The development of mega-SPIDER instrument for measurements of independent fission product yields

Panos Gastis

Staff scientist, P-3 Low Energy Nuclear Physics

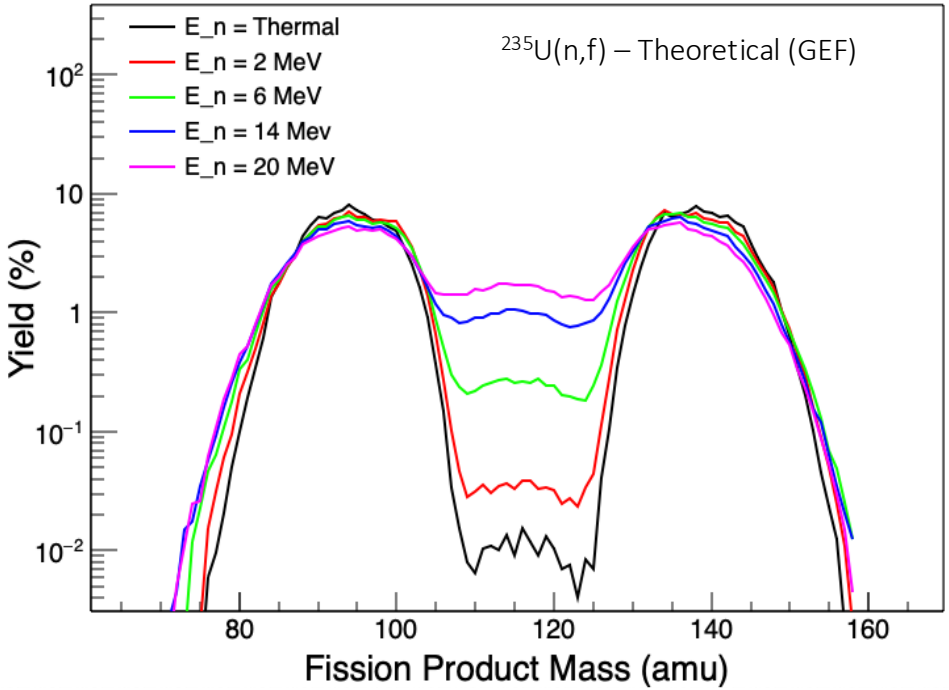
On behalf of the SPIDER team:

Jack Winkelbauer (PI), Panos Gastis, Som Paneru, Sean Kuvin, Chris Prokop

November 2024

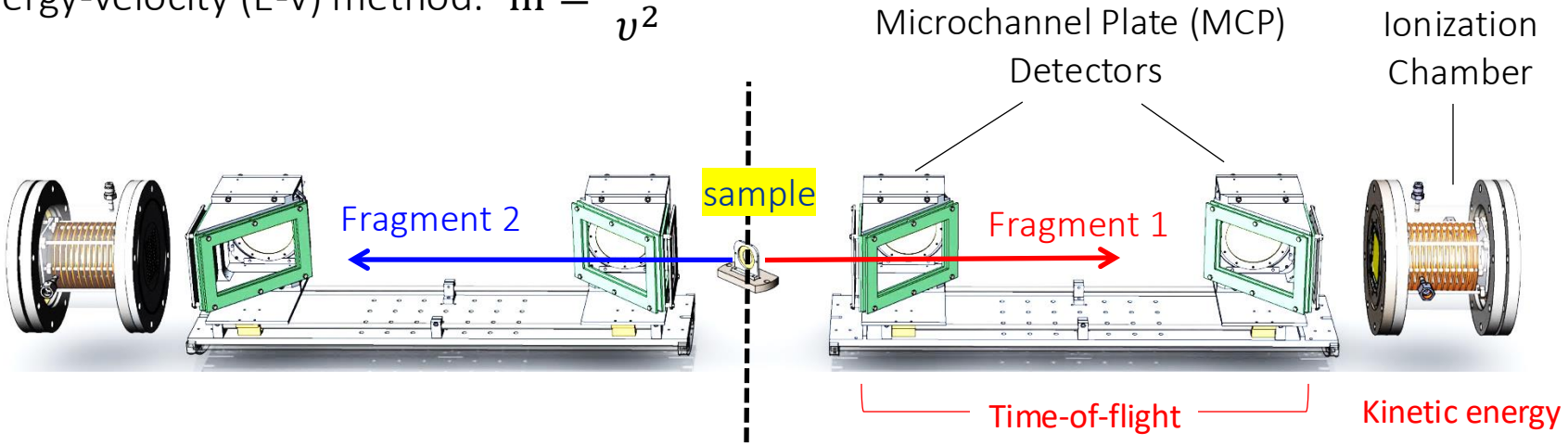
LA-UR-24-31780

Need for energy-dependent FPY



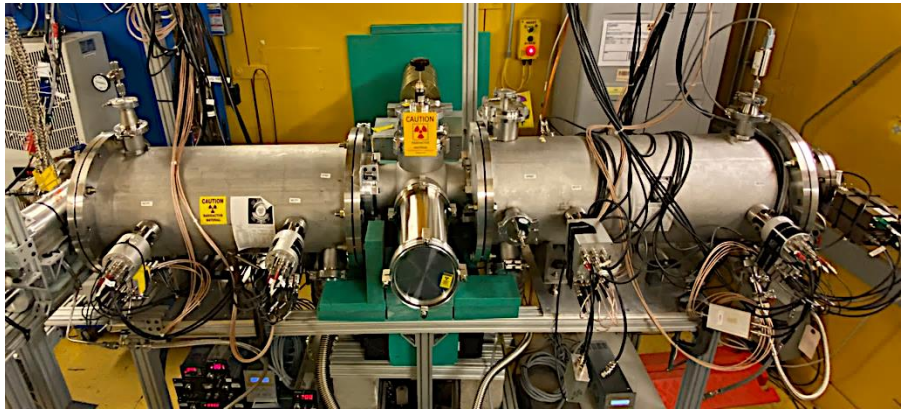
Spectrometer for Ion DEtermination in fission Research (SPIDER)

Energy-velocity (E-v) method: $\mathrm{m} = \frac{2\mathrm{E}}{v^2}$

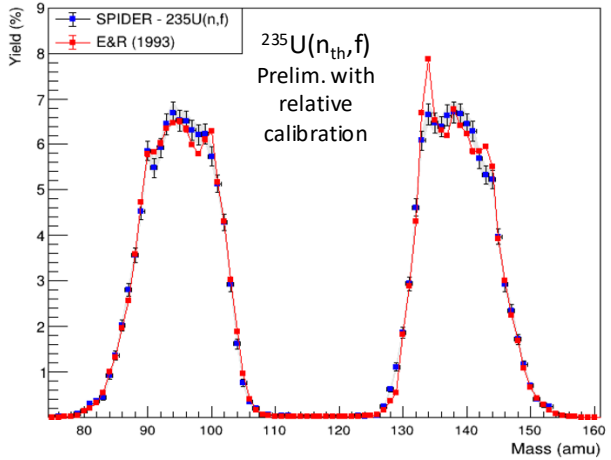


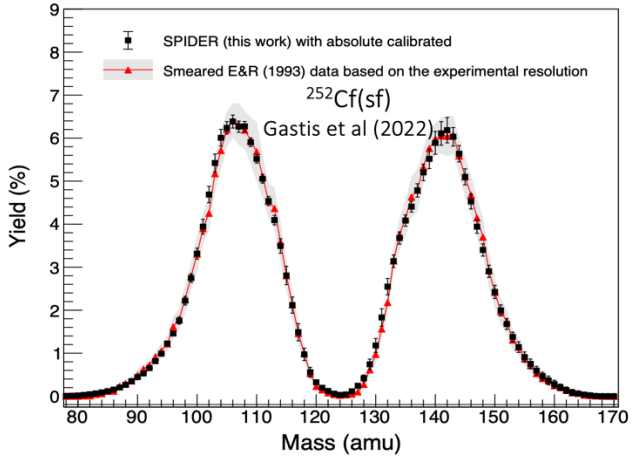
- Not a theory-dependent method
- High mass resolution: ~1 AMU for light fragments
- Measurement of prompt neutron emission $\bar{\nu}(A,E_n)$
- Measurement of TKE (E_n)

