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Fission yield activities at Uppsala University

V.D. Simutkin

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Projects Overview

1) Neutron-induced fission fragment mass yields in experiments with Frisch-grid ionization chambers:

1. Measurement of fission fragment mass yields of ^{232}Th and ^{238}U at incident neutron energy from 10 to 60 MeV (Khlopin Radium Institute, St.Petersburg and Uppsala University).
2. Studies of the ^{234}U(n,f) reaction at energies up to 5 MeV (IRMM JRC and Uppsala University)

2) Independent fission product yield measurements for various actinides at IGISOL (Uppsala University and University of Jyväskylä)

3) Integration of GEF and TALYS (A. Koning, K.-H. Schmidt, Uppsala University, PNPI, Gatchina, St.Petersburg)

Neutron-induced FF mass yields of ^{232}Th and ^{238}U

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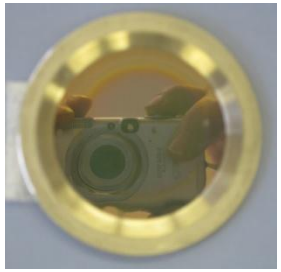
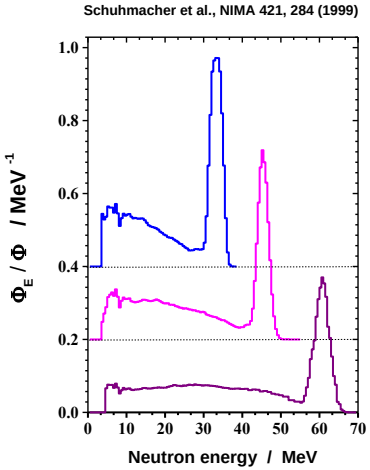
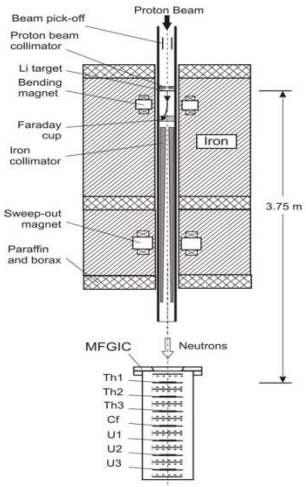


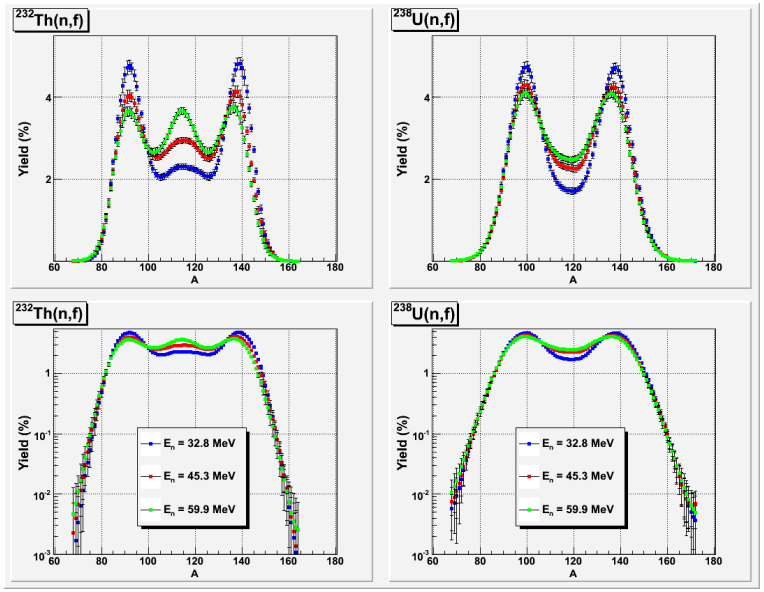
Method: 2E-method

Instrument: multi-section Frisch-grid ionization chamber

Neutron source: quasi-monoenergetic with peak energies 33, 45, 60 MeV, Louvain-la-Neuve.







Details of the experiment and results at 33, 45 and 60 MeV: Ryzhov et al., PRC 83, 054603 (2011)

