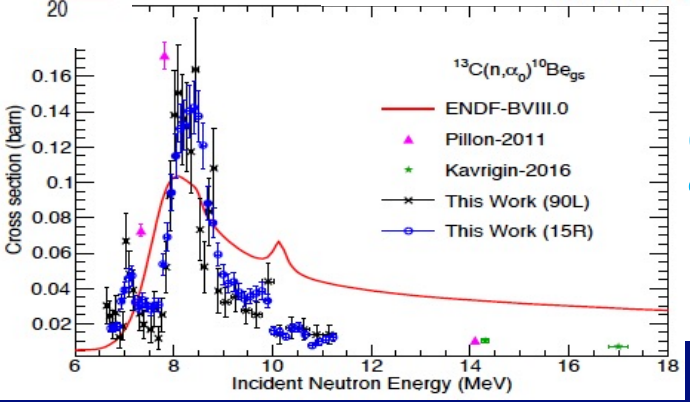
Neutron-induced reactions on natural carbon at LANSCE

One systematic measurement from threshold to 20 MeV





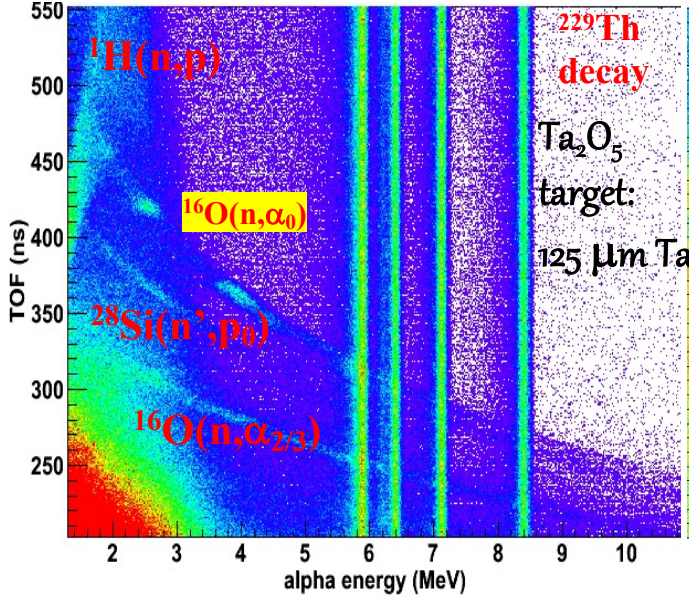
Directly measuring a diamond detector with the white source neutrons at LANSCE, carbon acted as an active target, enabling to measure (n,p), (n,d), (n,α) reactions along with the observed yields to infer neutron elastic scattering reaction. *Kuvin, Lee, et al. PRC 104, 014603 (2021)*



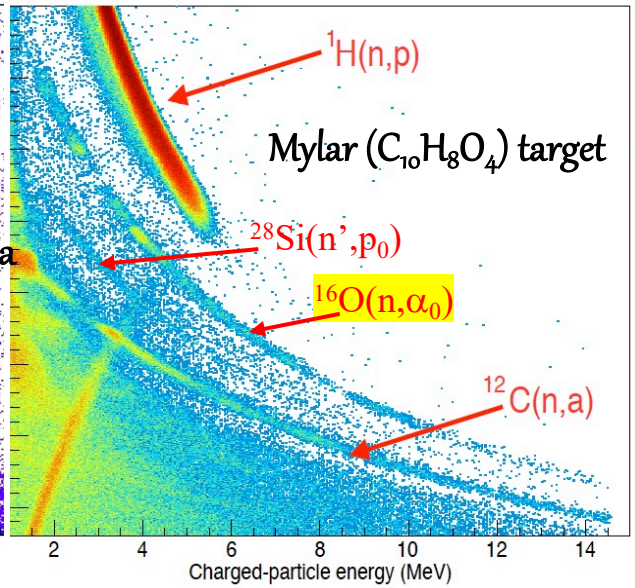
(n,α) channel was fitted with (n,n') data performed at Ohio U.

