Scoping Study of a Proposed Measurment of the $^{233}U(n,f)/^{235}U(n,f)$ Cross Section Ratio

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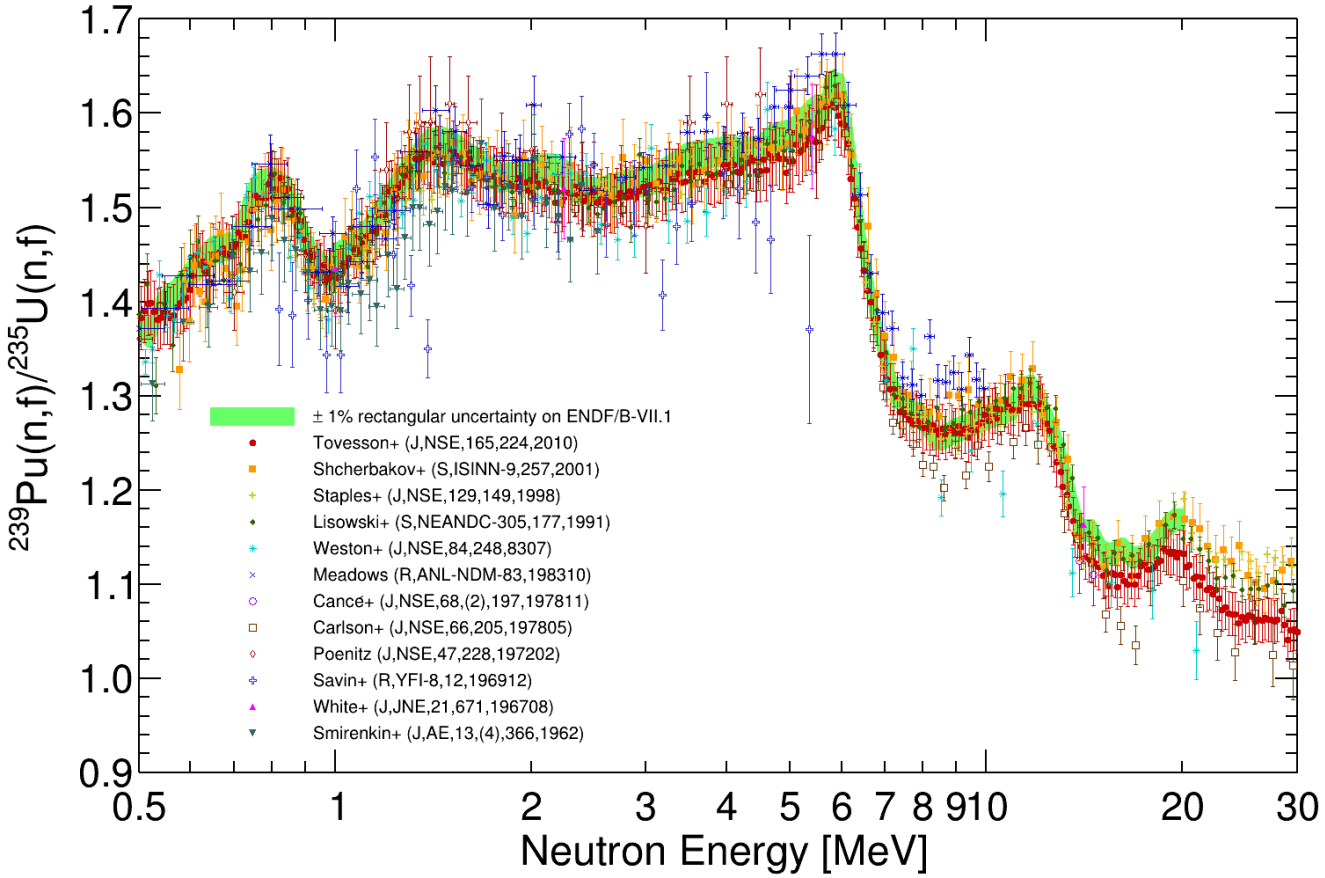
Outline

- **Review original motivation for fissionTPC**
- **Discuss some similarities in the case of ^{233}U**
- **Review technical options for a measurement**
  - FissionTPC
  - Fission Chamber
- **Cost Estimates**