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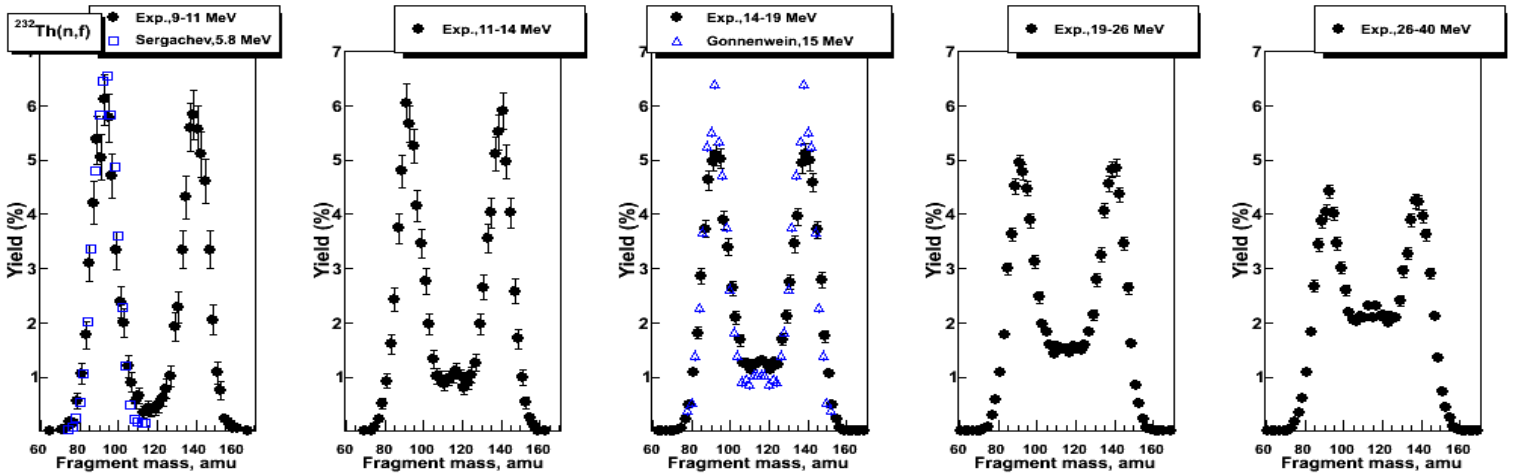
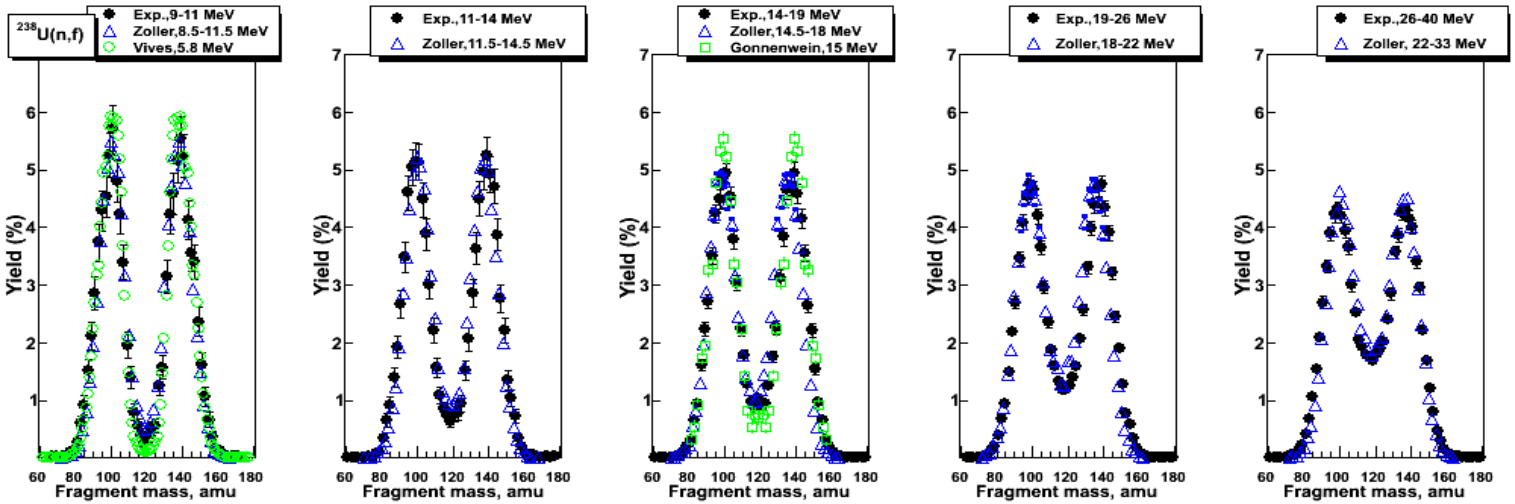
Experimental results



A.I. Sergachev et al., Yadernaya Fizika 7(4), 778 (1968)
F. Gönnenwein, E. Pfeiffer, Zeitschrift für Physik 207(3), 209 (1967)



C.M. Zöller, TH Darmstadt, PhD Thesis (1995)
F. Vivès et al., Nuclear Physics A662, 63 (2000)