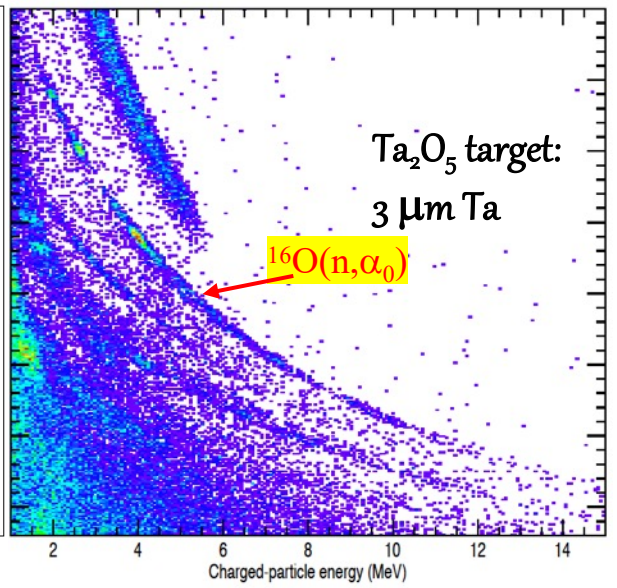
$^{16}O(n,\alpha)$: differential cross sections performed at LANSCE

