Fission Product Yield Measurements from LANSCE & TUNL

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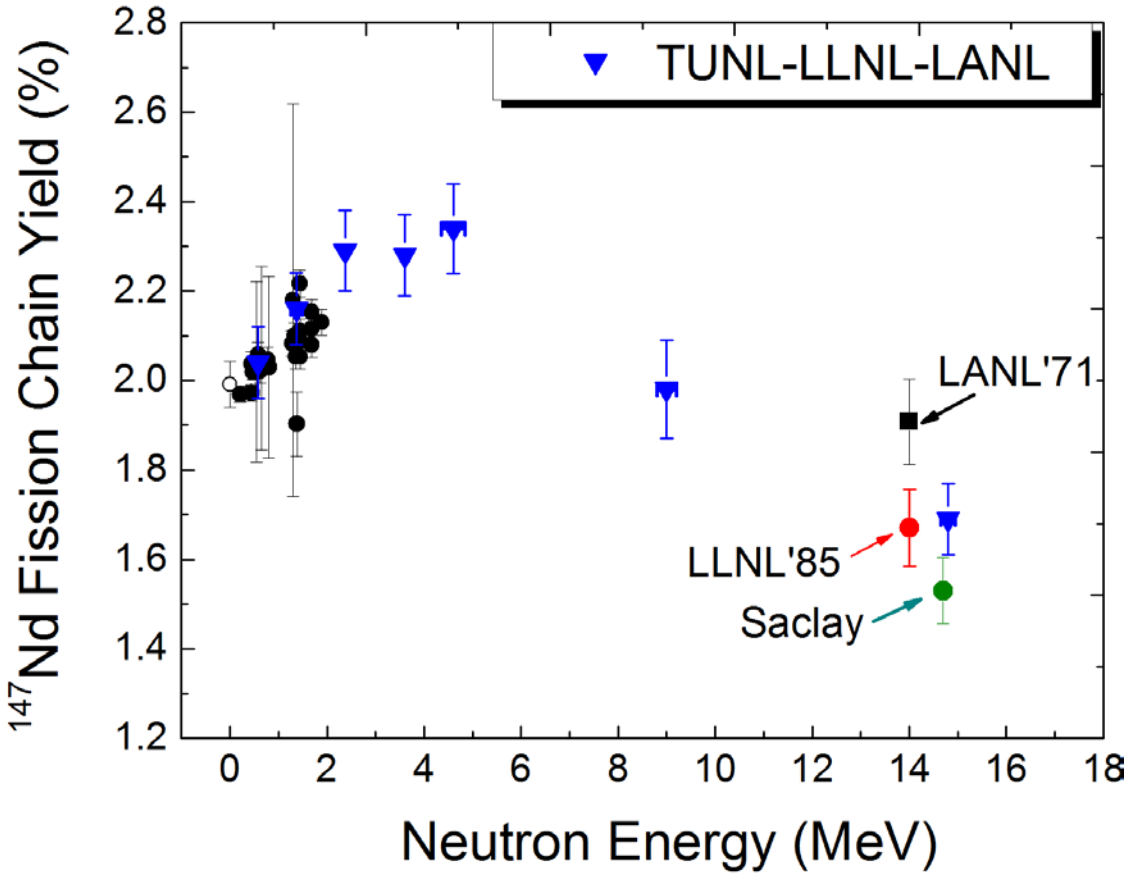
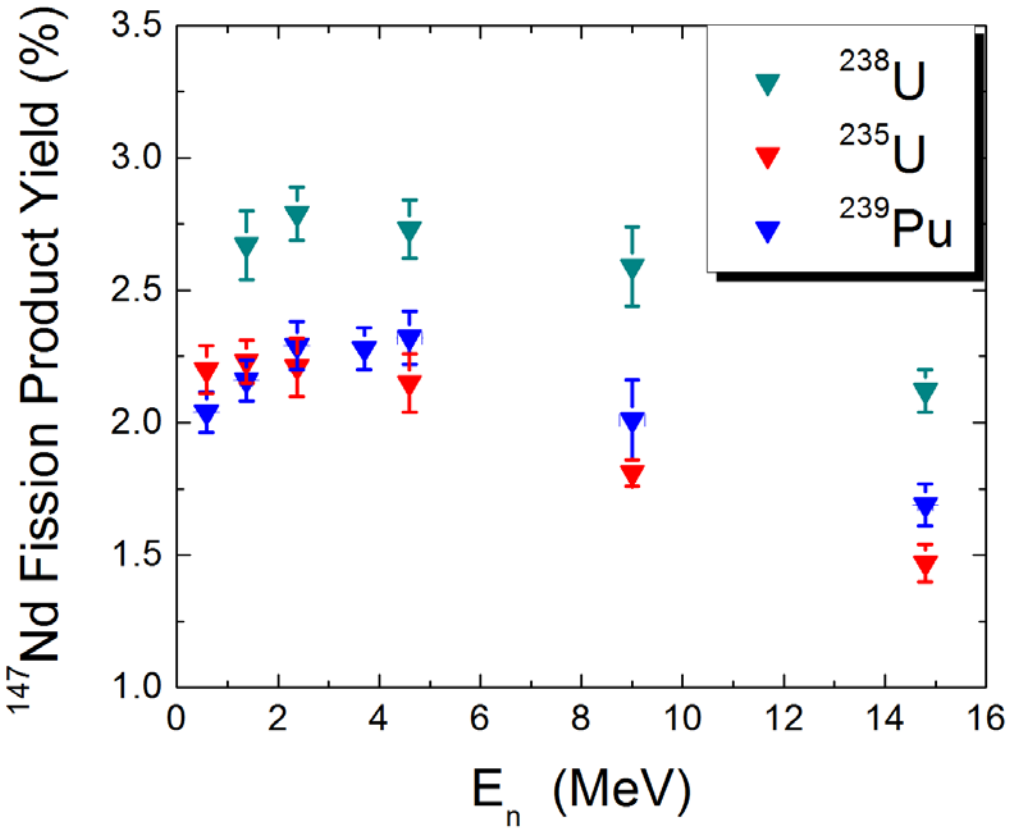
$^{239}Pu(n,f)^{147}Nd$ Absolute Fission Product Yield at Higher Energies