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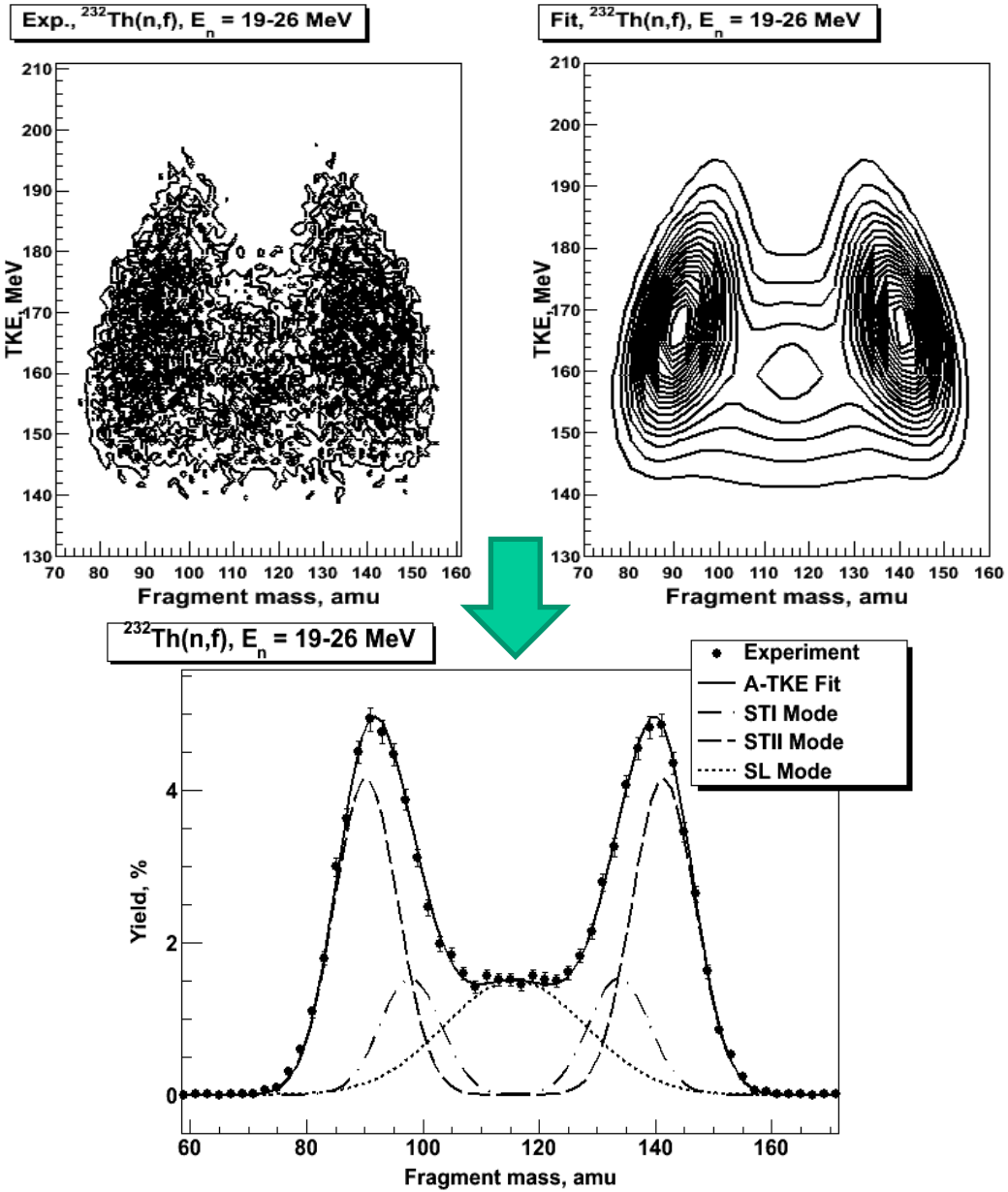
Y(M,TKE)

$$Y(M,TKE) = \sum y_c(M) \cdot y_c(TKE)$$ (S. Oberstedt et al., Nuclear Physics A644, 289 (1998))



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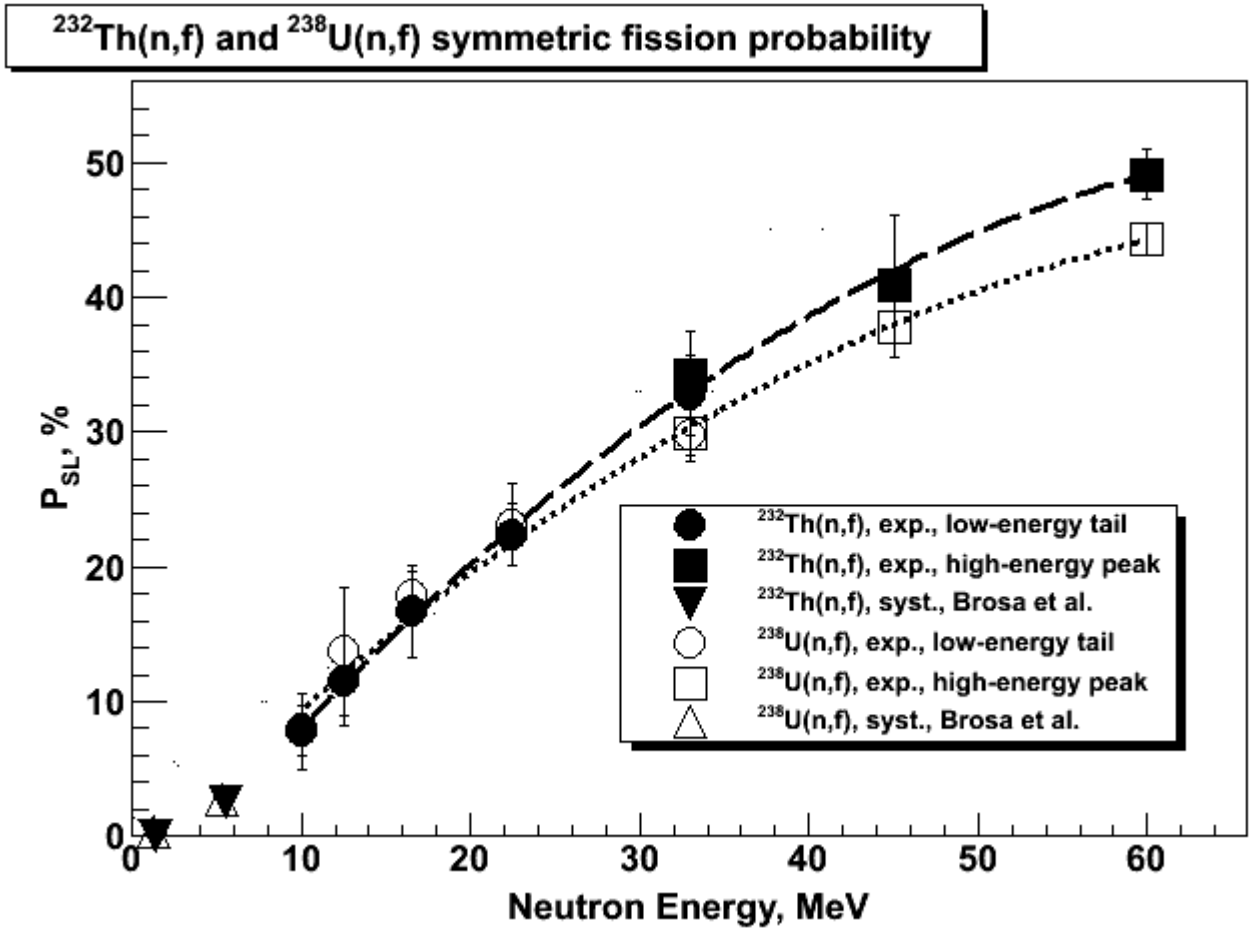
Symmetric fission probability