LENZ 2016 data



LENZ 2021 data



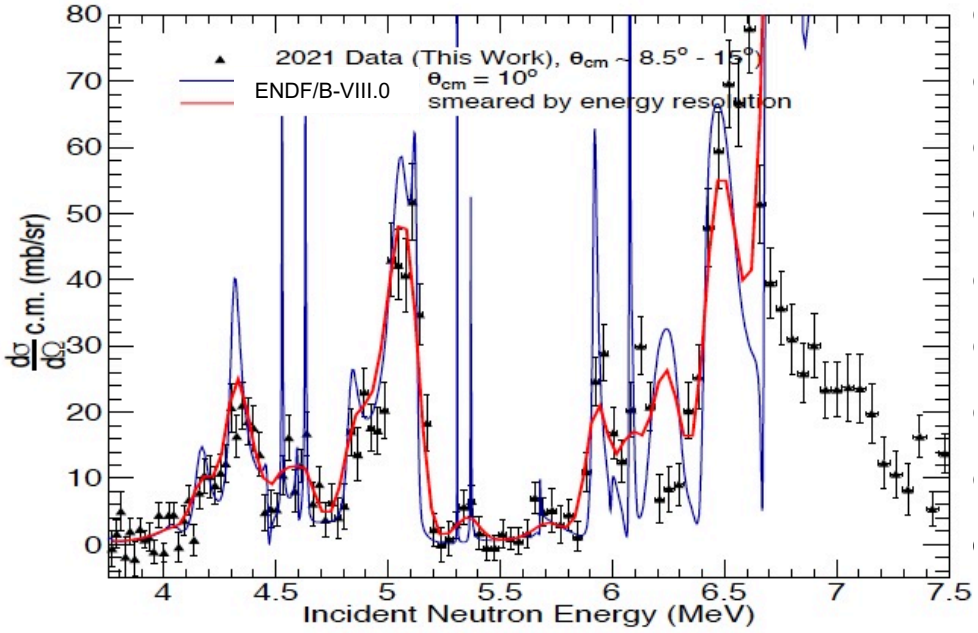


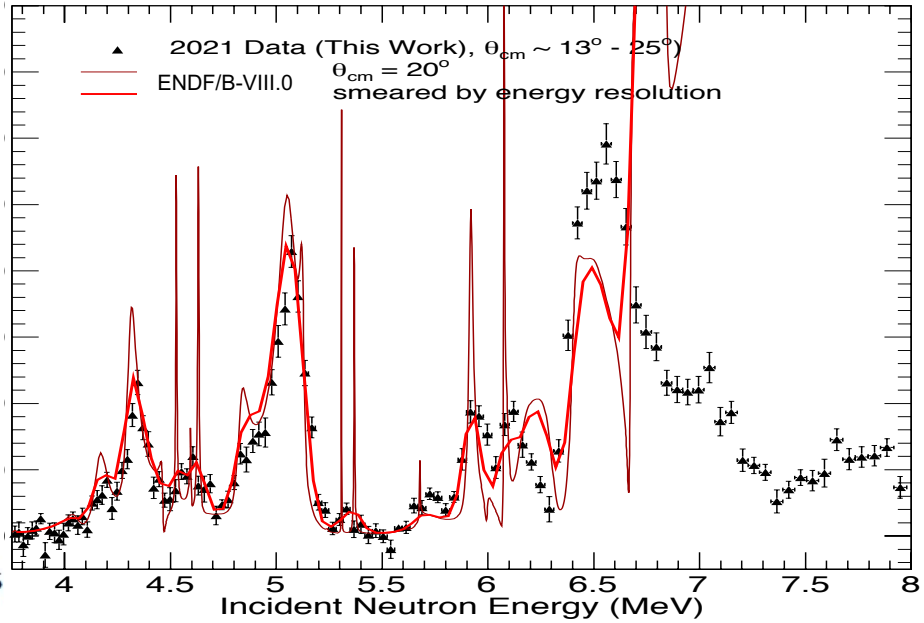
- LENZ 2016 data was taken using a 65 micron thick silicon strip detector in 2016
- LENZ 2021 data was taken using optimized experimental configurations and thinner Ta backing in 2021
- Ta_2O_5 targets with different thicknesses & Mylar ($C_{10}H_8O_4$) target for ratio method

2021 LENZ $^{16}O(n,\alpha_0)$ differential cross sections

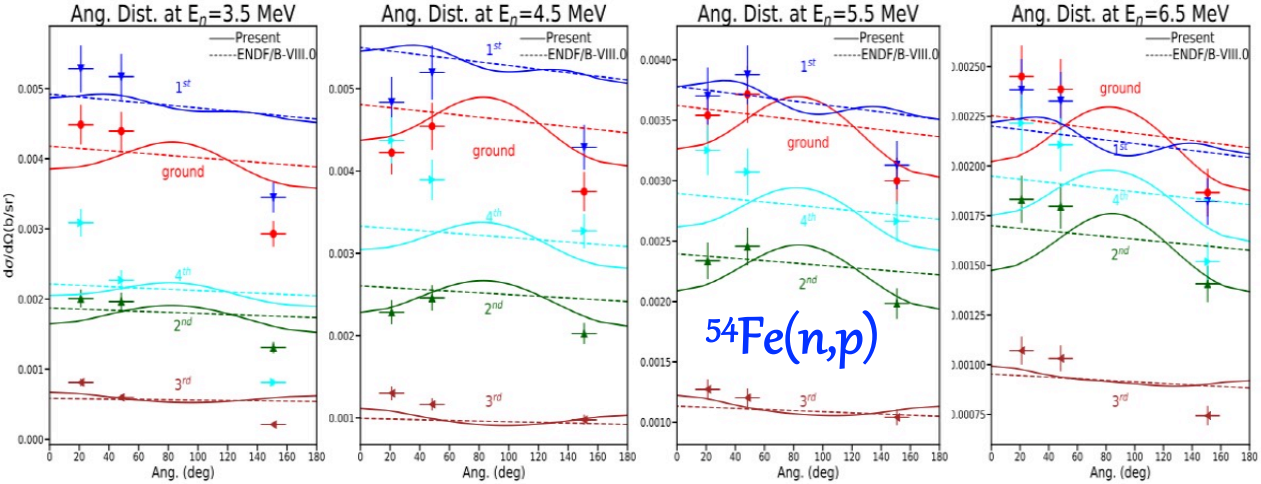
Lee, Kuvin et al. PRC (soon to be submitted)

1. Differential data can be directly used for R-matrix fits, with energy resolution functions
2. LENZ data well agreed with ENDF/B-VIII.0
3. Above 6 MeV, a new evaluation on angular distributions is needed with differential data sets.
4. (n,α_0) and $(n,\alpha_2+\alpha_3)$ angular distributions up to 12 MeV in neutron energy are deduced from our work

