



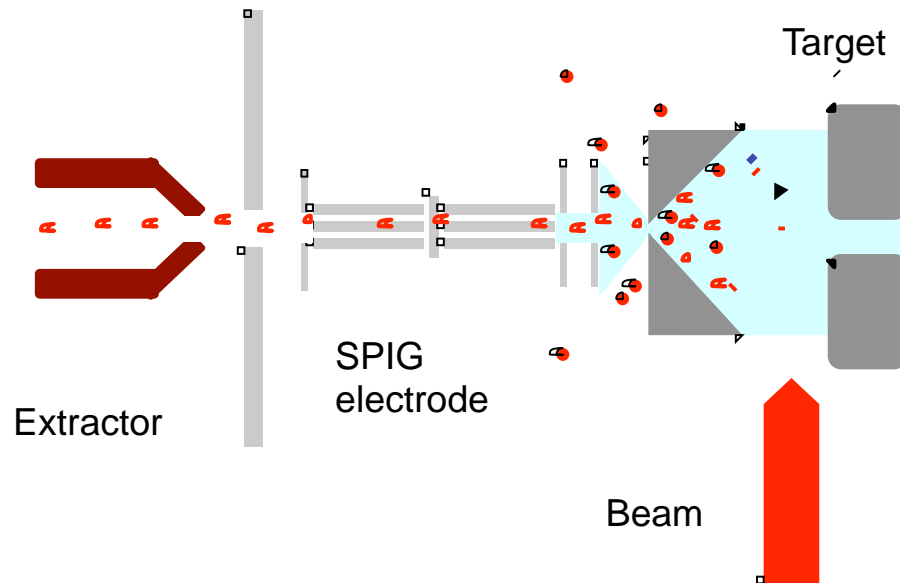
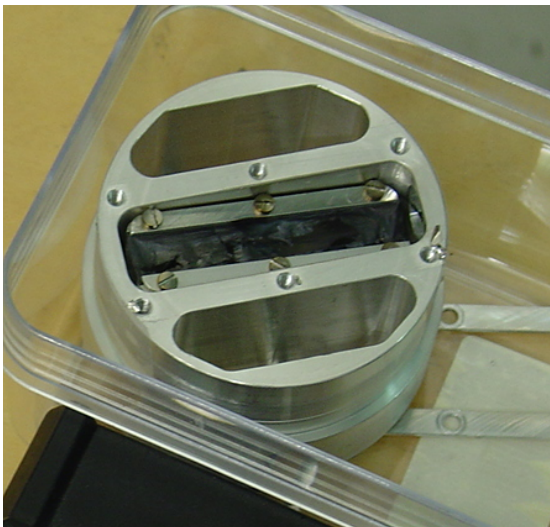
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# **Fission Yields Measurements at IGISOL-4**

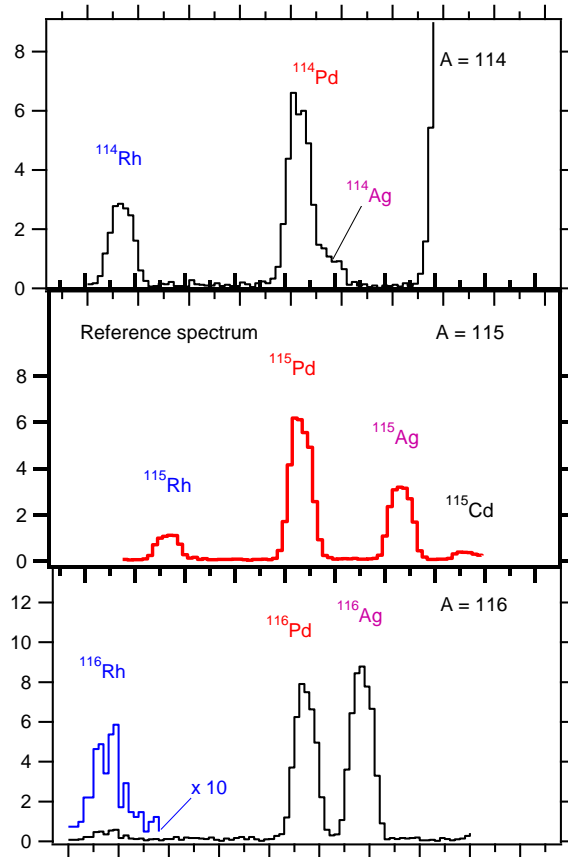
H. Penttilä, for the IGISOL group & collaborations

# Short recall: fission ion guide technique

- Based on survival of primary ions from nuclear reaction in helium buffer gas
  - Fast extraction of ions is required to prevent neutralisation
  - Charge state concentration: (0), +1, (+2)
  - Ion formation independent of chemistry**
  - Produces ions of any element
  - Millisecond time scale
  - Very small decay losses
- All ions come **directly from fission**
  - Ion rate corresponds to the independent fission yield - no\*) accumulation effects
  - No gaps in the systematic studies
  - Study the most neutron rich nuclei produced in the fission (isobaric background usually sets the limit)

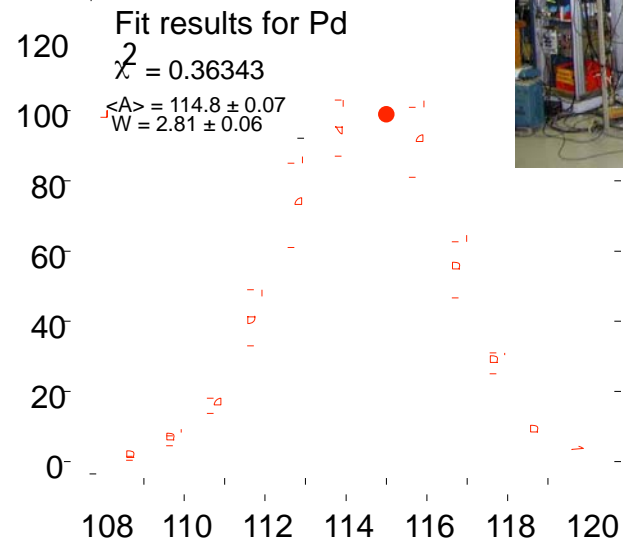


# Fission yields with a Penning trap



Based on **unambiguous identification** of isotopes by their **mass only**.

- No further knowledge on e.g. decay is needed
- Fast
- Yield of long-lived and stable isotopes can be determined

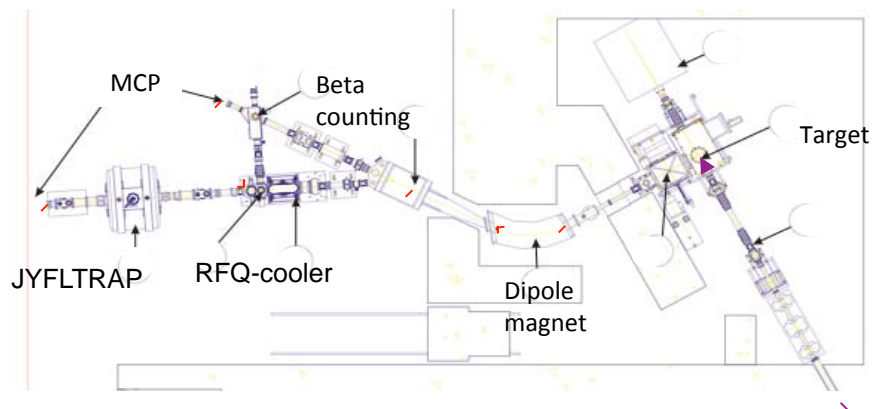


Eur. Phys. J. Special Topics 150 (2007) 317  
 Nucl. Instr. and Meth. A 576 (2007) 371  
 Eur. Phys. J. A 44 (2010) 140  
 Eur. Phys. J. A 48 (2012) 43