Fit: $P_{SL} = a + bE_n + cE_n^2$

U. Brosa et al., PRC 59(2), 767 (1999)

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Studies of neutron-induced fission of ^{234}U

Thorium-Uranium cycle

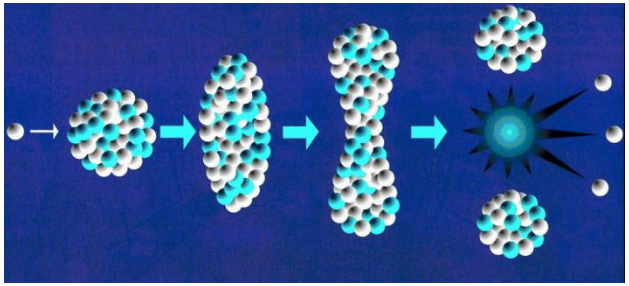
Waste management

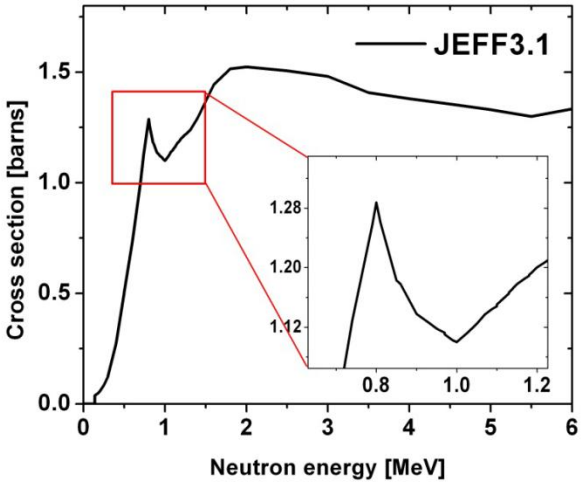
^{234}U(n,f)

Fission modelling

Second-chance fission ^{235}U(n,f)

E_n>6 MeV





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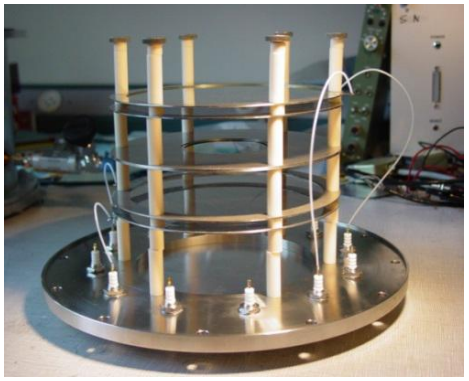
Experiment

Van de Graaff accelerator:

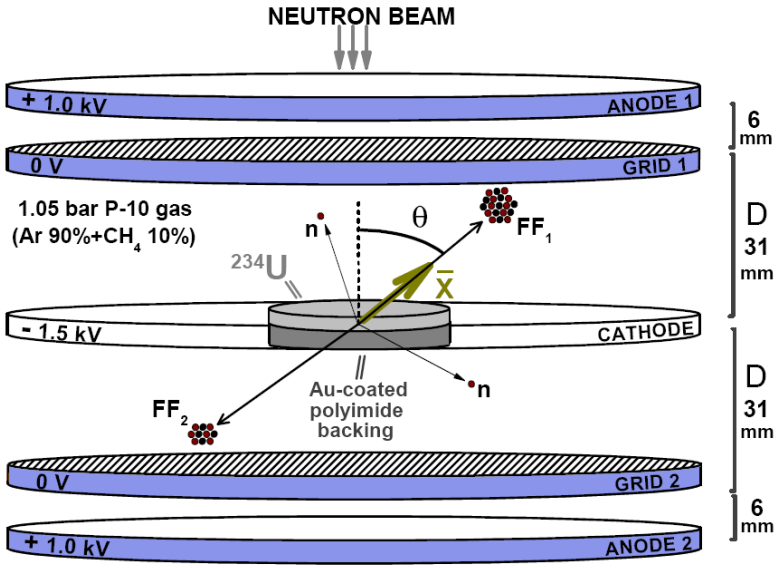
7 MV Quasi Mono-energetic

Twin Frisch-grid ionization chamber



Energy

Angle



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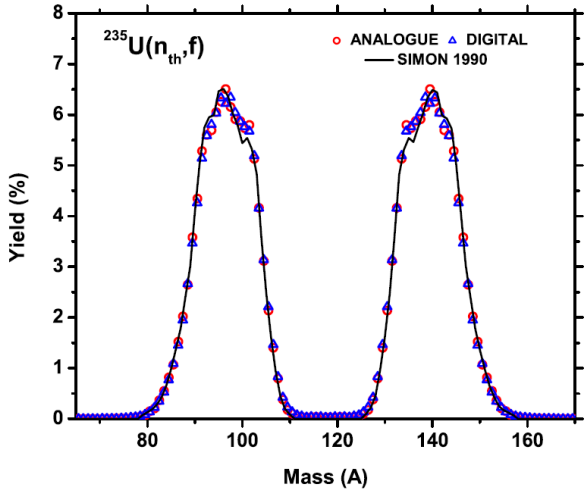
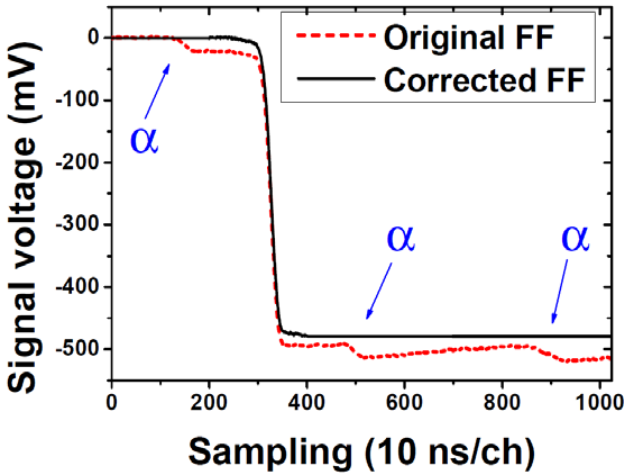
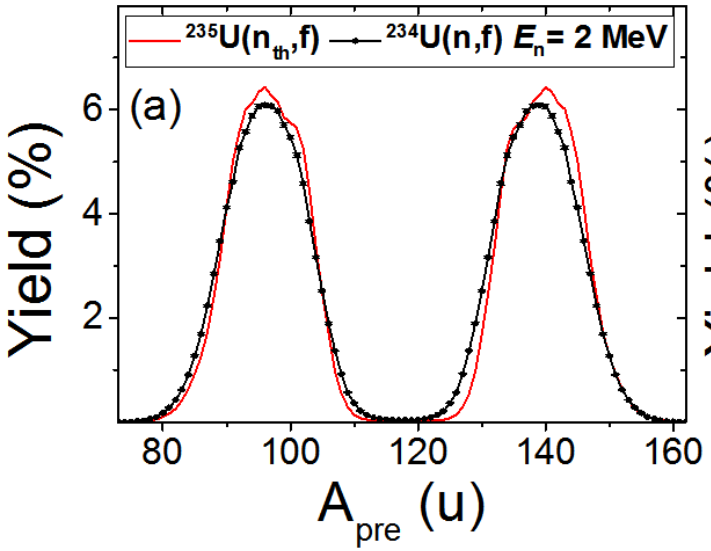
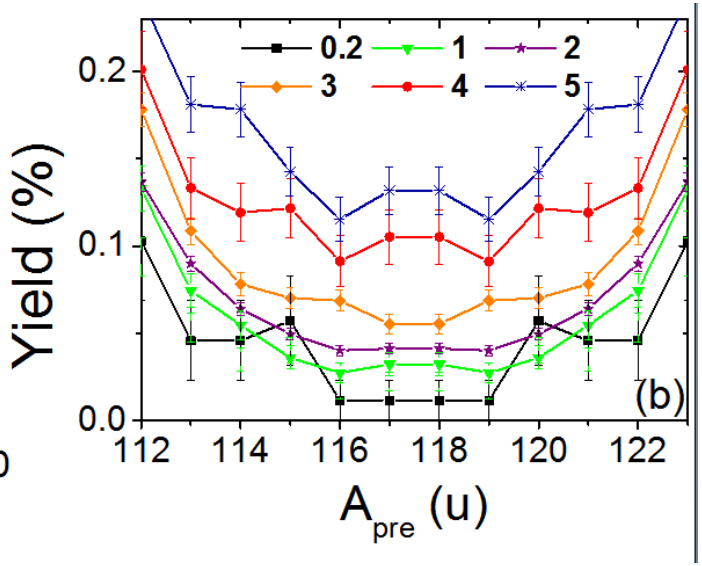
Results (1)