- At higher energies the FPY for ^{147}Nd turns over and decreases
- The TUNL measurements at 14.8 MeV is in a very good agreement with LLNL value
- Compared to the FPY at 4.6 MeV, the FPY has decreased by 37% at 14.8 MeV
- **Our new measurement helps resolve the long-standing discrepancy at 14.8 MeV !**

^{147}Nd Absolute Fission Product Yield from ^{239}Pu and ^{235,238}U: Challenge the Theory to Help Explain Data



- The slope of ^{147}Nd FPY is positive from 0.5 to 2.6 MeV in all three fissile actinides
- The slope of ^{147}Nd FPY from 4.6 to 14.8 MeV is negative in all three fissile actinides
- Joint LLNL/LANL theoretical teams, using this data, are spearheading a renaissance in fission theory resulting in expanded capabilities to understand detailed fission properties

Acknowledgements

TUNL

Duke

- **C. BHATIA (PD)**
- **M. BHIKE (PD)**
- **B. FALLIN (GS)**
- C. HOWELL
- W. TORNOW

N.C. State Univ.

- **M. GOODEN (GS)**
- J. KELLEY

LLNL

- J. BECKER
- R. HENDERSON
- J. KENNEALLY
- R. MACRI
- D. REGNIER
- C. RYAN
- S. SHEETS
- N. SCHUNCK
- M. STOYER
- A. TONCHEV