First generation 2–arm SPIDER



1-Arm system with Si detector

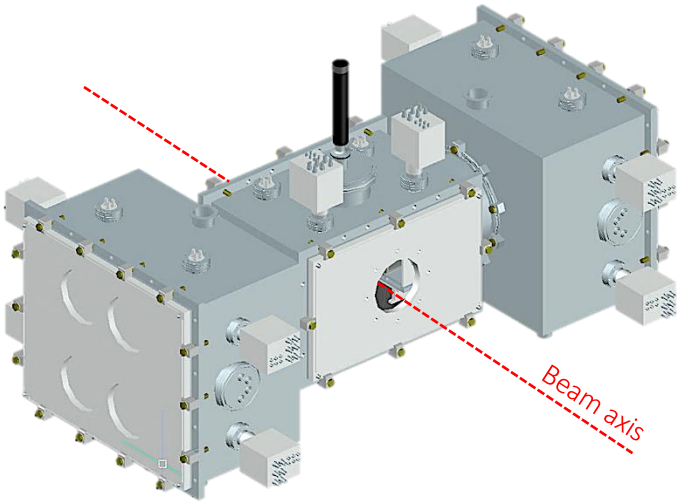


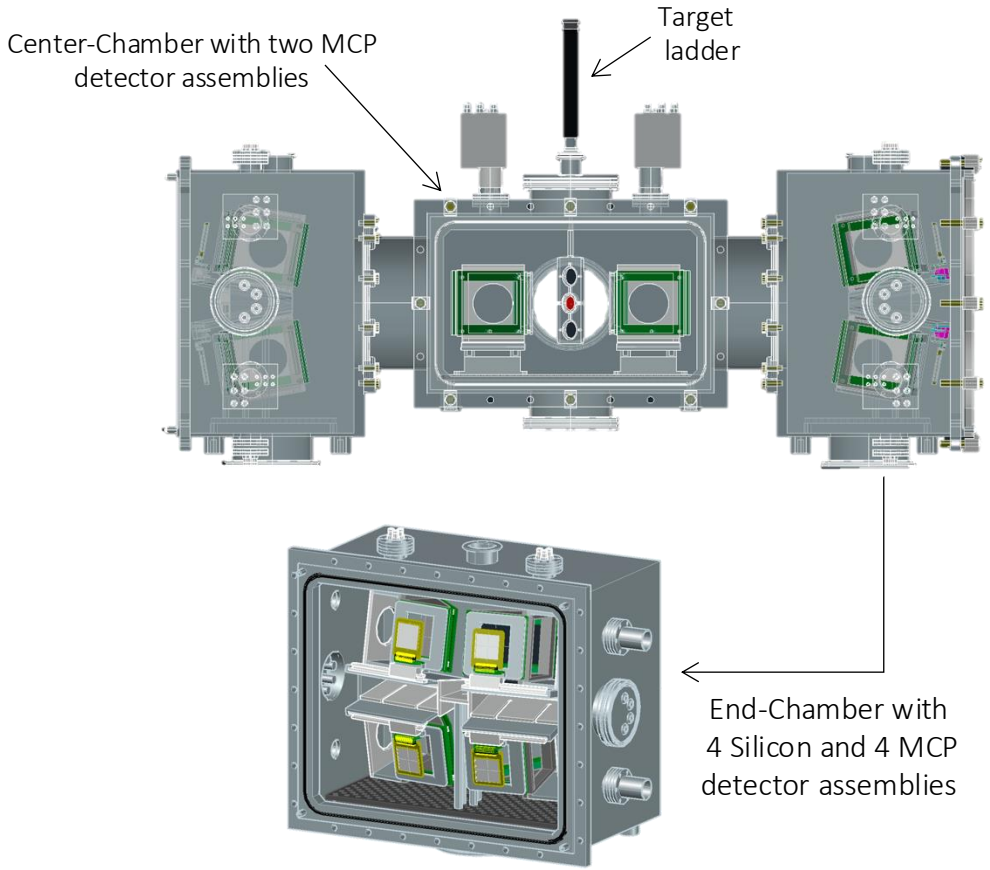