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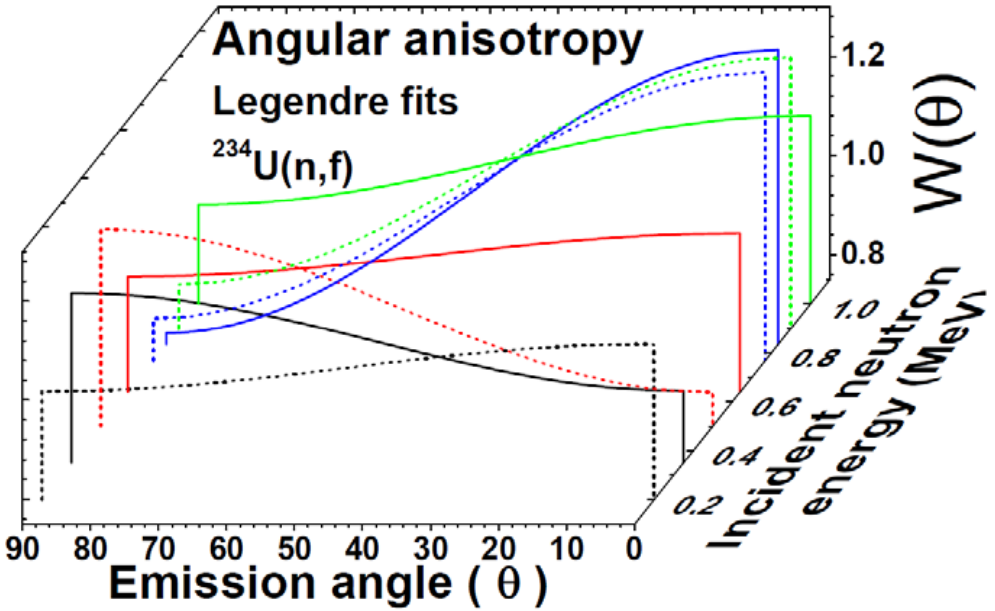
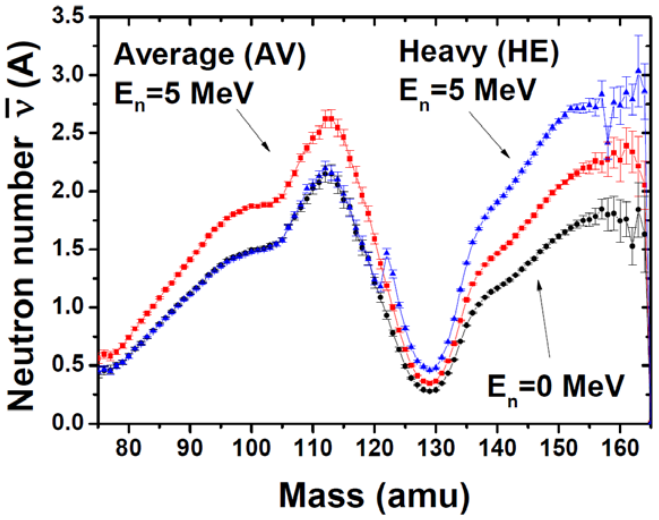
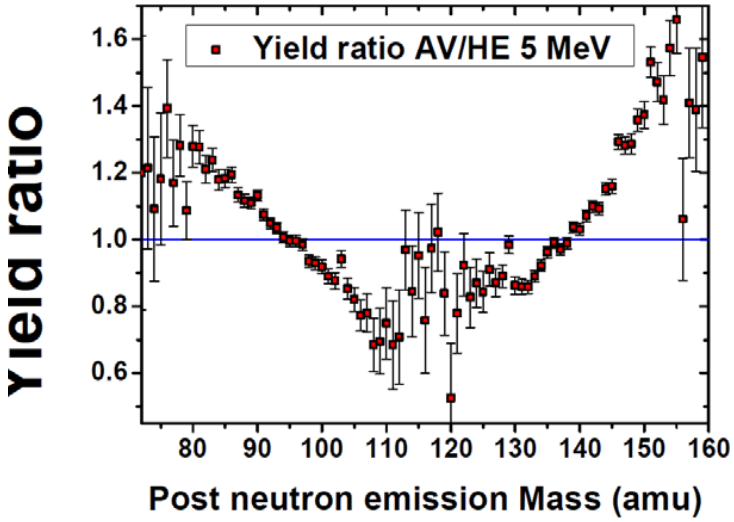
Results (2)







Ali Al-Adili: PhD thesis

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JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

Accurate FissiOn data for Nuclear Safety (AIFONS)

A. Solders[1], D. Gorelov[2], A. Jokinen[2], V.S. Kolhinen[2], M. Lantz[1], A. Mattera[1], H. Penttilä[2], S. Pomp[1], V. Rakopoulos[1] and S. Rinta-Antila[2]

[1] Uppsala University, Div. of applied nuclear physics, Sweden
[2] University of Jyväskylä, Dept. of physics, Finland

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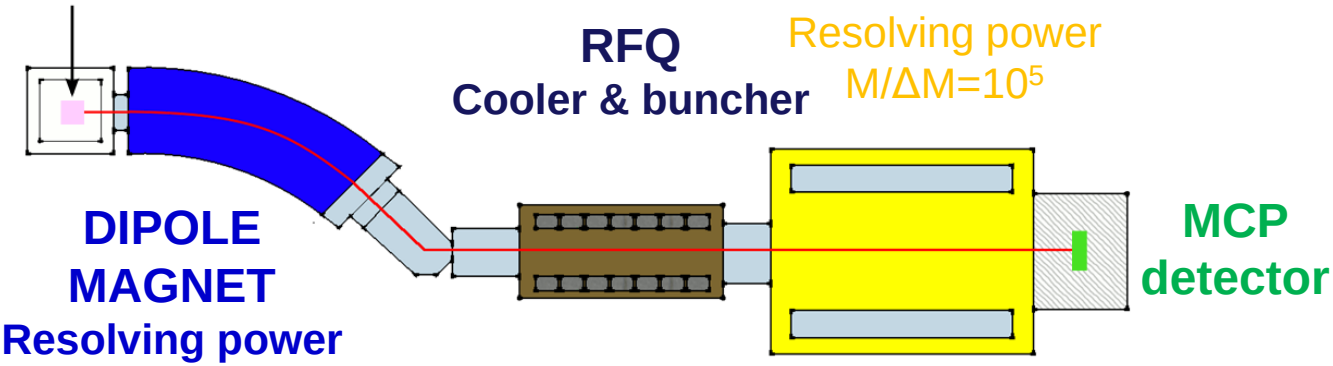
Measurement technique: IGISOL-JYFLTRAP