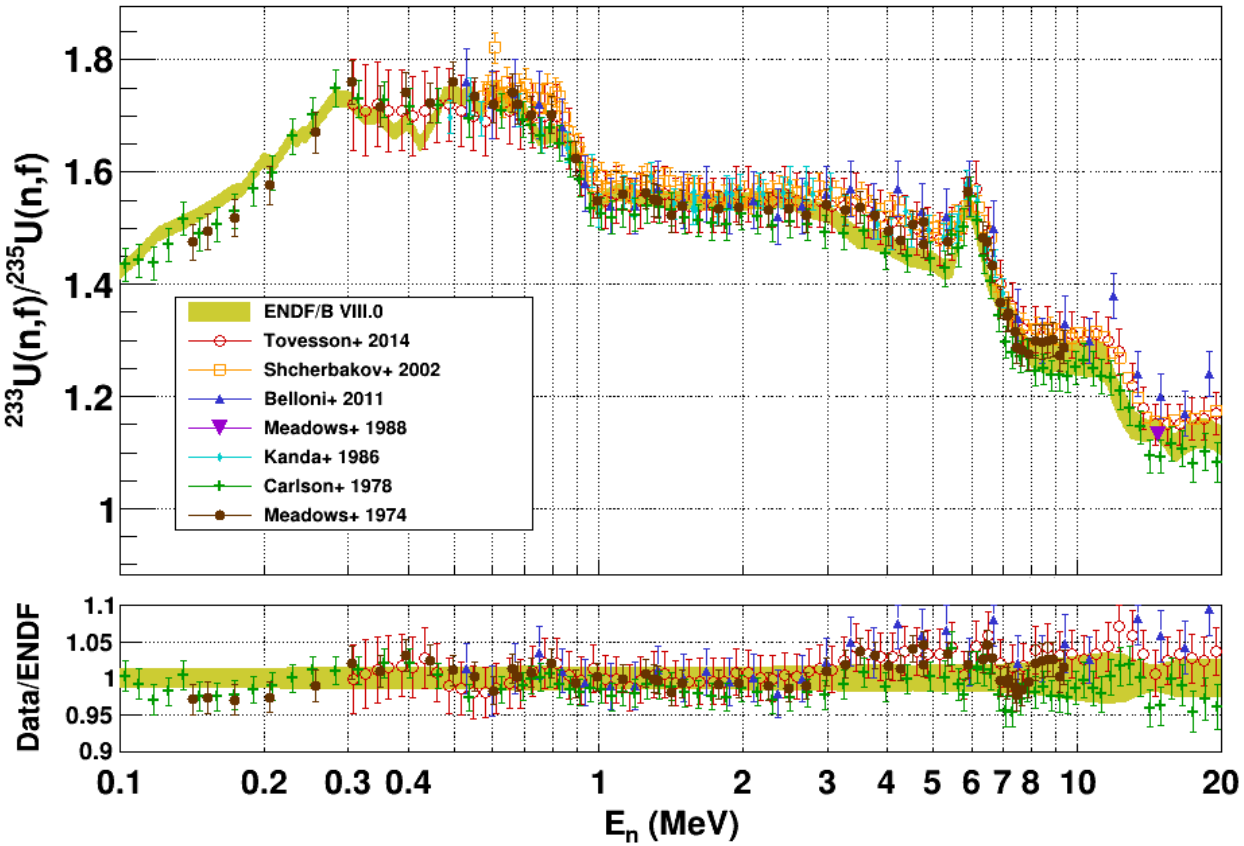
Motivation: Study and improve cross-section ratio systematics of ^{239}Pu(n,f)



Scatter in the data challenged the assertion of a 1% accurate ENDF ^{239}Pu evaluation.
USU have since been incorporated into some evaluations

^{233}U(n,f) Example

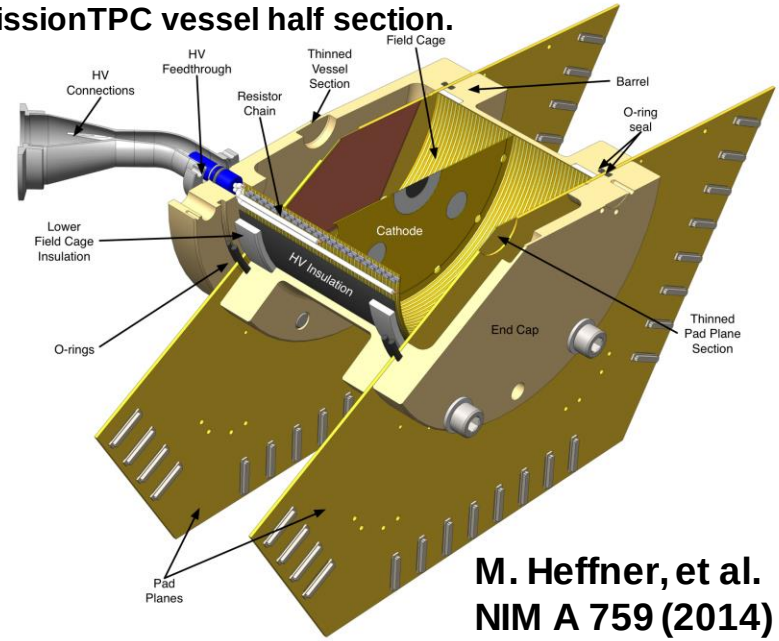
- Subset of ^{233}U(n,f)/^{235}U(n,f) data
- Disagreements of 3-4% between some data and ENDF
- Disagreement between data sets also
- Issues in resonance region and PFNS



