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Measurements of Isomeric Yield Ratios of proton-induced fission of ^{nat}U and ^{232}Th

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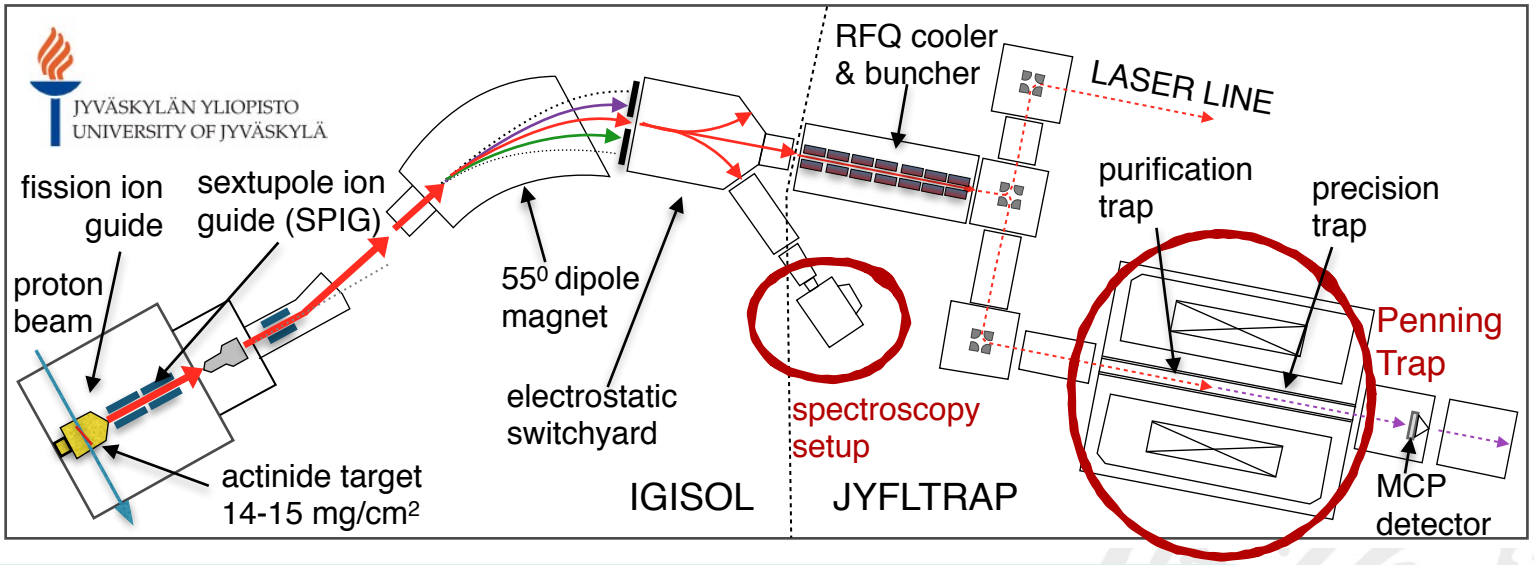
ND2016

Bruges, Belgium, 14-09-2016

Experimental Facility



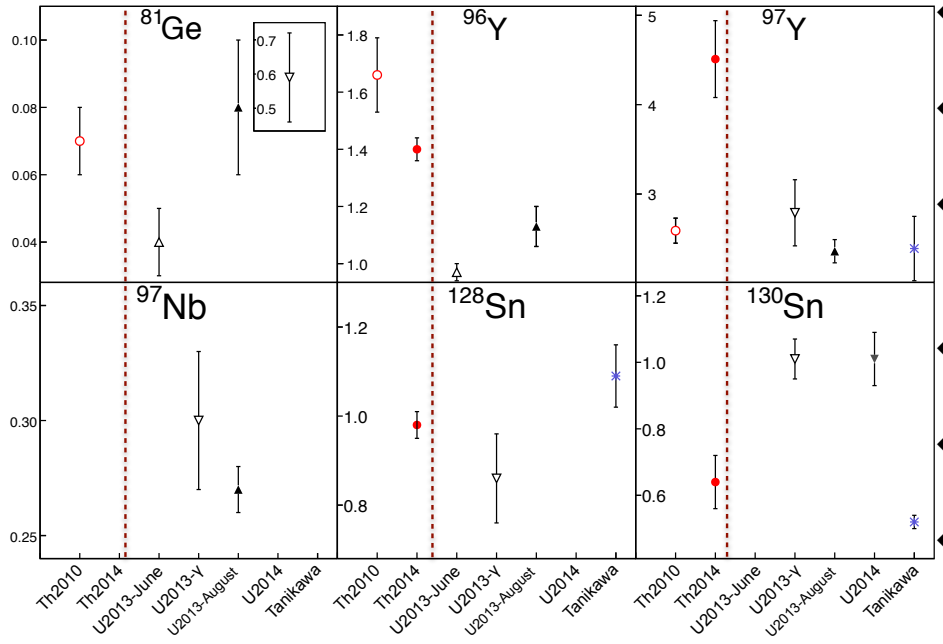
Yield ratios of fission products in 25 MeV proton-induced fission of ^{nat}U and ^{nat}Th at the IGISOL-JYFLTRAP facility in various experimental campaigns from 2010-2014 by:

(i) using the Penning Trap ➟ 1st ever measurement of IYR by means of ion counting

(ii) γ-spectroscopy

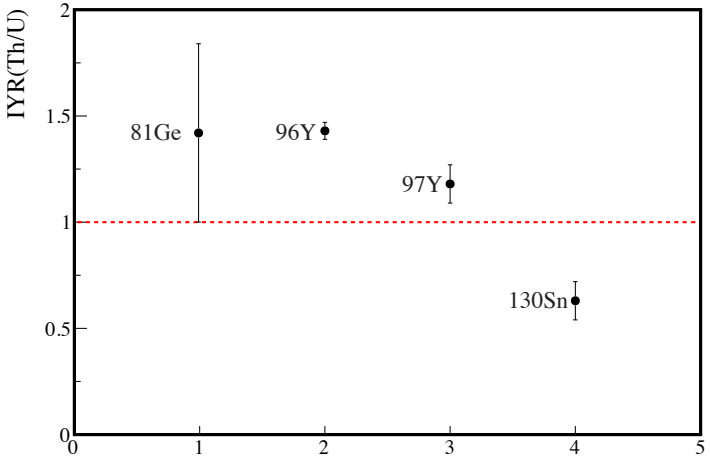
Aysto, NPA 693, 477, 2001
Moore et al., NIMB 317, 208, 2013
Kolhinen et al., NIMB 317, 506, 2013

Experimental Results



△ U - 6/2013 ▽ U - 6/2013 (γ)
▲ U - 8/2013 ▼ U - 2014
○ Th - 2010* ● Th - 2014
✳ Tanikawa†