Cyclotron beam

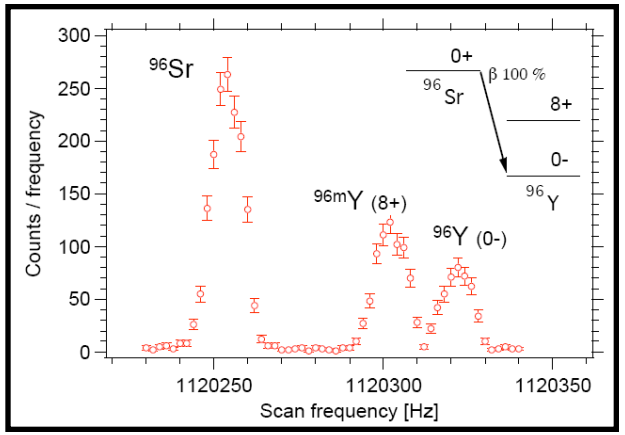


RFQ
Cooler & buncher

JYFLTRAP
Resolving power
$M/\Delta M=10^5$

DIPOLE MAGNET
Resolving power
$M/\Delta M=500$

MCP detector



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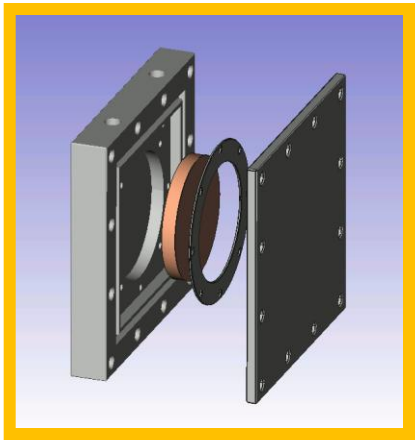
The neutron converter



- Flexible design
- 10^{12} high energy neutrons/s
- Moderated and fast reactor-like spectra
- Be or W
- Cooling
- Hydrogen build up
- Activation

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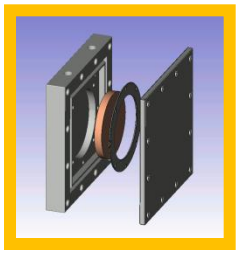
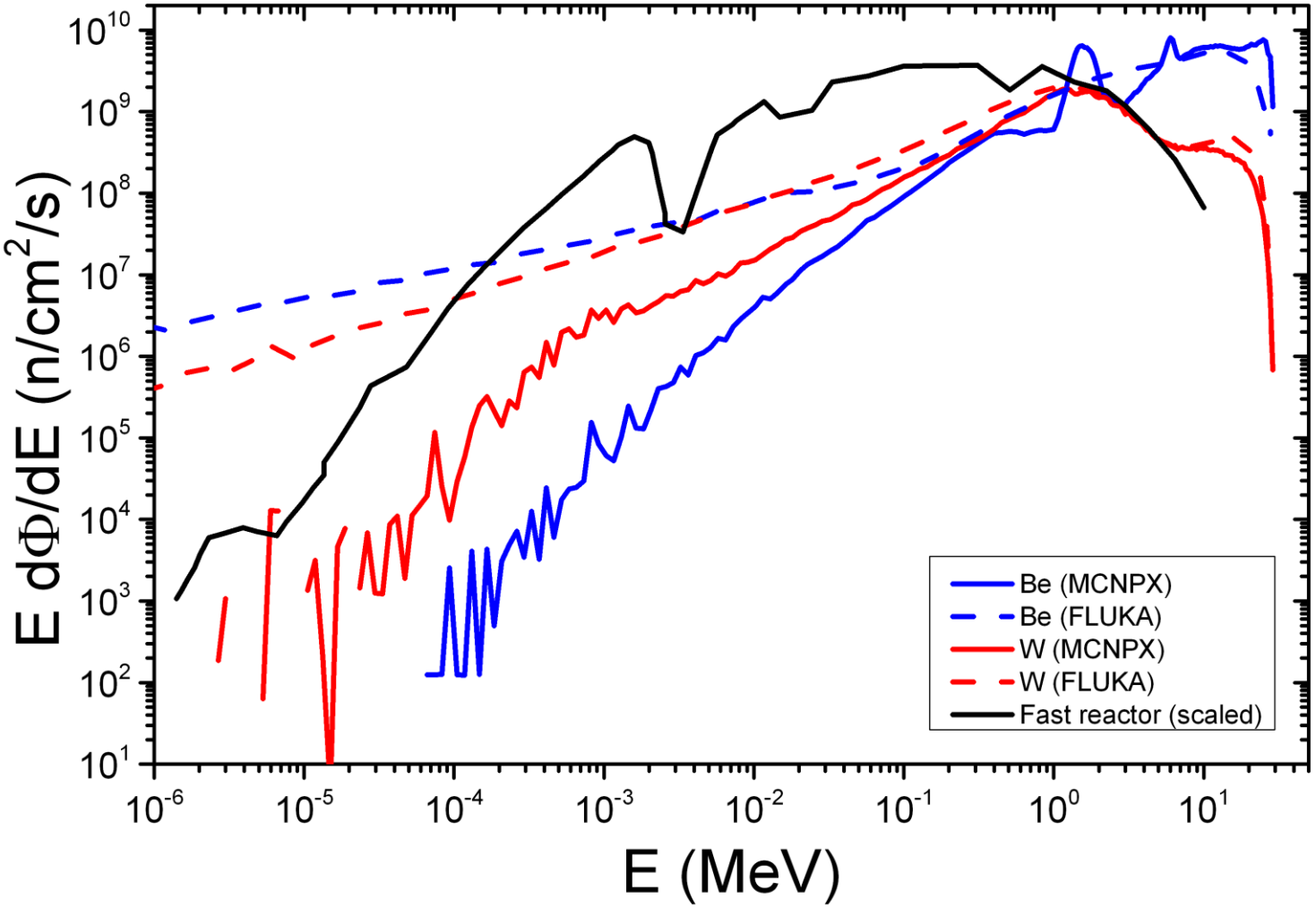
Simulated spectra (fast)