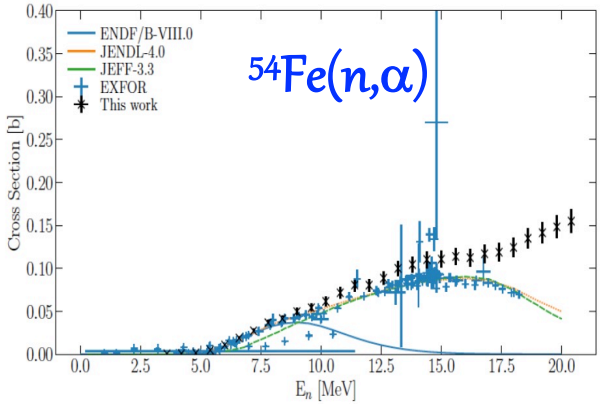




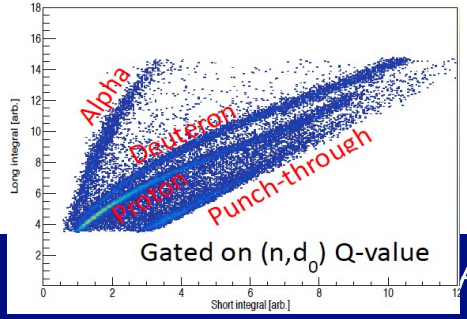
LENZ differential cross sections for discrete states demonstrate non-isotropic angular distributions, which are different from ENDF/B-VIII.0. "Present" evaluation is to improve angular distribution and energy spectra using LENZ data

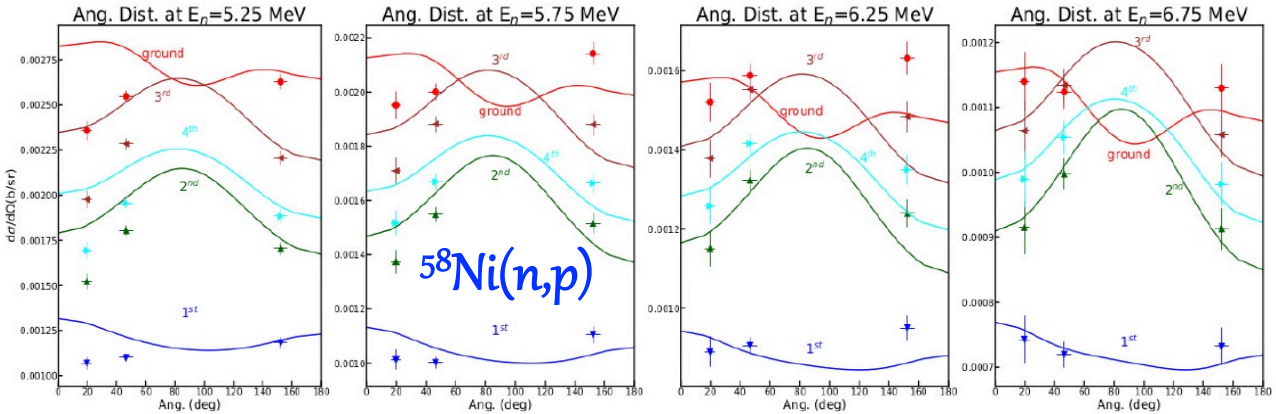


Georgiadou, Lee, et al. PRC (soon to be submitted)



As shown below, Pulse Shape Discrimination identifies reaction for (n,p), (n,d) and (n,α) from LENZ data