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# From IGISOL-3

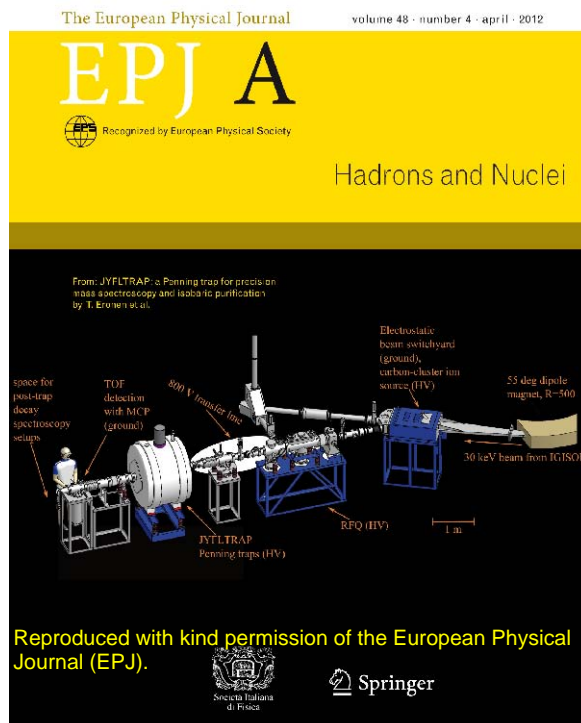
to IGISOL-4



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## From IGISOL-3

to IGISOL-4

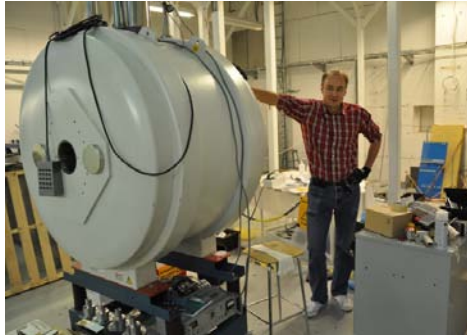


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## From IGISOL-3

\* Dec 3, 2003  
† June 29, 2010

to IGISOL-4



The European Physical Journal volume 48 · number 4 · april · 2012

# EPJ A

Recognized by European Physical Society

## Hadrons and Nuclei

From JYFLTRAP: a Penning trap for precision mass spectroscopy and isobaric purification by T. Eronen et al.

Space for ISOL-trap decay spectroscopy setups

TOF detection with MCP (ground)

800 V transfer line

Electrostatic beam switchyard (ground), carbon-cluster ion source (HV)

55 deg dipole magnet, R=500

30 keV beam from IGISOL

RFQ (HV)

1 m

PNTLTRAP Penning traps (HV)

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Springer

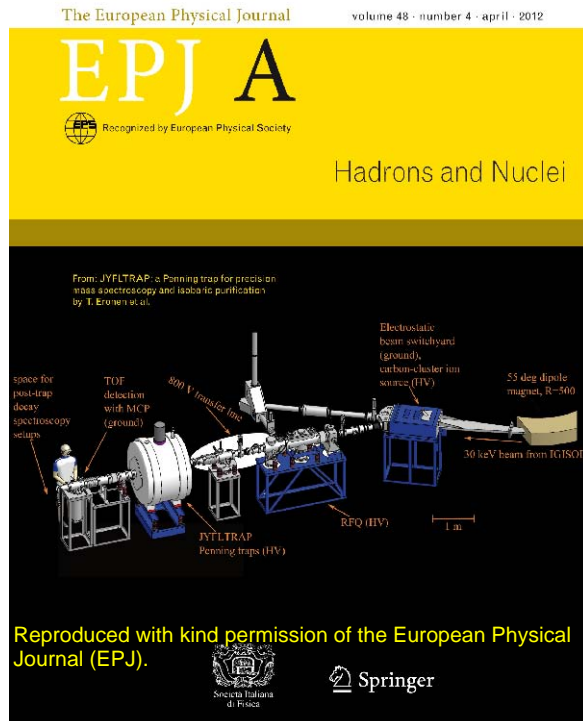
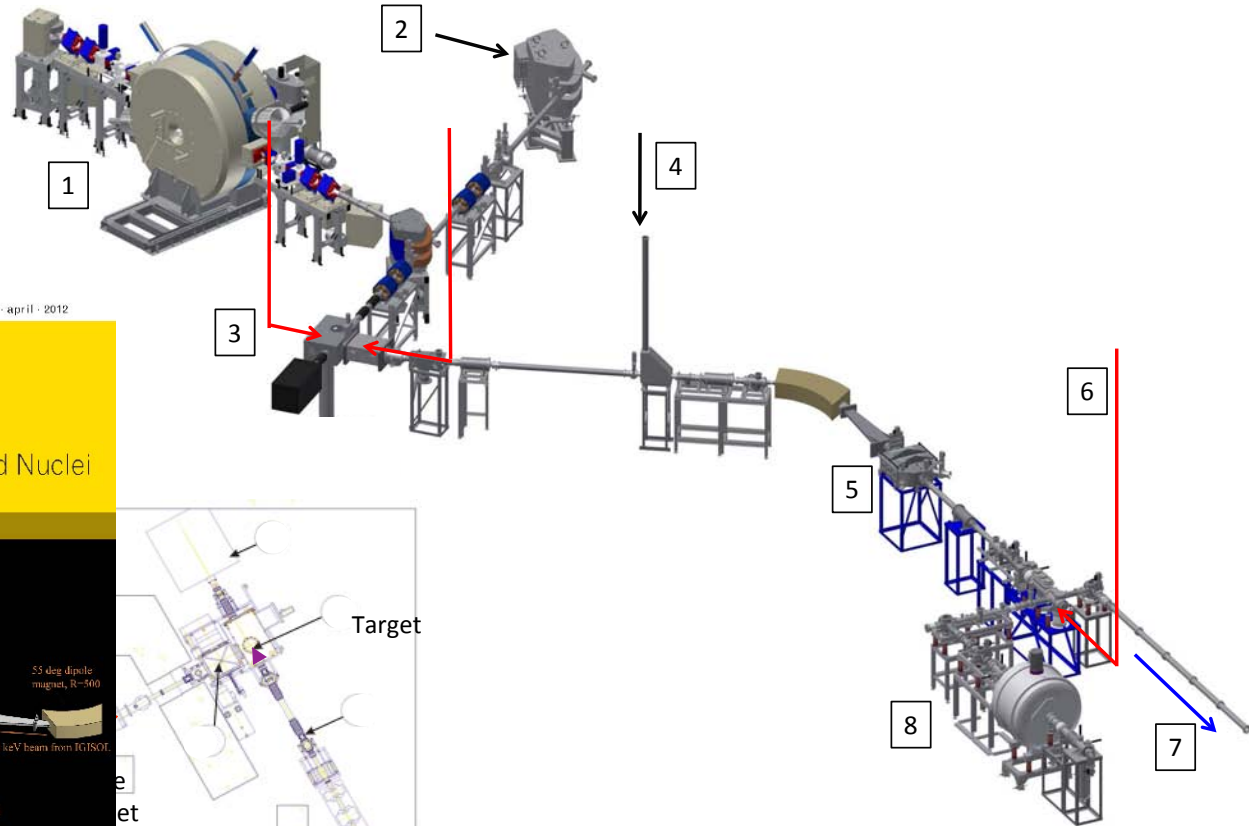
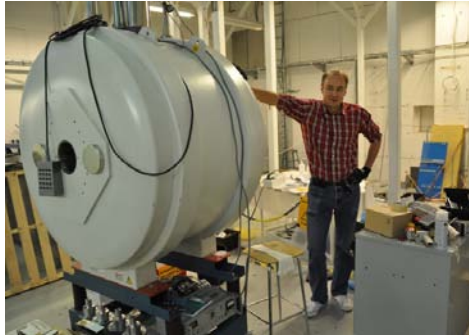