The mega-SPIDER instrument

8-arm system

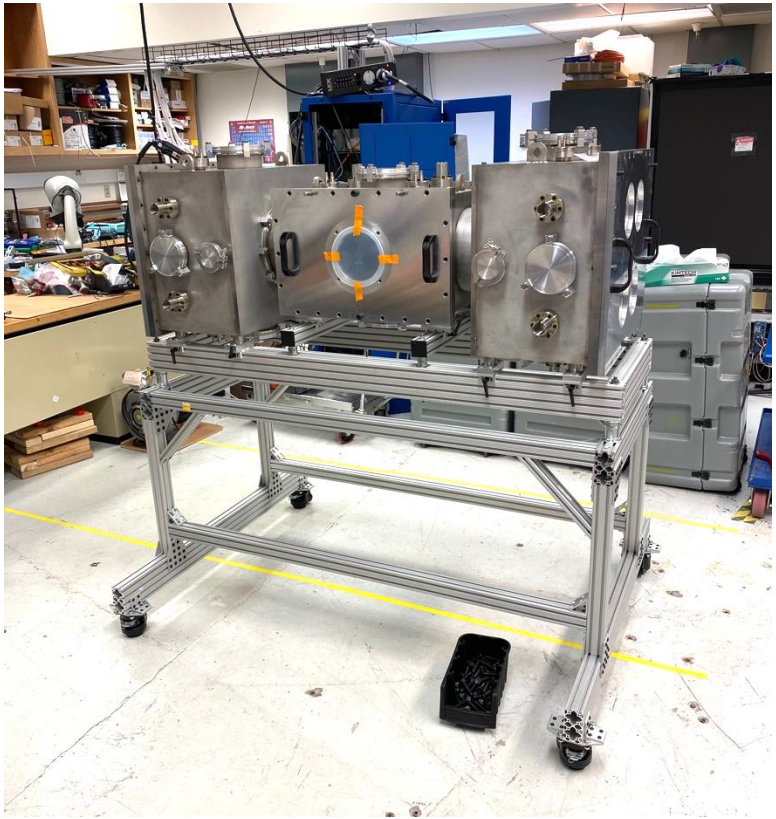
- 10 MCP detectors
- 8 silicon detectors
- 16 times higher efficiency from the 2-arm SPIDER