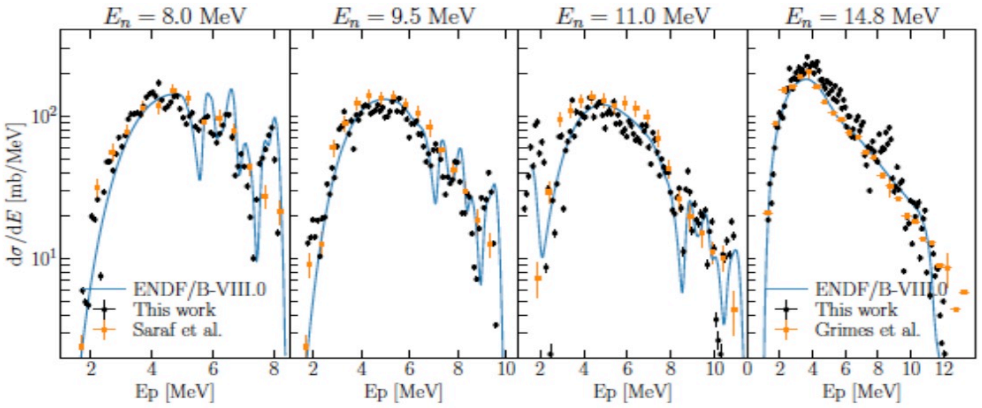


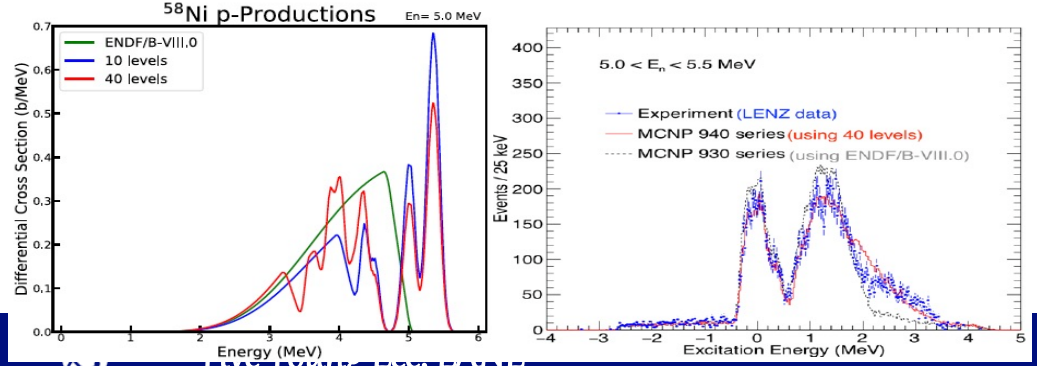


ANL

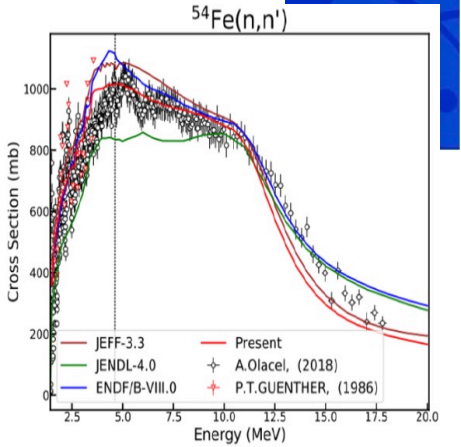
Evaluation effort for ^{54}Fe(n,p) cross sections

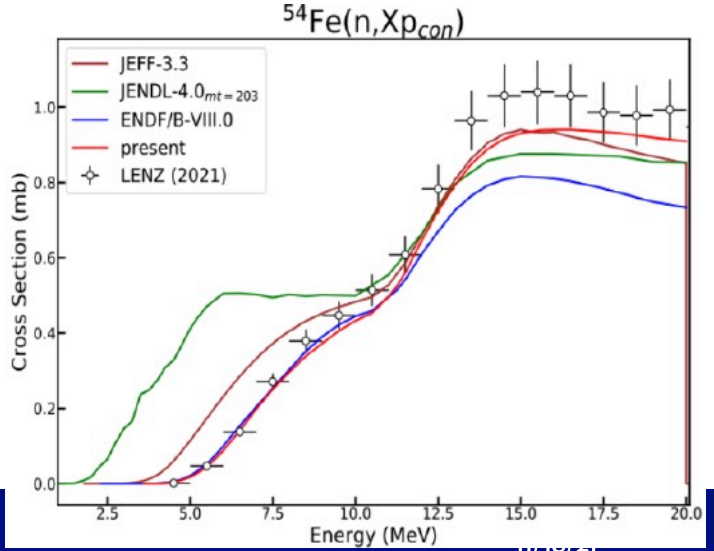
While comparing proton production cross sections, we investigated the adequate number of discrete levels by comparing MCNP simulations with LENZ data





