Total absorption spectroscopy of neutron-rich indium isotopes beyond N=82

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et al.

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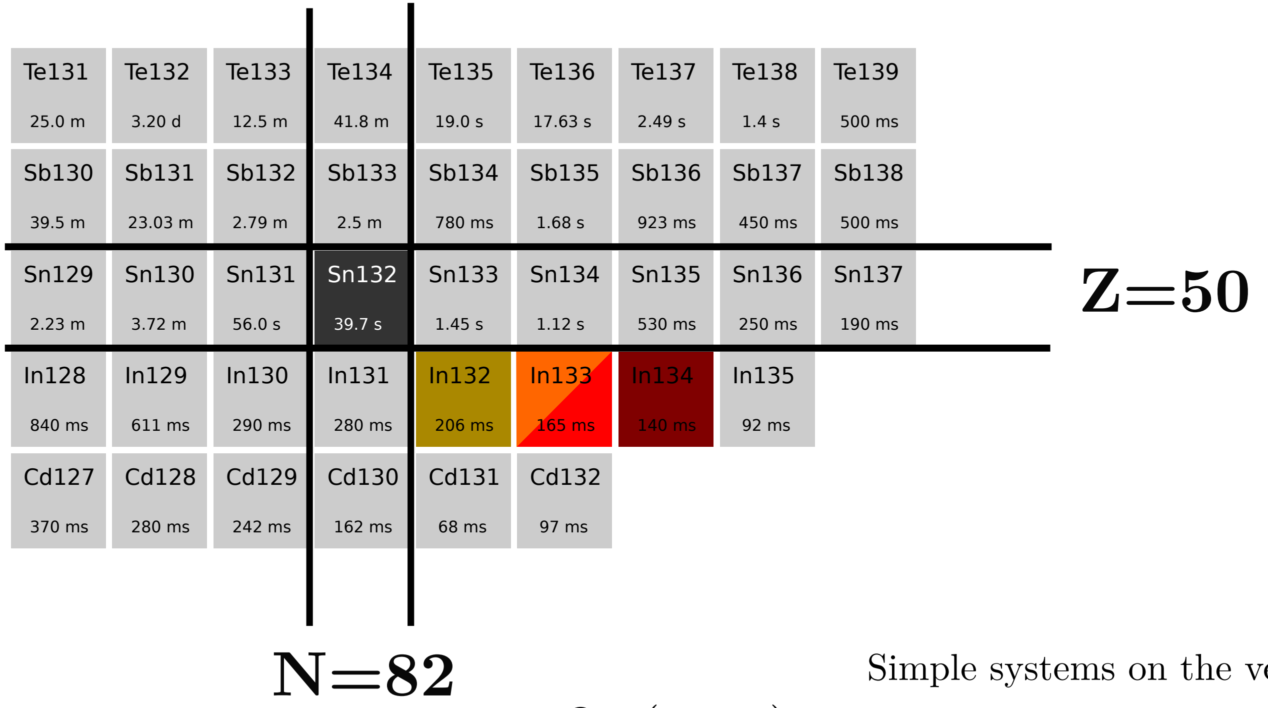
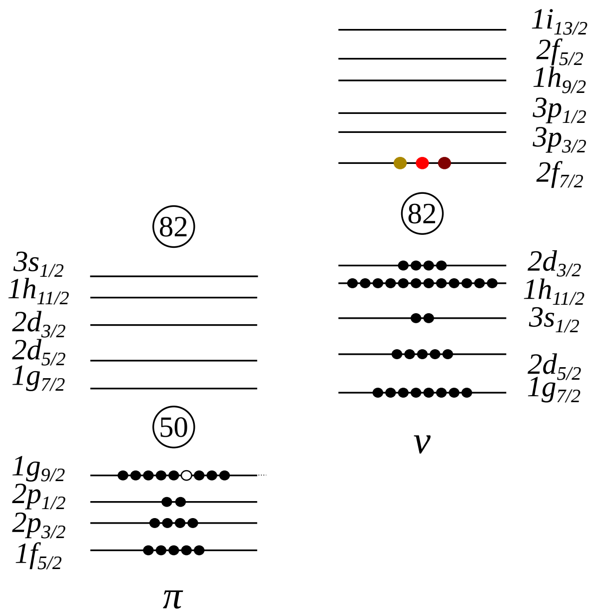
INTC meeting June 24th, 2020

Physics cases





			Q_β (MeV)
^{134}In	(50) -1,	(82) +3	**14.8**
^{133}In	(50) -1,	(82) +2	**13.4**
^{132}In	(50) -1,	(82) +1	**14.1**

Simple systems on the very neutron side of nuclear landscape.