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Planed measurements

- Isomeric yield ratios

  Proton induced fission in ^{nat}U

- Neutron-induced independent fission yields of various actinides
  - ^{238}U, ^{235}U, ^{232}Th, …
  - Fast reactor-like spectra
  - Thermal reactor-like spectra
  - Energy dependence (thin and thick target)
  - Isomeric yield ratios

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TALYS and GEF integration

TALYS:

- Various fission models
- A need for better fission yield models

GEF:

- Good fission yield model
- Takes the fissioning system as the starting point

  (Multi-chance fission model has been added to GEF)

Objective: to integrate GEF fission yield model and TALYS to use the strengths of the both codes

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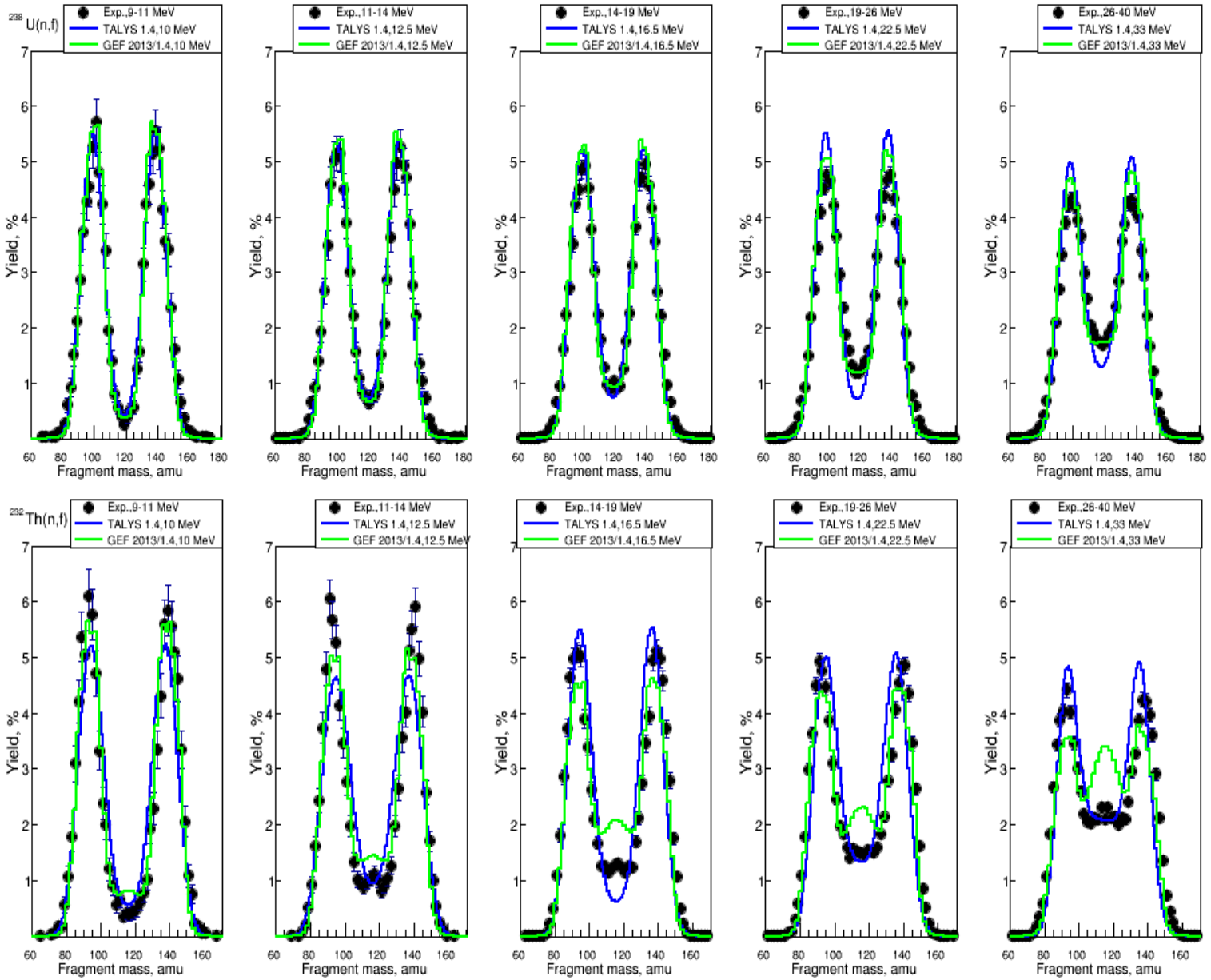
TALYS and GEF integration



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Thank you for your attention!