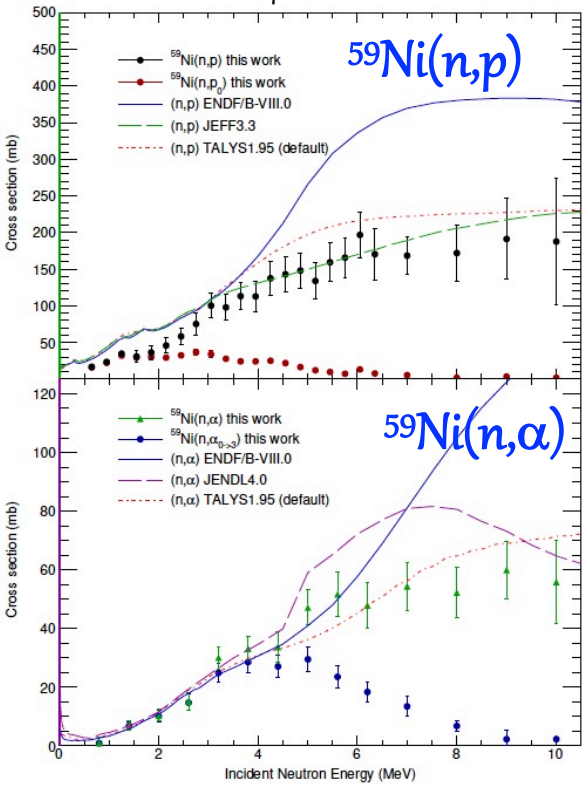
New experimental (n,xp) cross section for continuum initiated a new evaluation by revisiting (n,tot), (n,el), (n,n'), (n,np), etc. up to 20 MeV. :"Present" evaluation reproduces the experimental data better among available evaluation libraries



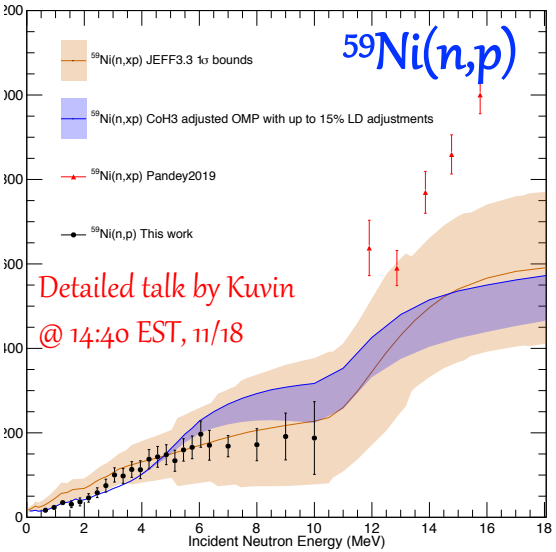


Radioactive ^{56,59}Ni(n,z) reaction measurements

Experimental differential cross sections on ^{59}Ni have been compared with available evaluations and the previous measurement by "surrogate method"

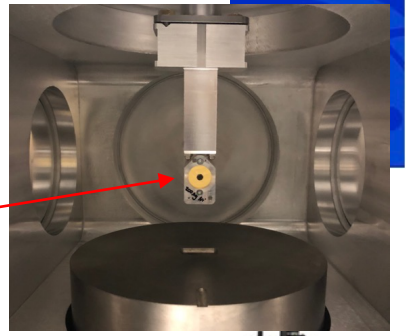


Kuvin, Lee, et al. PRC (soon to be submitted)



Detailed talk by Kuvin @ 14:40 EST, 11/18

radioactive isotope on Au foil (deposit has 6 mm in diameter)

