Gamma-ray Tagging with SPIDER

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What is SPIDER?

- Mass \( \propto (E)^*(TOF)^2 \)
- Goal: <1 AMU mass resolution, fast neutrons, known uncertainty
- Challenges: Resolution, Calibration

Meierbachtol et al., NIM A 788 (2015) 59-66
Gamma Ray Tagging (Take One)

- 2018 NDWG interagency FOA
- Use existing LaBr3
- 1 uCi 252Cf(sf)
- Moderately careful simulations
- Inconclusive Data
- -> Procure hpGe

10 days, 10 uCi, 8 detectors
Gamma Ray Tagging (Take Two)
Gamma Ray Tagging (Take Two)

Front HPGe
- detection of prompt gammas

$^{252}$Cf sources

Back HPGe
- detection of delayed gammas from stopped fission fragments

10 uCi $^{252}$Cf(sf)
Prompt Gamma Rays
Delayed Gamma Rays

CGMF calculation

Experimental

time cut
70 nsec – 5 usec

97Sr
98Y, 99Zr
109Ru
104Tc
107Mo, Tc

92Rb
109Tc
Q: What's the resolution?

A: ~3.0 mass units (Using Si DSSD)

Q: What's the calibration?
Tagging with (n,f)
Tagging with (n,f)
Where are we going from here?
Who did this work?

- Legacy SPIDER: K. Meierbachtol, C.W. Arnold, D. Mayorov, F. Tovesson

- Current SPIDER: J. Winkelbauer (PI), S. Mosby (PL), D. Connolly (PD), P. Gastis (PD), C. Prokop (S), S. Kuvin (S)

- University Collaborations: Adam Hecht (UNM), Uwe Greife (CSM)
What's next?

FP-12 235U(n,f)

Test new IC Window

MegaSPIDER
Window Redesign

- Circular window cells
- Larger (9mm vs 3.75mm)
- Complete assembly by manufacturer (Norcada)
- Secondary Electrons?
MCP Position Readout

Fission Fragment → Window

$X \propto (\Delta T_R - \Delta T_L)$

Delay line wire

Los Alamos National Laboratory

Managed by Triad National Security, LLC for the U.S. Department of Energy's NNSA
MCP Position Readout

See:

S. Lipschutz et al, NIMA 815, 2016
C. Prokop et al, NIMA 741, 2014
Si DSSD

- Position Sensitive
- Marginal Resolution
- Logistically trivial
- Good testbed for Gamma ray tagging