FissionTPC or Fission Chamber?

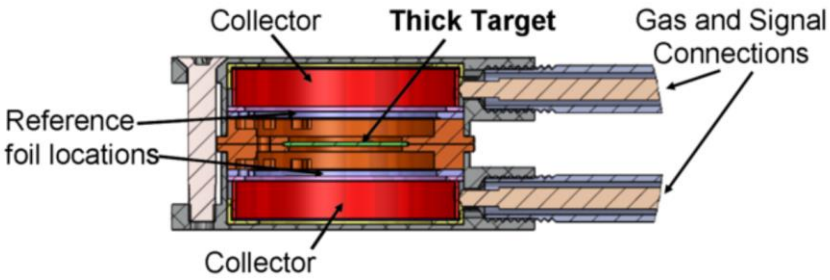
- Accuracy
- Complexity (ease of use/analysis)
- Facilities (neutron energy)
- Cost

FissionTPC vessel half section.



M. Heffner, et al.
NIM A 759 (2014) 50-64

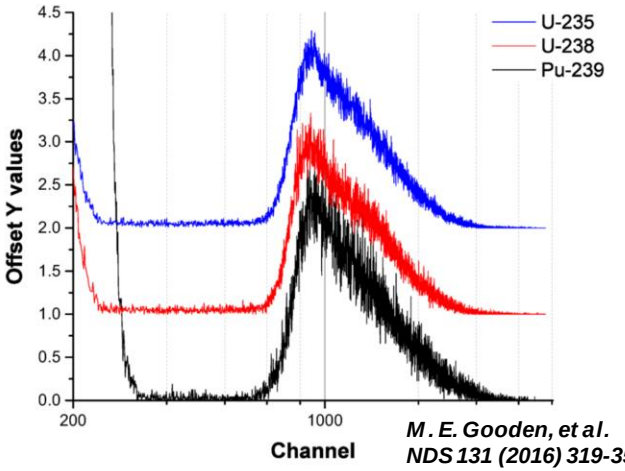
Fission chamber cross section.



M. E. Gooden, et al.
NDS 131 (2016) 319-356

Fission Chamber vs. FissionTPC

- Fission chambers have been used since the beginning of fission research
- Simple, reliable, and robust
- Record particle energy
  - Certain configurations can give track angle