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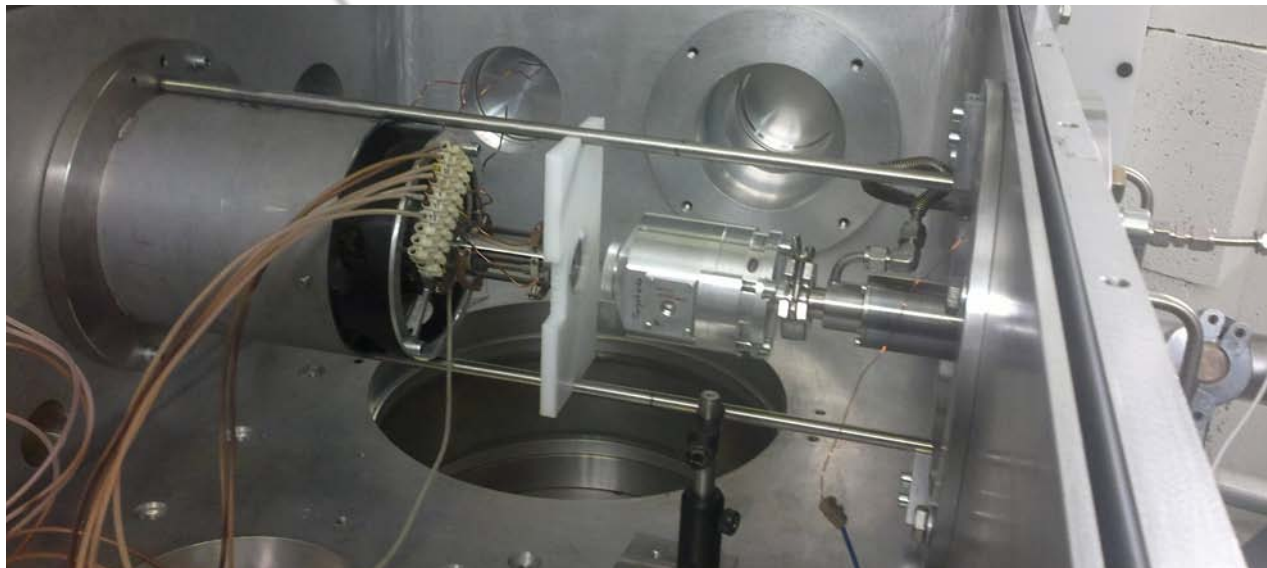
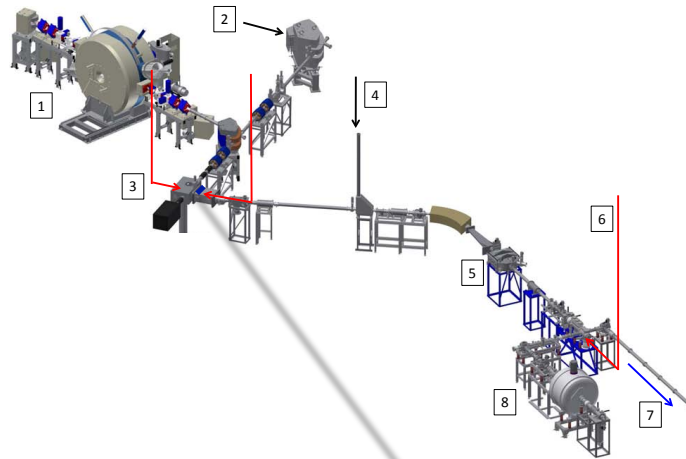
## to IGISOL-4



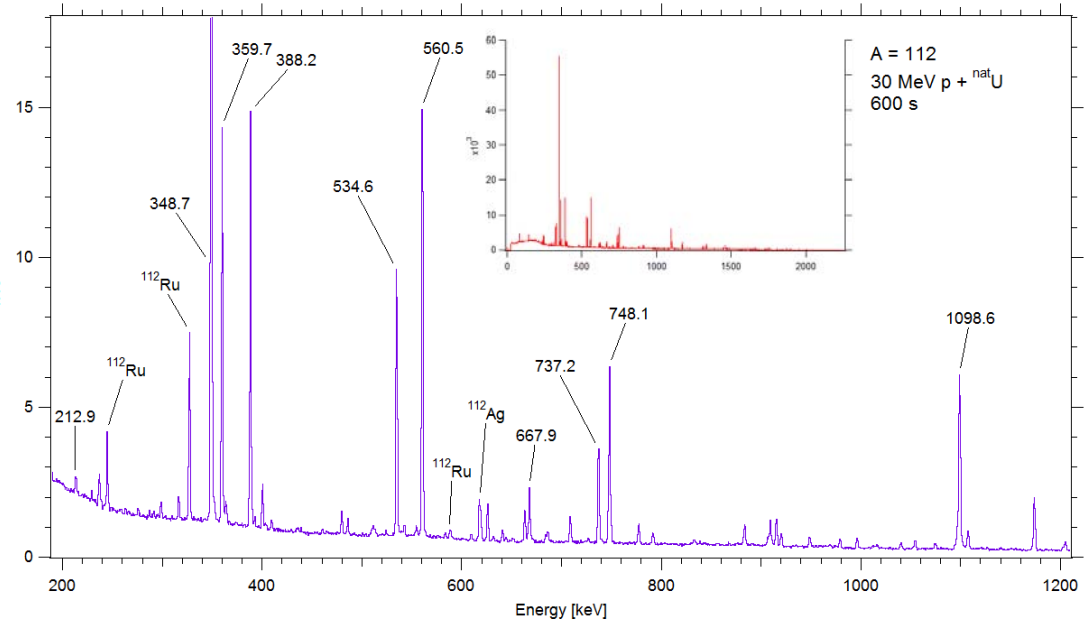
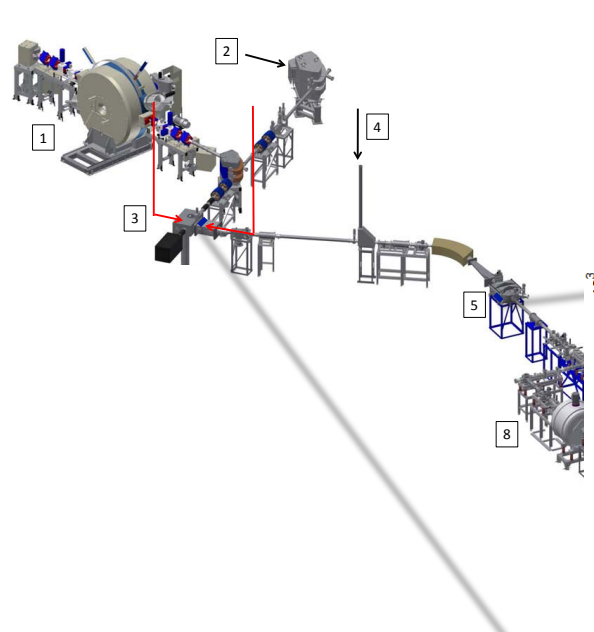
I. Moore et al, EMIS-2012