LANL

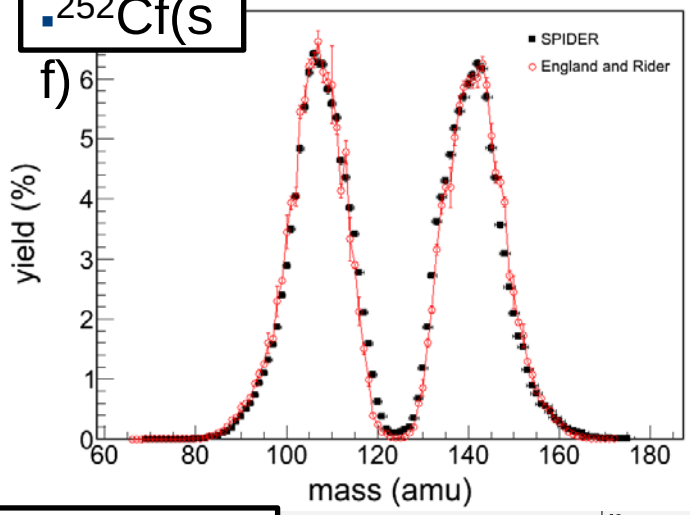
- C. ARNOLD

E. BOND

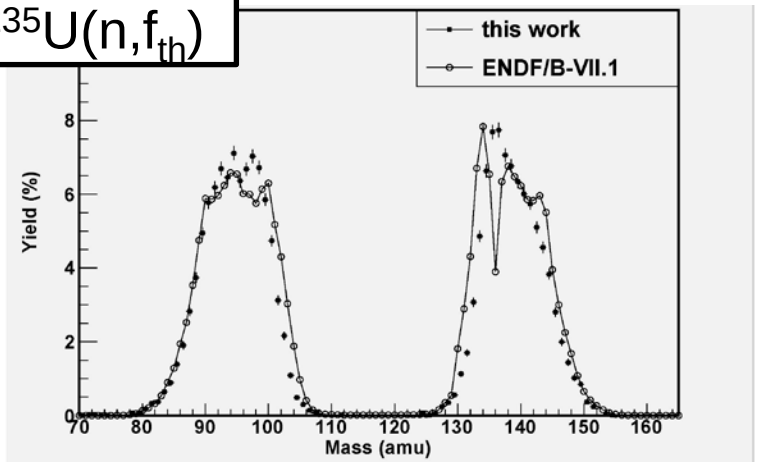
- T. BREDEWEG
- M. CHADWICK
- M. FOWLER
- W. MOODY
- P. MOOLER
- R. RUNDBERG
- G. RUSEV
- A. SIERK