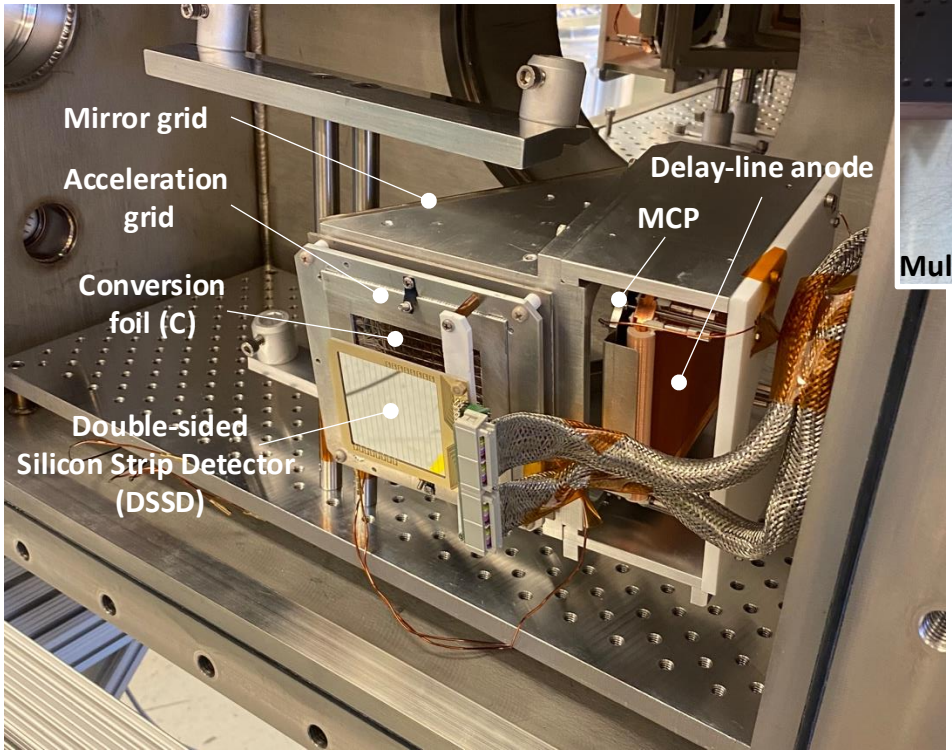


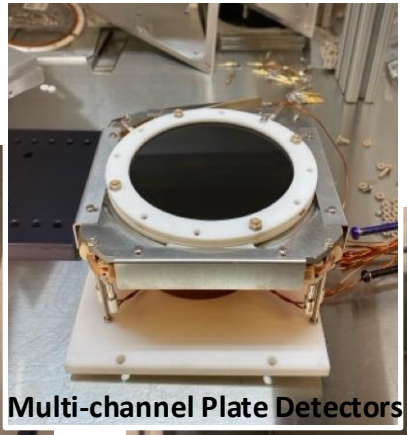
The mega-SPIDER instrument

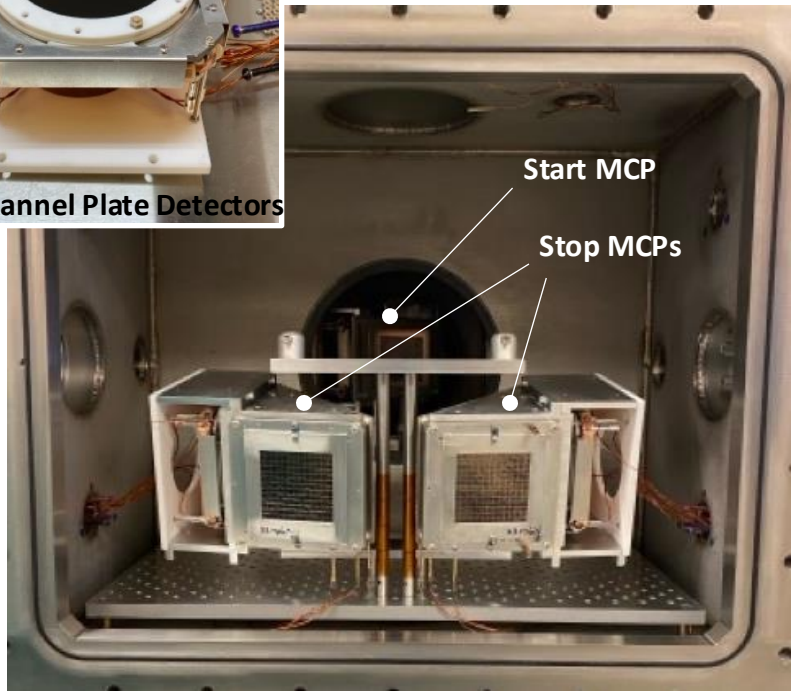
- Vacuum chamber assembled and tested: ~ 10^{-7} Torr
- Movable stand for easy transportation and alignment