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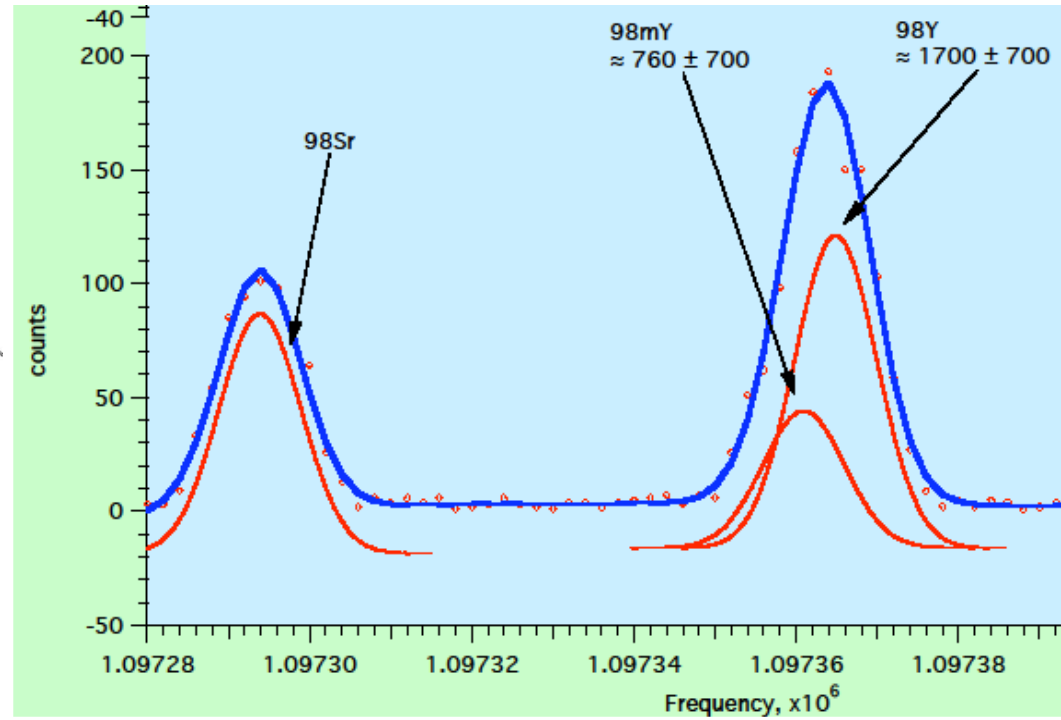
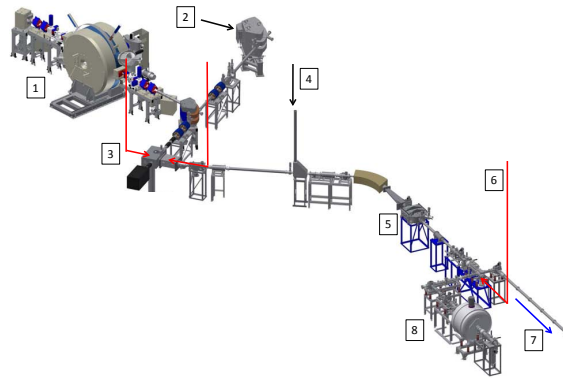
# Fission at IGISOL-4