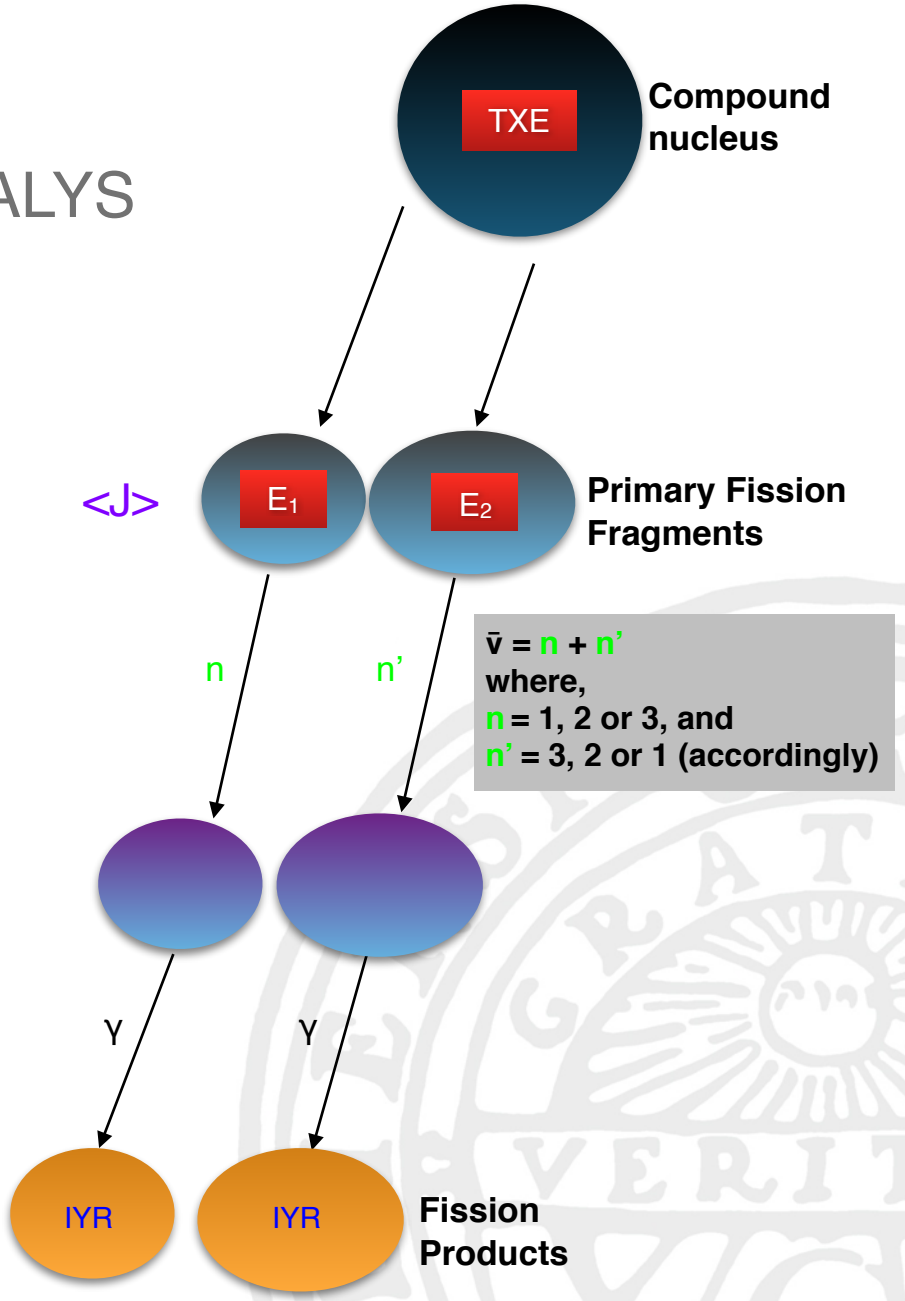
- All isomeric pairs in the Th(p,f) system were measured for the first time.
- Three pairs measured for the first time in the U(p,f) case (^{81}Ge, ^{96}Y, ^{130}Sn).
- With the *IGISOL technique* isomeric states separated a few hundreds keV from the ground state could be resolved (^{81}Ge, ^{97}Y).
- It can contribute to lower uncertainties, as it is a direct ion counting method.
- No knowledge is needed for the branching ratios of the emitted γ-rays.
- Indications of dependence on the fissioning system, more systematic studies are necessary in order to draw safe conclusions.



* performed at IGISOL-3
†Tanikawa et al, Z. Phys. A, 347,53-62, 1993

Deduction of <J> of the initial fragment using TALYS

- Using the TALYS code, the IYR of a fission product, resulting from the de-excitation of a specific initial fragment was calculated.
- By **varying** the **<J>** of the initial fragment, an iterative procedure was followed, until the **IYR as estimated by TALYS reached a good agreement with the experimental value.**
- The **excitation energy (E_1, E_2)** and the number of the **emitted neutrons (n, n')** from the initial fragment were given to the code as **parameters**.
- **1, 2 or 3 neutrons** were assumed to be **emitted** from the initial fragment.
- The **total excitation energy (TXE)** of the system was presumed to be **shared** between the initial fragments **(E_1, E_2)**, **based on the fraction** of the neutrons emitted from that fragment over **the total average number ($\bar{\nu}$)** emitted from each fissioning system.
- The **uncertainties** of the <J> as estimated from TALYS **arose from the experimentally determined IYR.**