Understanding such a system is crucial in order to be able to make predictions about the structure of the nuclei further away from magicity.

Ideal case to explore the single particle energies and the two-body matrix elements of the residual interaction.

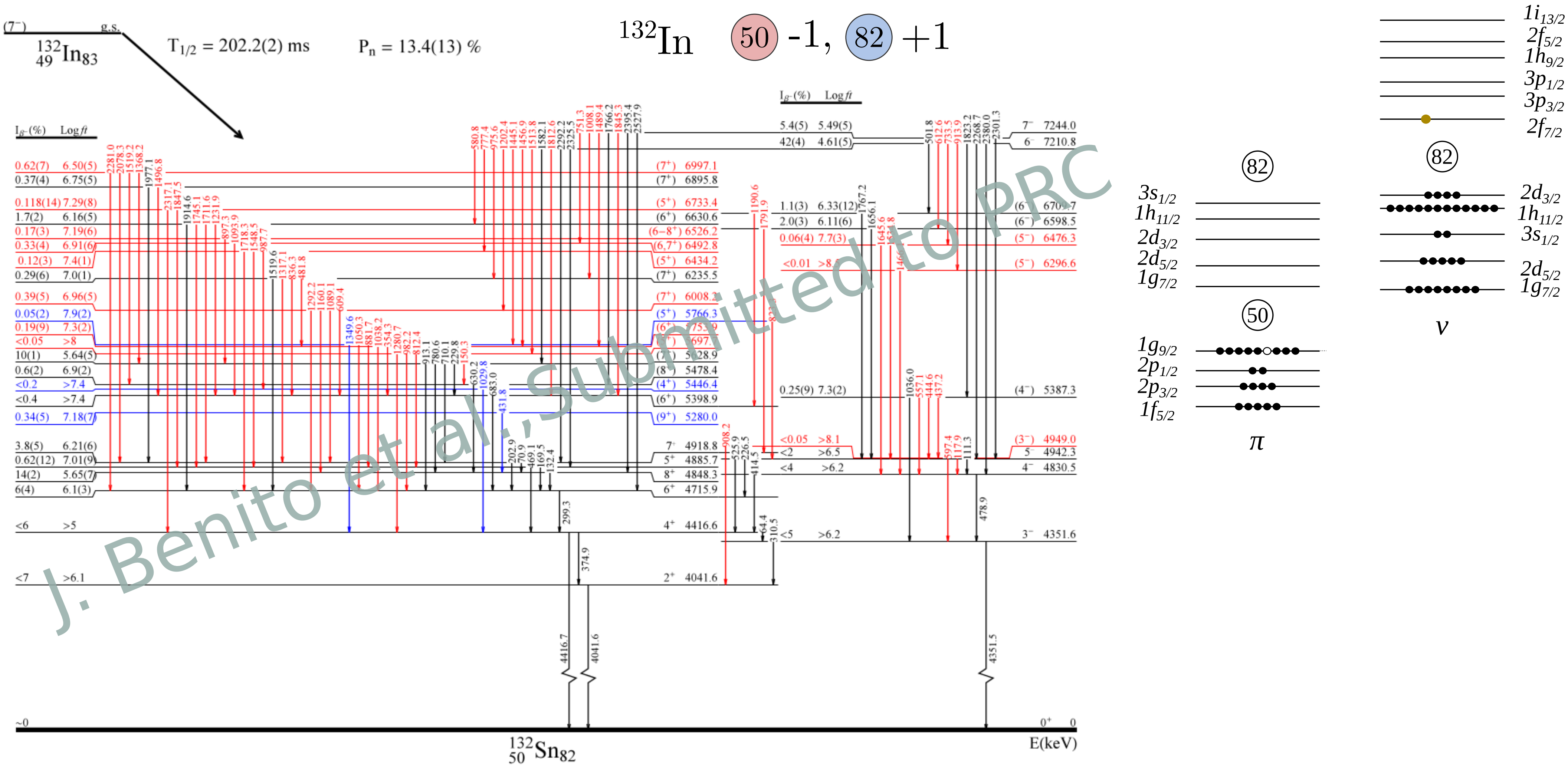
Important for the understanding the astrophysical r-process.