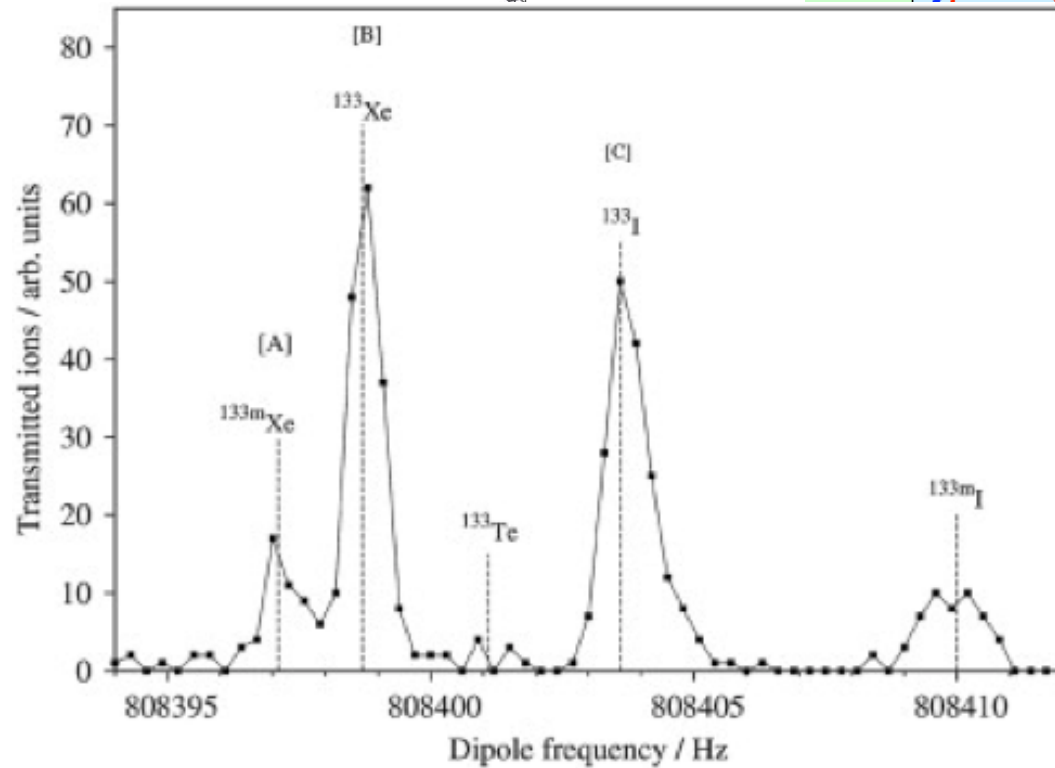
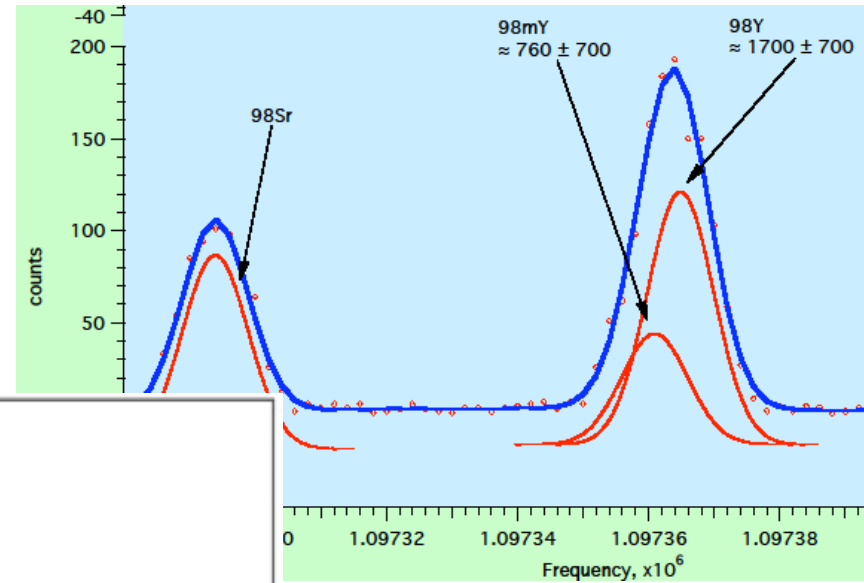
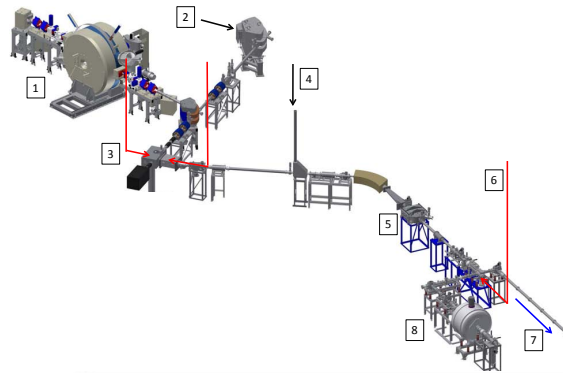
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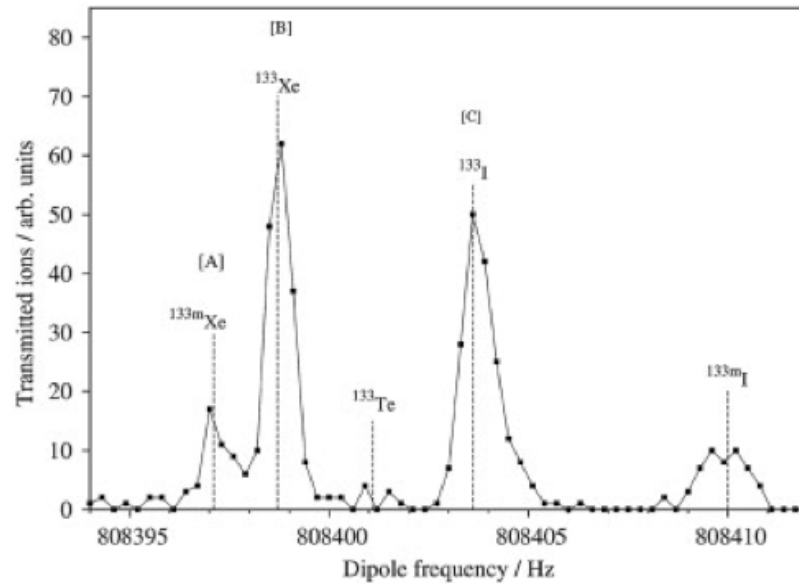
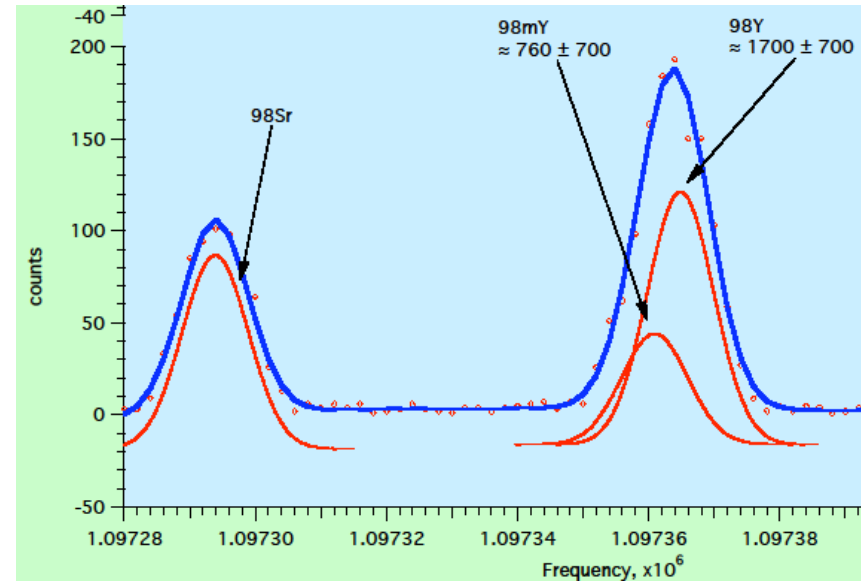
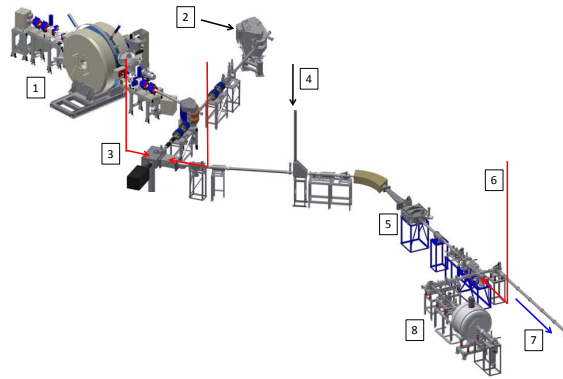
# Isomeric ratios of fission yields