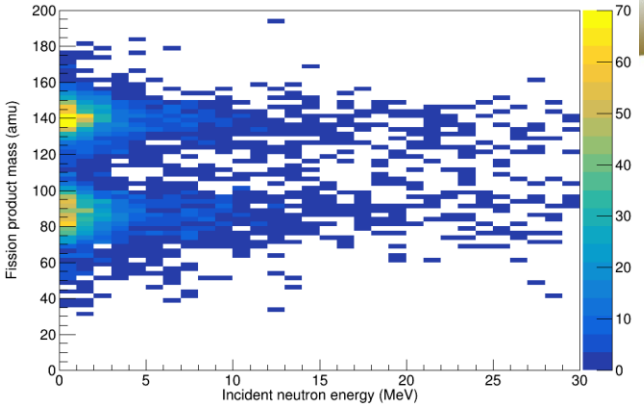
The mega-SPIDER instrument



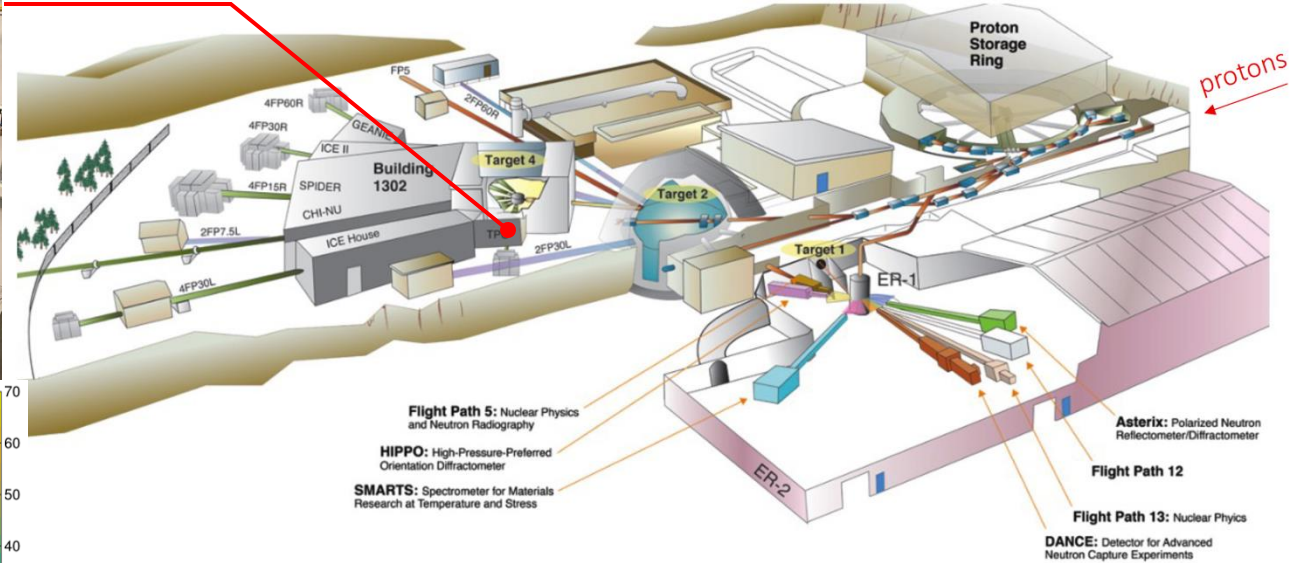




First test measurements at WNR/90L with the 1-arm SPIDER: ^{235}U(n,f)