Fission mass yields with SPIDER

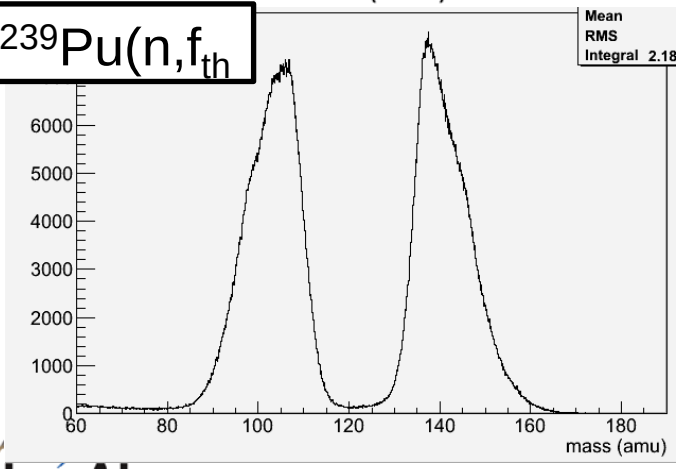
- $^{252}Cf(sf)$



- $^{235}U(n,f_{th})$

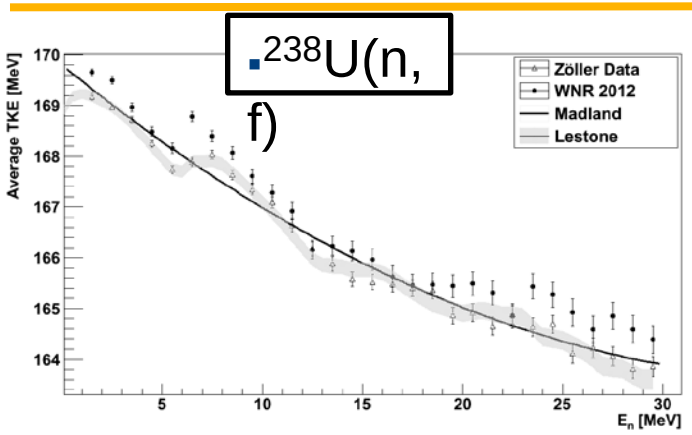


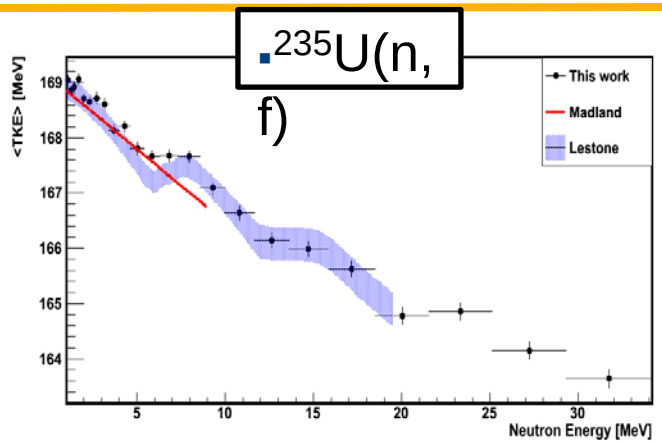
- $^{239}Pu(n,f_{th})$

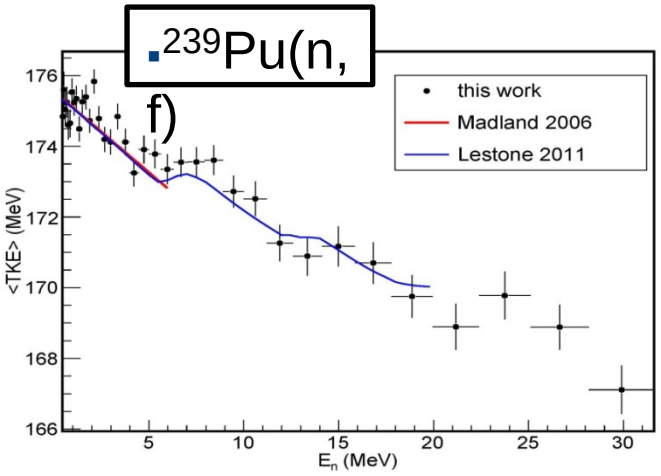


- Spontaneous fission of Cf-252 is used as benchmark
- U-235 and Pu-239 for thermal neutrons can be compared to data from ILL, Grenoble
- Current mass resolution is 1.2 amu for light fragment group and 1.6 amu for heavy fragment group
- Lujan thermal measurement establishes accuracy

Total Kinetic Energy (TKE) results







- **Zöller et al. data for U-238 extends beyond 30 MeV**
  - For U-235 no previous data above 9 MeV
  - For Pu-239 no data beyond 5 MeV
- **Madland evaluation is fit to experimental data**
  - Not intended for extrapolation
  - ENDF values for 14 MeV never the less are extrapolations
- **Semi-empirical modeling by Lestone et al. in close agreement with new data**
  - J.P. Lestone, T.T. Strother, Nuclear Data Sheets **118,** 208 (2014)
- **ENDF ^{239}Pu fission energy deposition needs to be increased by 2 MeV**

Current status and future plans

- **Fission yields**
  - Thermal mass yields obtained for U-235, Pu-239
  - First test with fast neutrons completed
  - Remainder of FY2015
    - Complete data analysis
    - Improve mass resolution from 1.2 to 0.8%
  - FY2016
    - Measure fission fragment coincidence measurement on Pu-239
    - Make decision on SPIDER scale-up for fast neutron measurements at LANSCE/WNR
- **Total kinetic energy release**
  - Completed measurements for U-238, U-235, Pu-239
  - Remainder of FY2015
    - Publish U-238, U-235
  - FY2016
    - Publish Pu-239
    - Measure other isotopes?
    - Combine with fission neutron detection

Acknowledgements

- **Los Alamos National Laboratory**
  - **Postdocs**: Krista Meierbachtol, Rhiannon Meharchand, Brett Manning, Charles Arnold
  - **Students**: Verena Kleinrath, Dan Shields, Dana Duke
  - **Staff**: Shea Mosby, Alexander Laptev, Justin Jorgenson, Morgan White, Todd Bredeweg, Arnie Sierk, Marian Jandel
- **University of New Mexico**
  - Adam Hecht, Rich Blakeley, Lena Heffern, Drew Mader, Erin Dughie
- **Colorado School of Mines**
  - Uwe Greife, Bill Moore