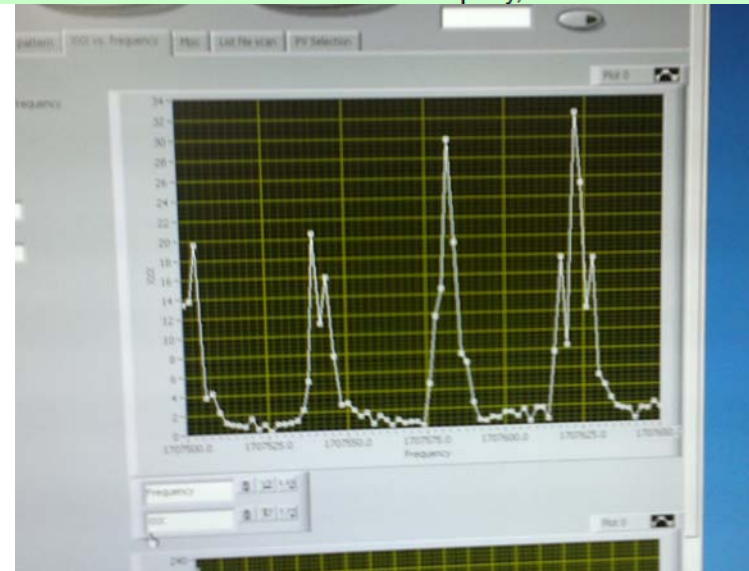
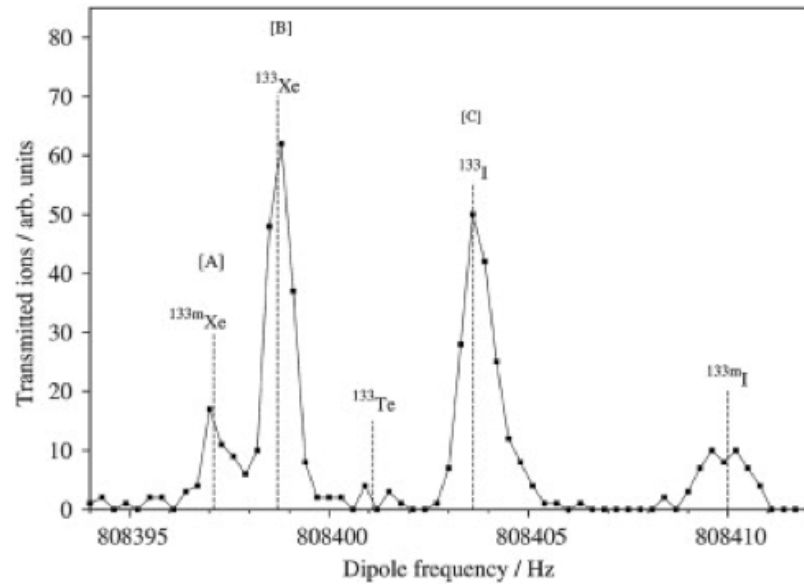
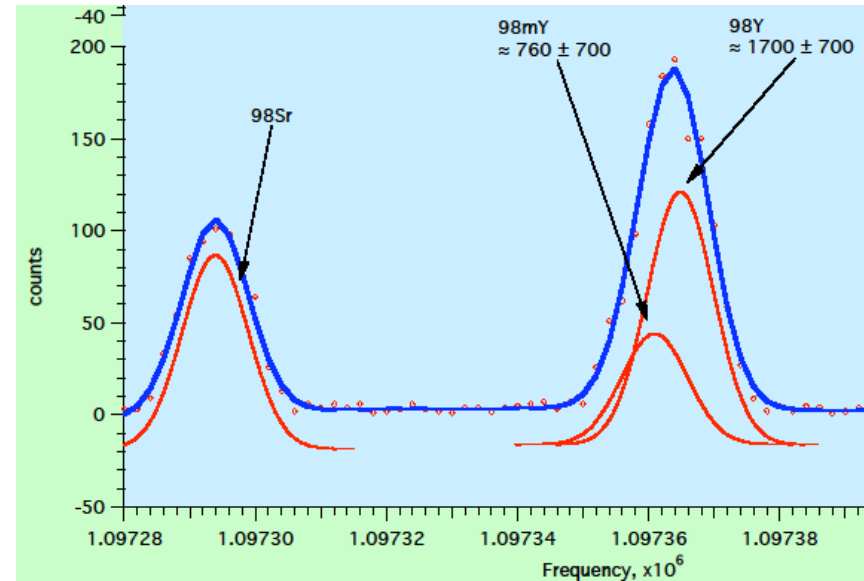
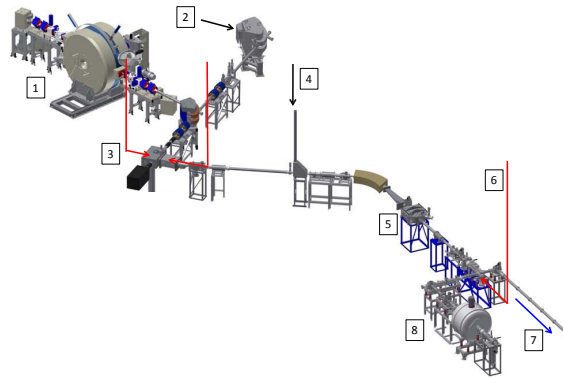
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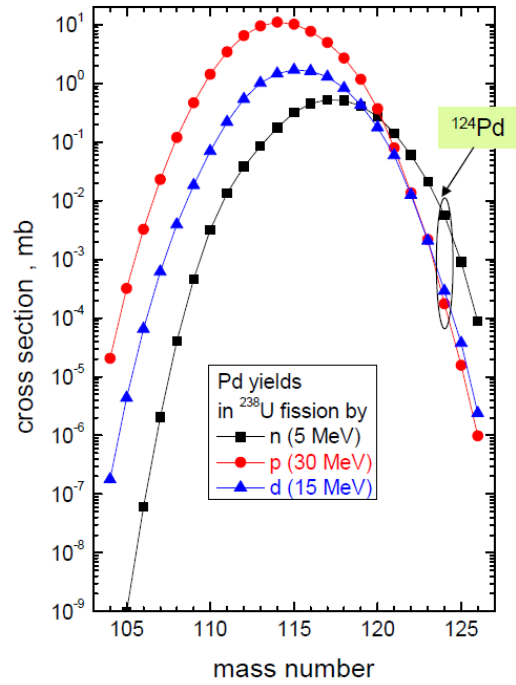
# Isomeric ratios of fission yields



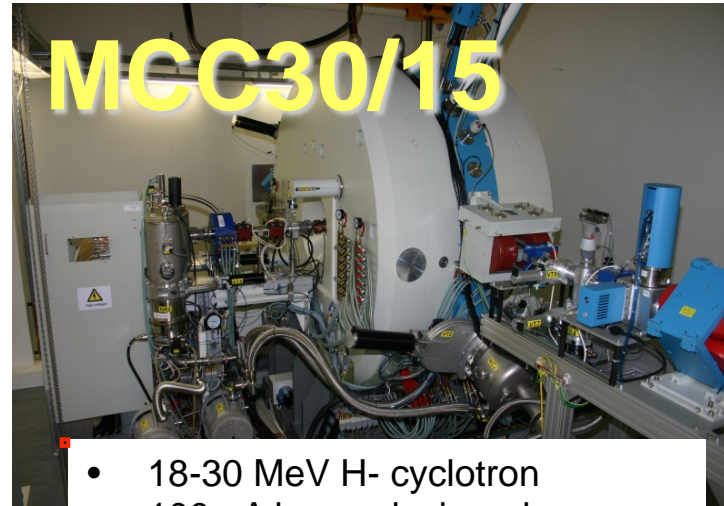
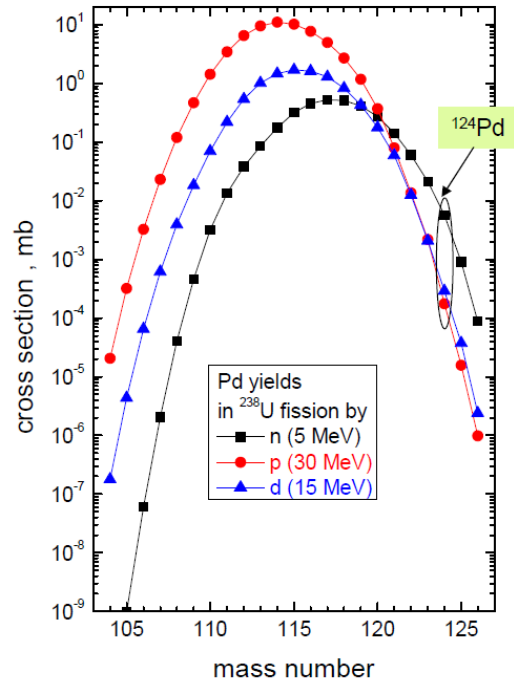
# Isomeric ratios of fission yields