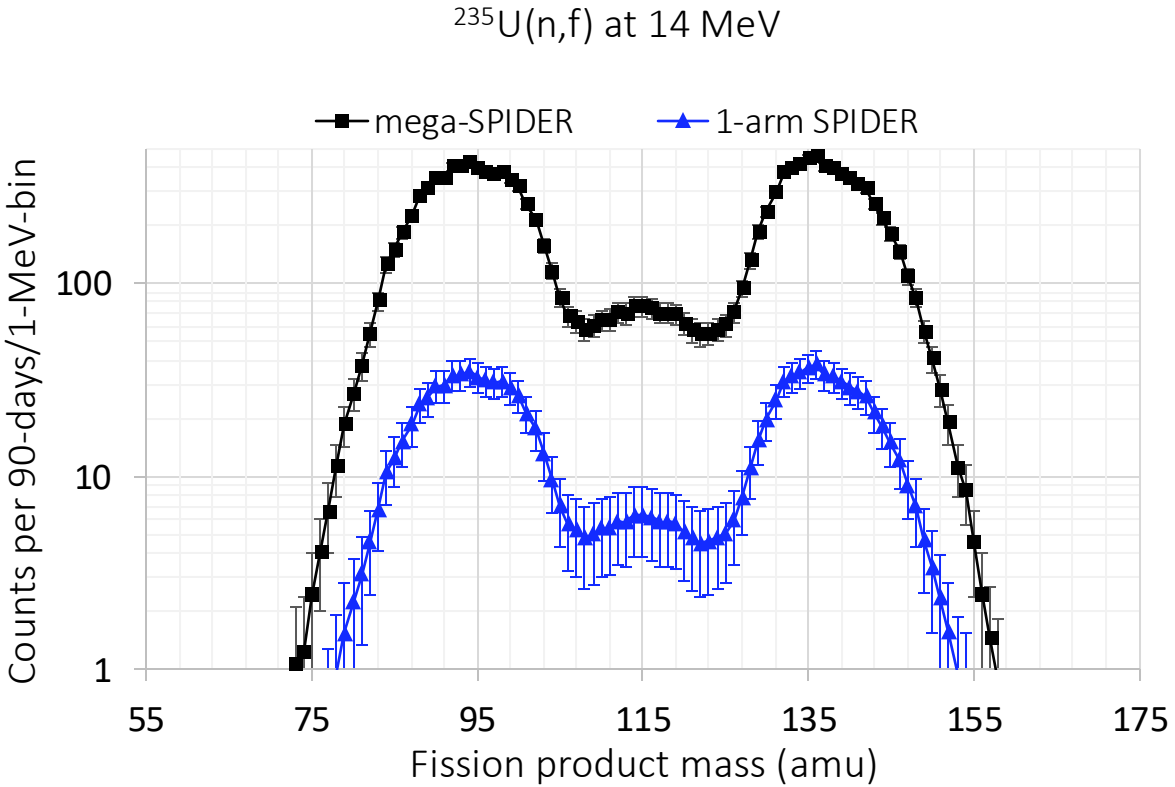
Neutron-beam facilities at the Los Alamos Neutron Science Center



Experiment objectives:

- ✓ Measure count rates
- ✓ Test detectors response
- ✓ Test electronics
- ✓ Background characterization in 90L

