Independent Fission Product Yields from 0.5-20 MeV

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SPIDER: Independent FPY’s with E-v method

\[ m = \frac{2E_{\text{TOF}}}{v^2} \]

- \( E_{\text{in}} \) (Sample)
- \( E_{\text{TOF}} \)
- \( E_{\text{measured}} \)
- \( \Delta E_{\text{C}} \)
- \( \Delta E_{\text{window}} \)
- \( \Delta E_{\text{PHD}} \)

Time-of-flight
SPIDER: Independent FPY’s with E-v method

- Independent FPY’s (before beta decay, t<100ns)
- Probe incident energy dependence (neutron tof)
- Potentially extract $\nu(A)$
- Deceptively simple
Absolute Calibration with Gamma-ray Tagging

1-arm SPIDER system with Si detector
P. Gastis et al., NIMA 1037, 166853 (2022)
Effect of “Absolute Calibration” (Energy losses, PHD)
Gamma-ray tagging with ionization chambers

PRELIMINARY
Outstanding issues with ionization chambers

- Edge-effects in IC are significant
- IC severely limits geometric efficiency
- Practical considerations are huge

~4x higher acceptance when a DSSD is used
New MegaSPIDER design!
New MegaSPIDER design!

- Final Design/Procurement underway
- Initial WNR scoping tests Fall 2023 (targets, backgrounds, count rates, collimation)
- Planning to have 8 arms (2x IC-MegaSPIDER efficiency) instrumented in 2024
- Further scalable, multiple chambers in series
2-arm SPIDER at Lujan Center (thermal)

- Data analysis ongoing
- Mark IV Lujan Target (<100 keV)
- Testbed for coincidence analysis
SPIDER Acknowledgements

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Gamma-ray tagging with Silicon DSSD

Front HPGe
Detection of prompt gammas

$^{252}\text{Cf}$ sources

Back HPGe
Detection of late gammas from stopped fission fragments

P. Gastis et al., NIMA 1037, 166853 (2022)
Gamma Ray Tagging

1-arm SPIDER system with Si detector
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Resolution (FWHM): 1.18 ± 0.24 amu
Challenges in E-v calibration
FPYs from 2E Method

- Advantages:
  - Geometric efficiency
  - Operational Simplicity
  - Measure TKE, FPY’s simultaneously
- Disadvantages:
  - Requires theoretical $\bar{\nu}(A)$
  - Resolution depends on $\bar{\nu}(A)$
  - $\bar{\nu}(A)$ comes from FPY’s!
- Advantage:
  - Feasibility
Microcalorimeters for SPIDER?

- Energy resolution @100MeV: 0.02-0.1%
- 0% pulse height deficit
- Windowless
- ~0.6 AMU (FWHM) mass resolution for A>130