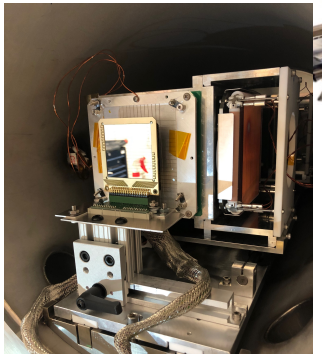


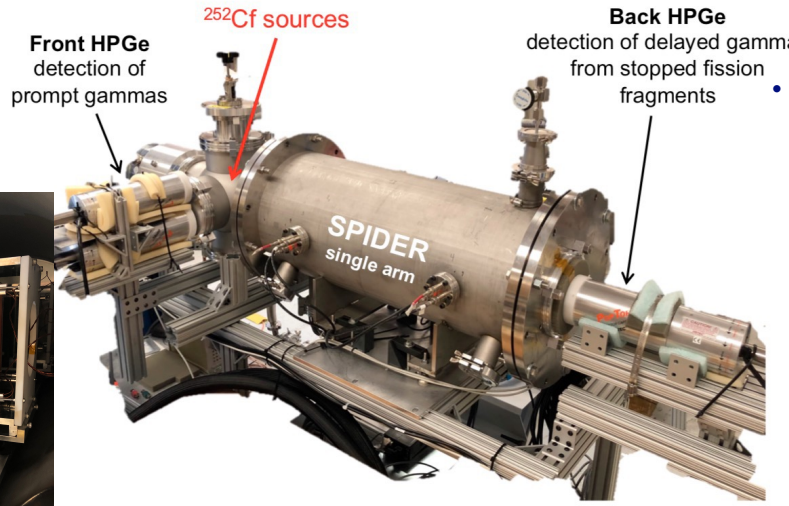
hotLENZ: for radioactive isotopes (^{56}Ni, ^{59}Ni, ^{44}Ti, ^{40}K, ^{26}Al ...)

hotLENZ data on ^{56}Ni is being deduced for first, direct experimental cross sections over a broad neutron energy

SPIDER - Recent Highlights - Gamma-ray Tagging

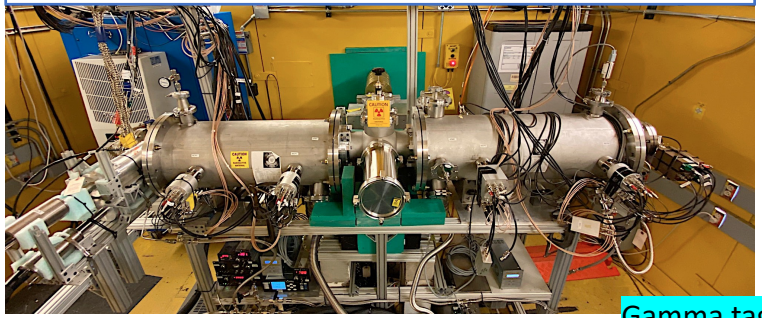
P.I. Jack Winkelbauer, LANL



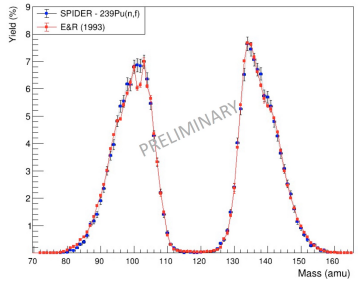


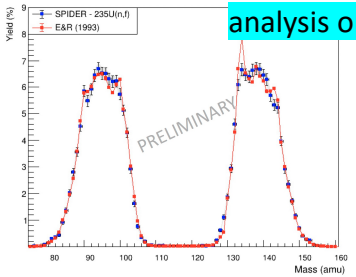
- (Independent) Fission Product Yields from thermal to 20 MeV
  - 2E-2v: Mass ∝ (E)*(TOF)^2
  - Goal <1 AMU mass resolution, **fast neutrons**, well-understood uncertainty/covariance
  - Challenges: resolution, calibration, scalability