Expected count rates at WNR/90L with mega-SPIDER

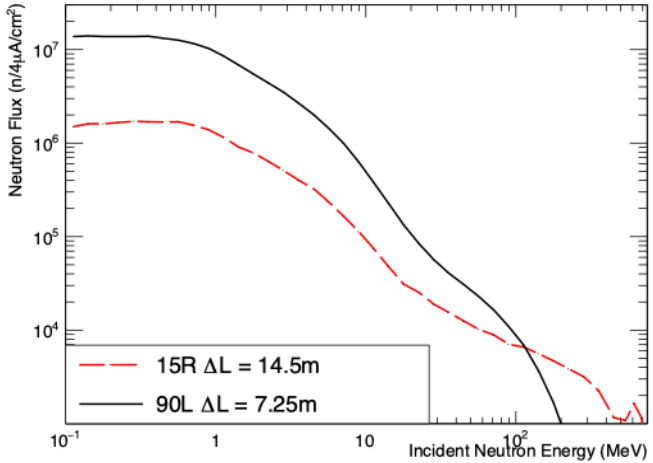


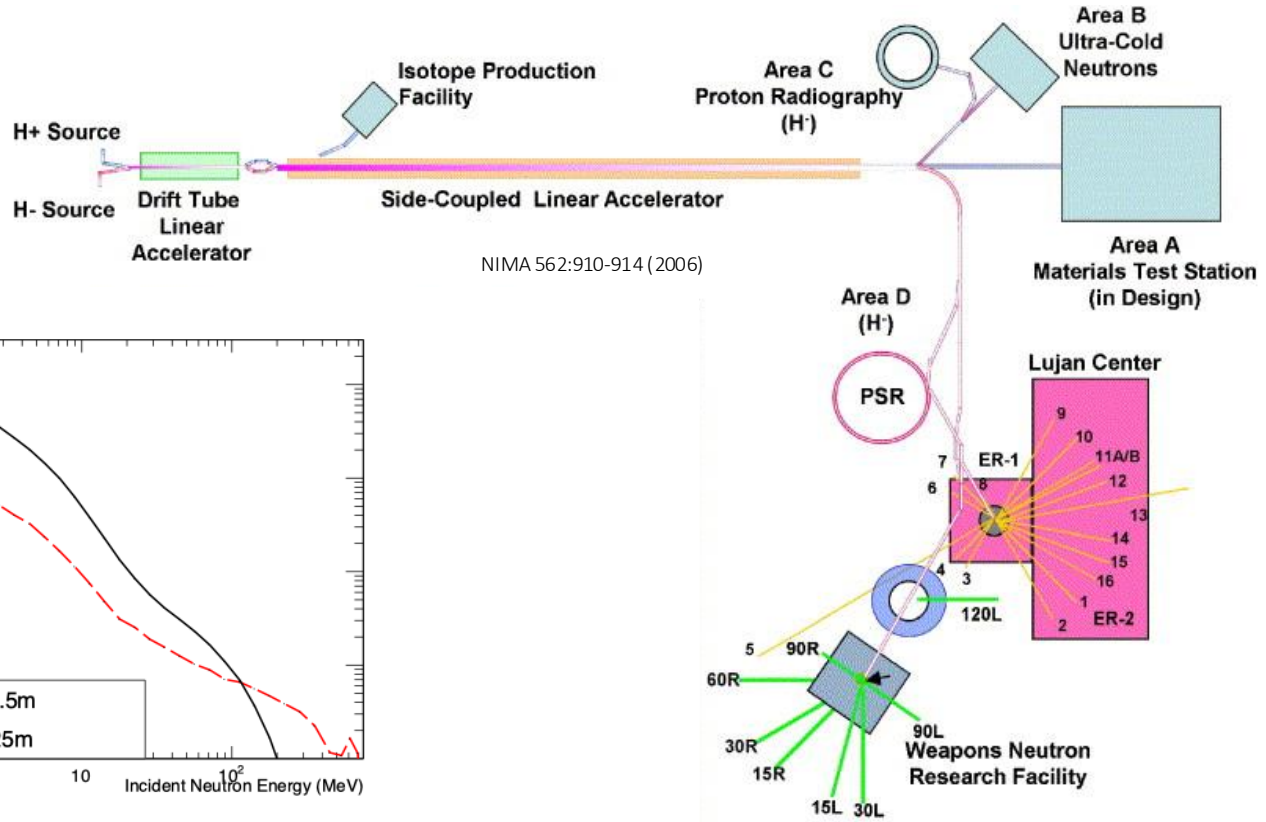
SUMMARY

- mega-SPIDER: energy-dependent fission product yield measurements in direct kinematics
- Capability to collect correlated fission data → FPY (E_n) & $\nu(A,E_n)$ & TKE (E_n)
- Design and assembly of the instrument have been completed
- Detector tests are ongoing
- First in-beam tests in 2025

This work is supported by the US Department of Energy through the
Los Alamos National Laboratory (Contract No. 89233218CNA000001)

EXTRA





NIMA 562:910-914 (2006)