# Neutron-induced fission



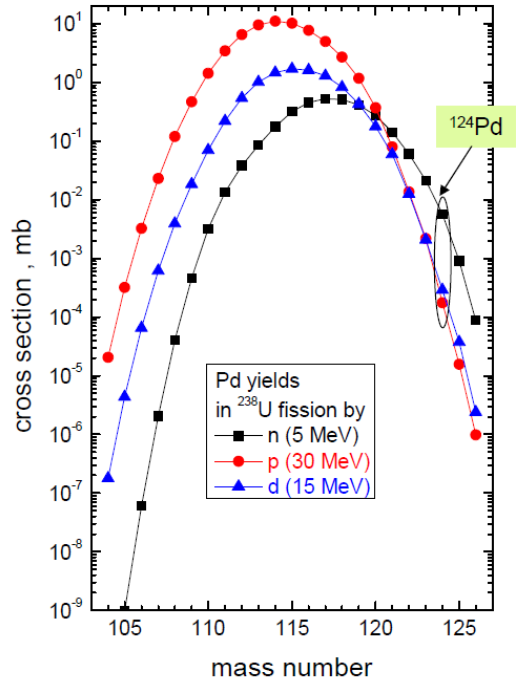
# Neutron-induced fission



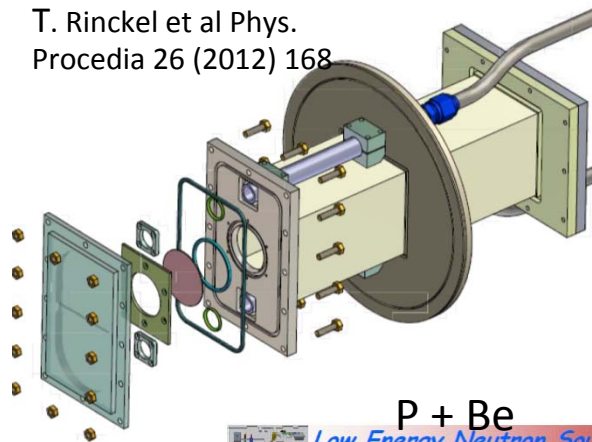
- 18-30 MeV H- cyclotron
- 100  $\mu\text{A}$  beam designed
- 220  $\mu\text{A}$  beam measured (internal)



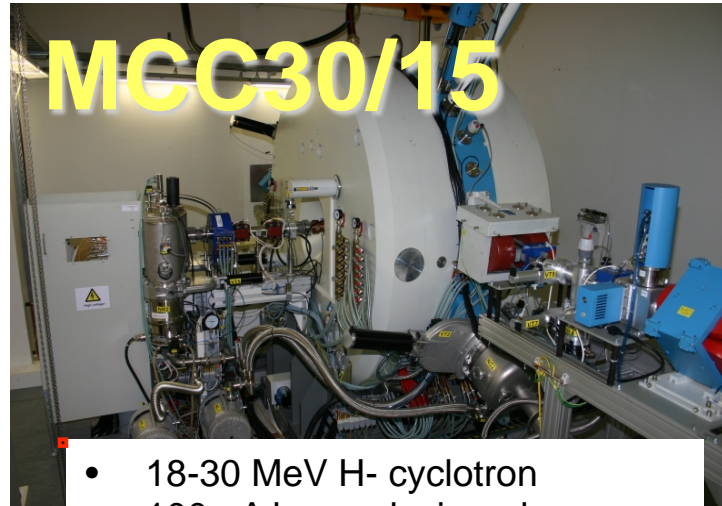
# Neutron-induced fission



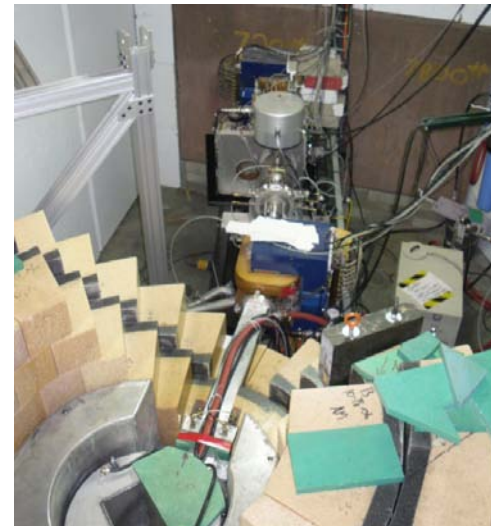
T. Rinckel et al Phys. Procedia 26 (2012) 168



**P + Be**  
**Low Energy Neutron Source**  
Center for the Exploration of Energy and Matter

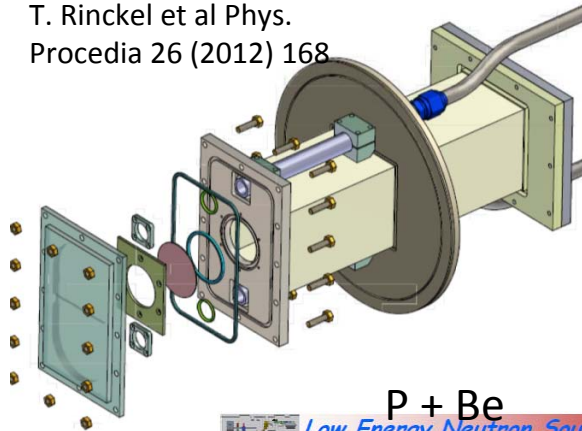


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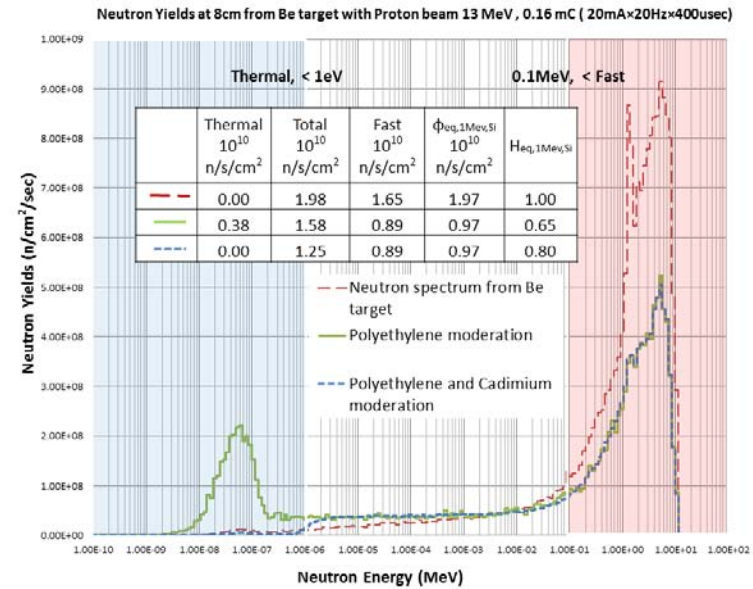