Application to 2-arm system with IC's

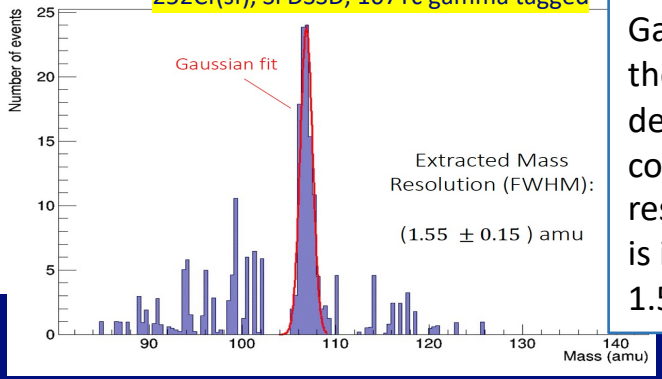


Gamma tagging analysis ongoing





252Cf(sf), Si DSSD, 107Tc gamma tagged



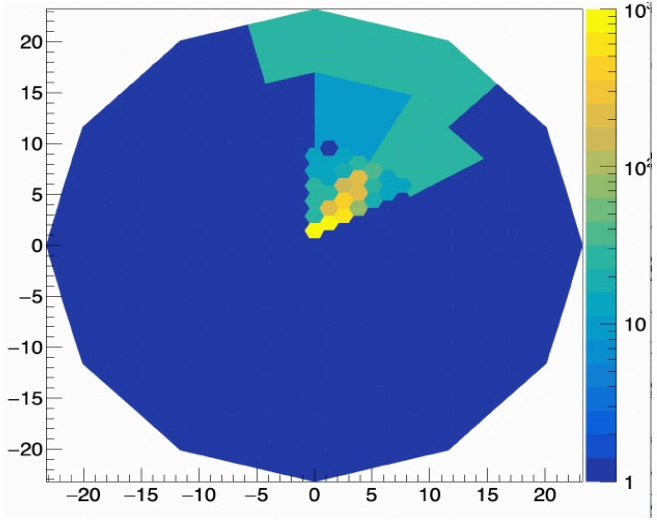
Gamma tagging enabled the proper velocity-dependent energy corrections, so mass resolution for Si detectors is improved from 2.5 to 1.5 amu

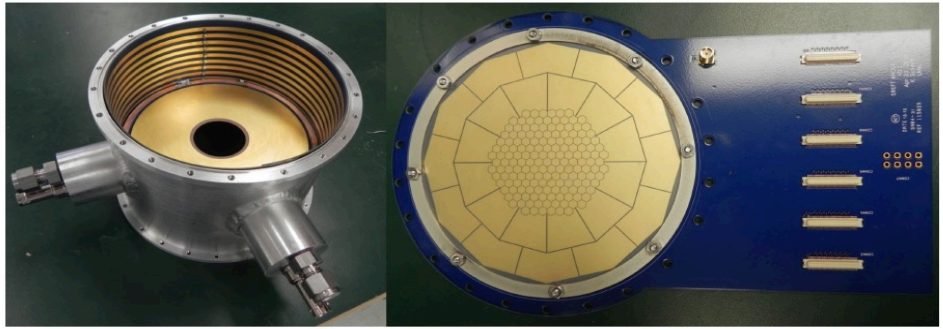
Spatially REsolved Fission Tracker (SREFT)

P.I. Christopher Prokop, LANL

- SREFT is the Spatially Resolved Fission Tracker under development at LANL
  - Small-scale TPC designed to be cheaper and easier to run
  - Minor actinide cross-section ratios, 2D beam imaging for LANSCE flight paths, possibly enhanced TKE measurements
  - Commercial DAQ hardware (CAEN vx2740) and preamplifiers (Kromek ev-5903)
  - We have ^{252}Cf data with 1/6 of one side of SREFT

^{252}Cf event recorded in SREFT





  - It is nearing completion
    - Analysis and simulation development is ongoing
    - Anode plane revisions underway
    - Gas handling almost complete pending delivery of controllers
    - Low-voltage power supplies being tested