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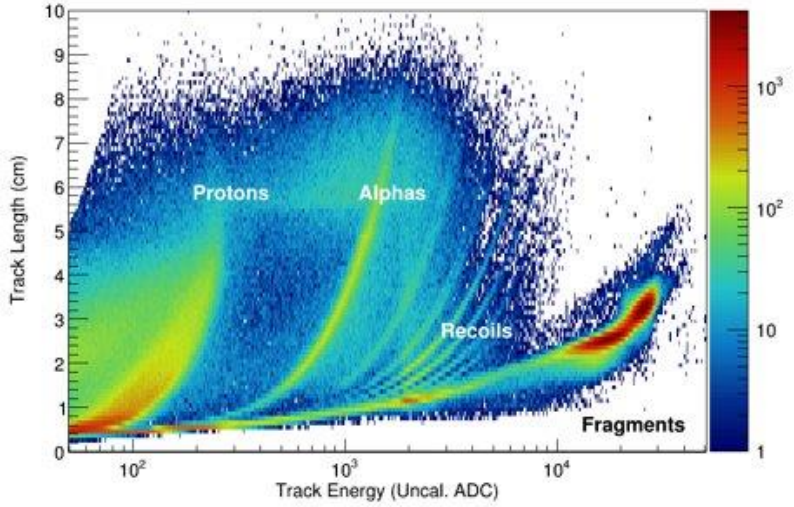
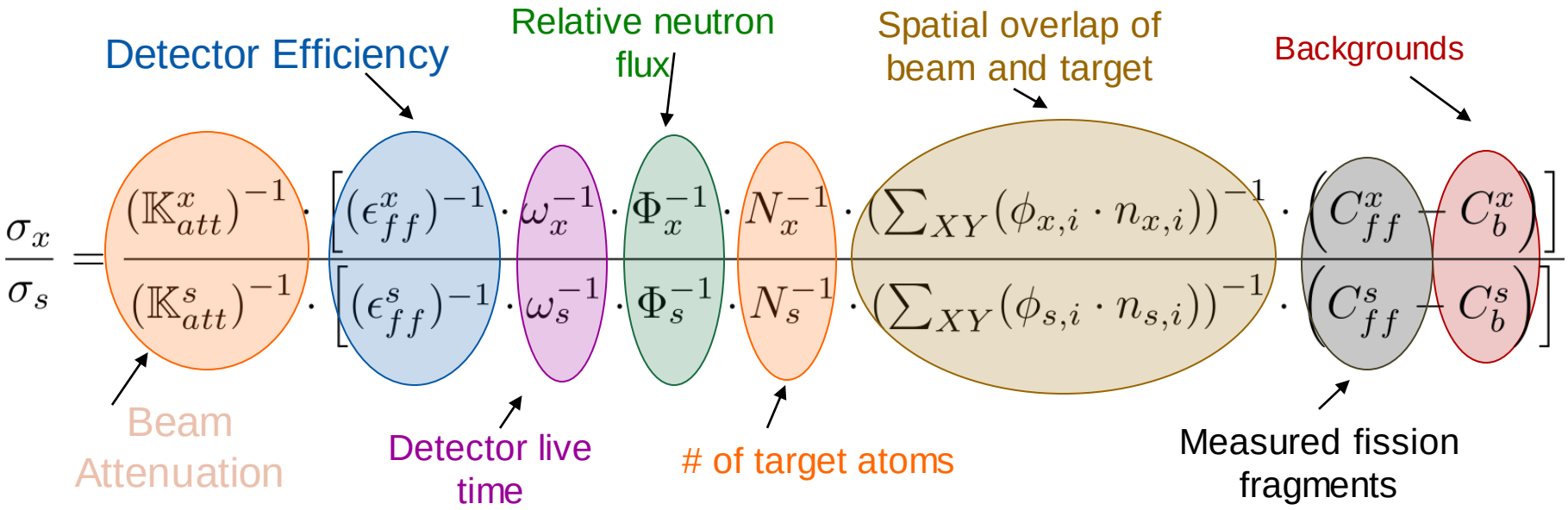
- FissionTPC operates on same basic principles
- Full 3D particle track reconstruction for a more detailed analysis of uncertainties



Measurment uncertainties

- A variety of terms contribute to a cross section ratio
- The fissionTPC was designed to address each of these in detail and achieve sub 1% accuracy
- Fission chamber measurements attempt to minimize the corrections and/or have them drop out in ratio, achieving 2-5% accuracy



Operational Complexity
Fission Chamber vs. FissionTPC

- 2 – 6 channels
- Basic data acquisition system with off-the-shelf components
- A few days to few weeks of data collection
- A relatively straightforward data analysis

- 6k channels of custom electronics
- 3 kW power, large equipment footprint
- Extended setup and data collection time
- Specialized knowledge in operation and data analysis

Facilities: LANSCE, Lujan, TUNL, Ohio...
FissionTPC footprint could present a challenge

Cost Analysis

TPC

Task	FY24 $k	FY25 $k	Total $k
Target Prod.	50	0	50
DAQ Maint.	25	25	50
Code Maint.	25	25	50
Data Collection	260	0	260
Data Analysis	530	670	1200
Total Cost	890	720	1610

FC

Task	FY24 $k	FY25 $k	Total $k
Target Prod.	50	0	50
Data Collection	55	0	55
Data Analysis	375	375	750
Total Cost	480	375	855

Conclusions
Fission Chamber vs. FissionTPC

- Clear that a fission chamber is cheaper and easier
- Will another fission chamber measurement help improve the evaluation?
  - Shared systematic uncertainties, highly correlated with previous measurements
  - Would need to work hard to get uncertainties at 2% or lower if possible, to have a meaningful impact

Targeted monoenergetic FC measurement w/

Both FC and TPC at TUNL & LANSCE (Lujan)

A careful target characterization normalization measurement is essential!

Recommendations:
- Make a target now that will fit both FC and fissionTPC and characterize it *an entirely different experiment(s)!*
- Conduct a mock evaluation to guide your choice