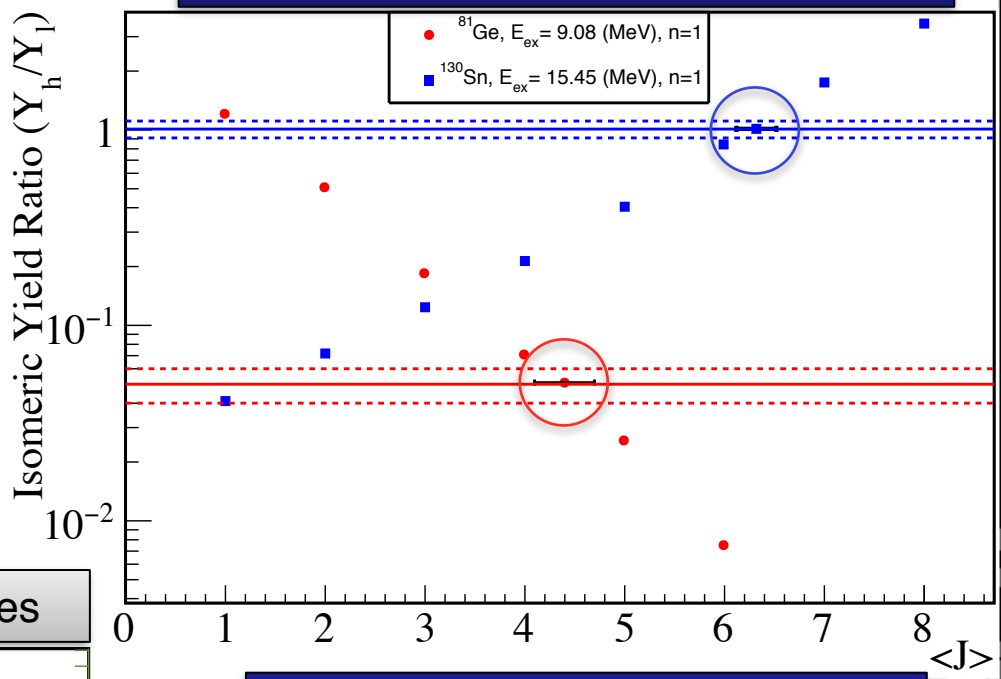


The IYR (estimated by TALYS), is compared with the experimentally determined IYR, until a good agreement of the two values is reached.

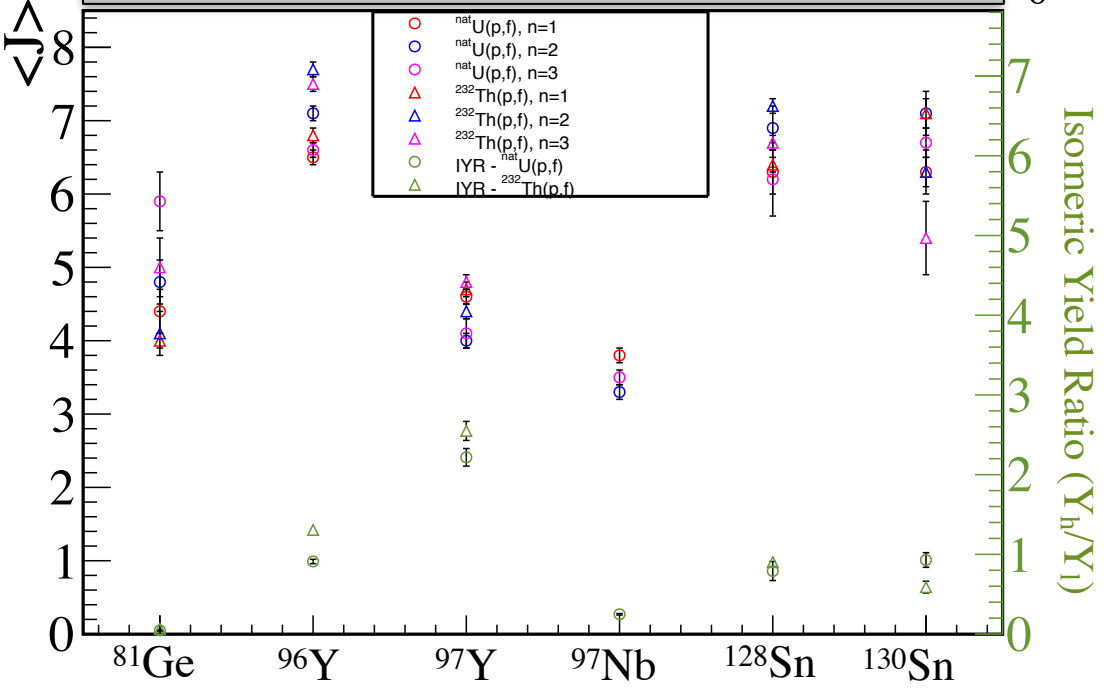
TALYS calculations

for more info
see poster: P075

Isomeric yield ratio as a function of <J>



<J> and measured IYR for various isotopes



The trend of the curve depends on the spin difference between the ground state and the metastable state. For the ^{81}Ge case $J_{g.s.}=9/2^+$ & $J_m=1/2^+$, while for the ^{130}Sn case $J_{g.s.}=0^+$ & $J_m=7^-$. In circles the experimental values are highlighted.