# Neutron-induced fission

T. Rinckel et al Phys.  
Procedia 26 (2012) 168

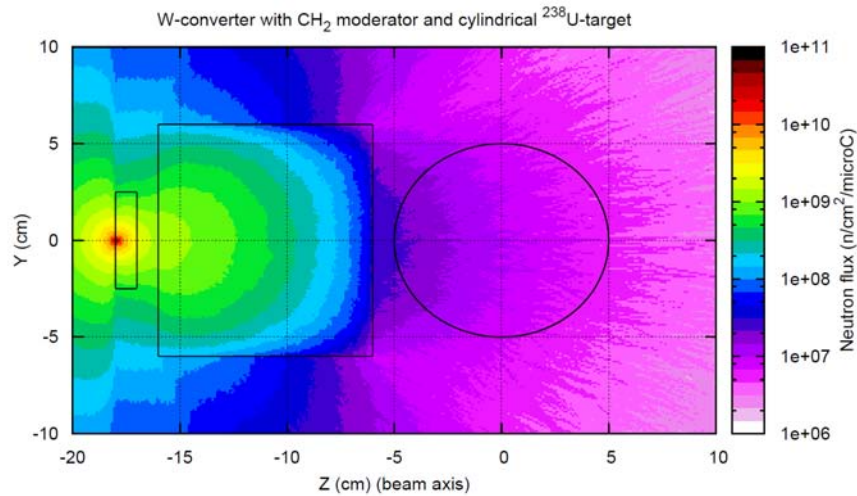
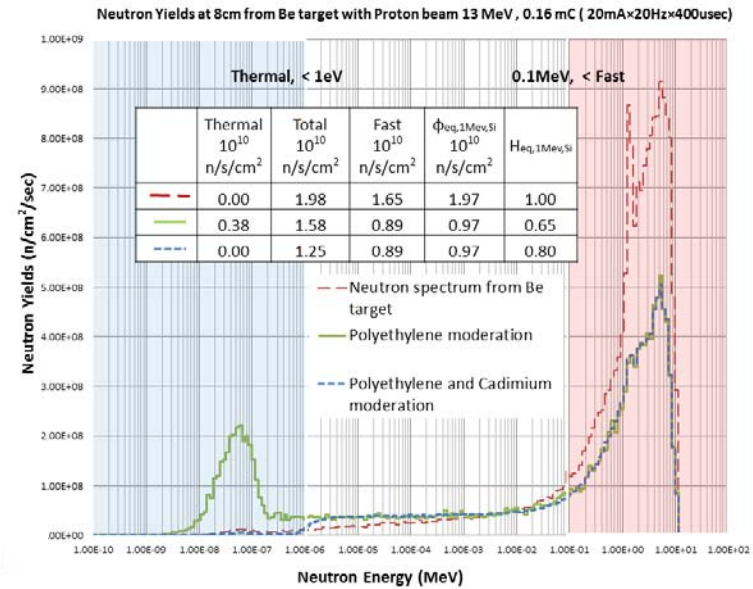
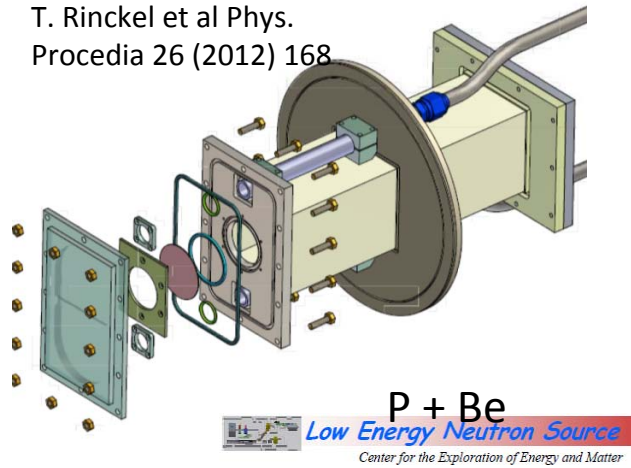


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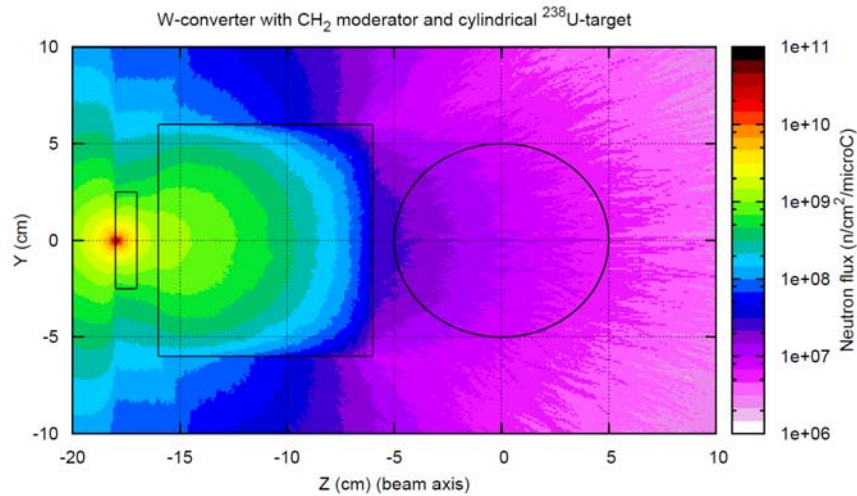
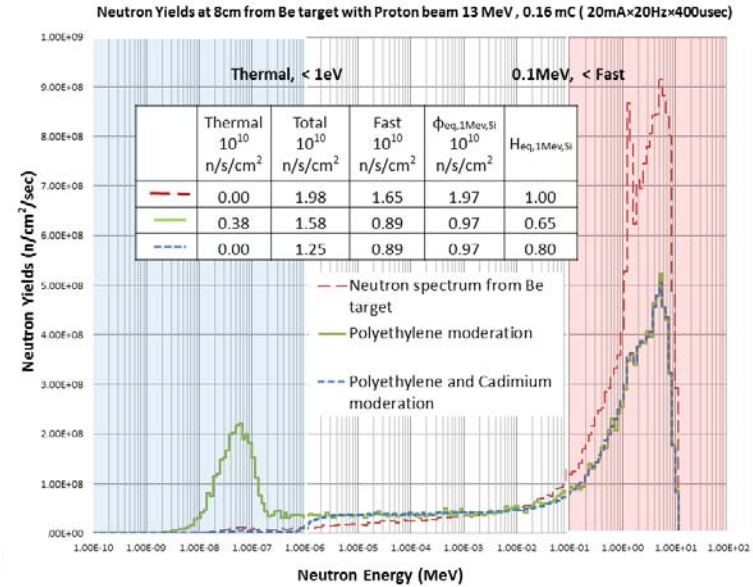
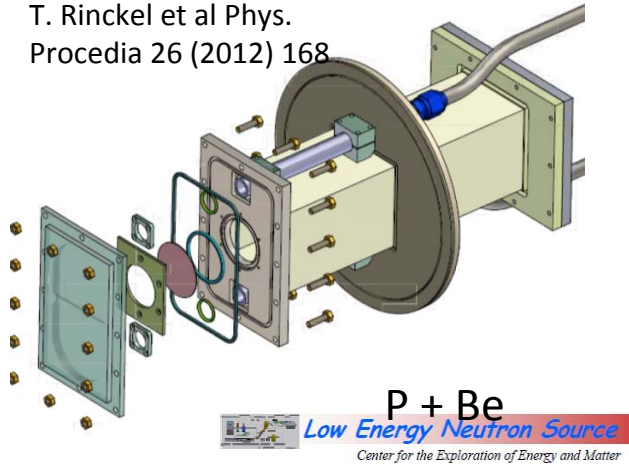
T. Rinckel et al Phys.  
Procedia 26 (2012) 168



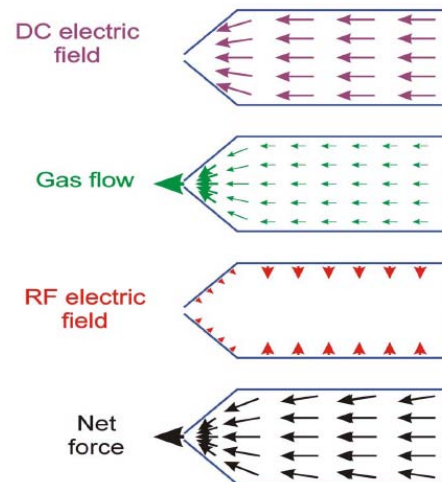
M. Lantz et al, Physica Scripta T150 (2012)

# Neutron-induced fission

T. Rinckel et al Phys. Procedia 26 (2012) 168



M. Lantz et al, Physica Scripta T150 (2012)



G. Savard,  
SMI-10 conference,  
Stanford, April  
2010

## Summary

- IGISOL-4 facility at JYFL has finally become operational
- The measured fission yield 300 atoms/( $\mu\text{C} \cdot \text{mbarn}$ )
- JYFLTRAP penning trap has sufficient performance for yield measurements

=> IGISOL ready for fission yields measurements