Studied with high resolution γ-ray detectors and neutron time-of-flight technique detectors, but some questions still remain open.

Promising cases to observe PDR populated in β decay.

ISOLDE provides unique capabilities to study these nuclei

^{132}In



Essential information for the understanding neutron-rich nuclei in the region.

Particle-hole (p-h) configurations create multiplets of excited states.

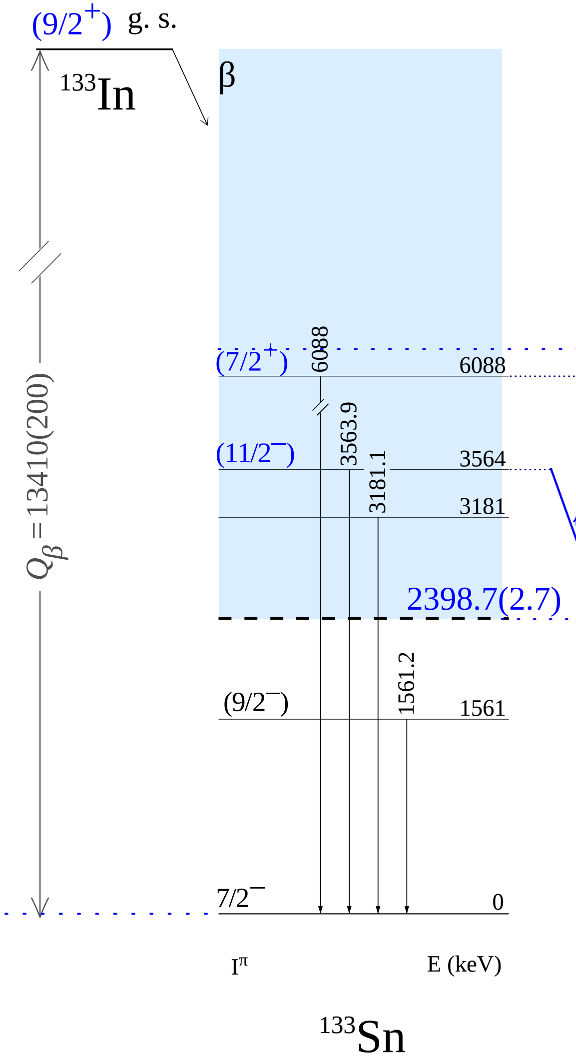
The identification of these multiplets provides information on the nuclear two-body matrix elements.

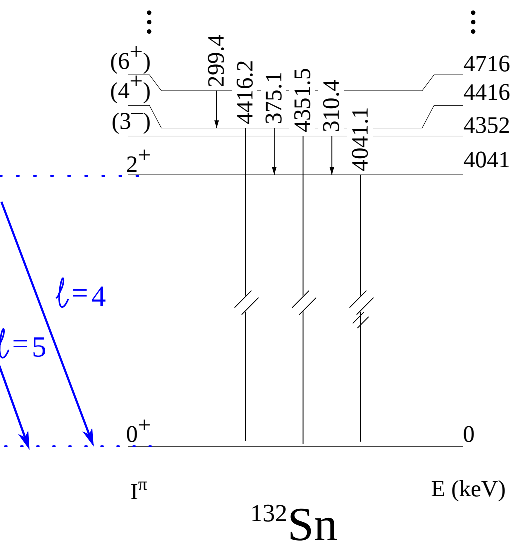
J. Benito, PhD thesis, Universidad Complutense de Madrid, (2020)

^{133}In, Neutron-γ-ray competition

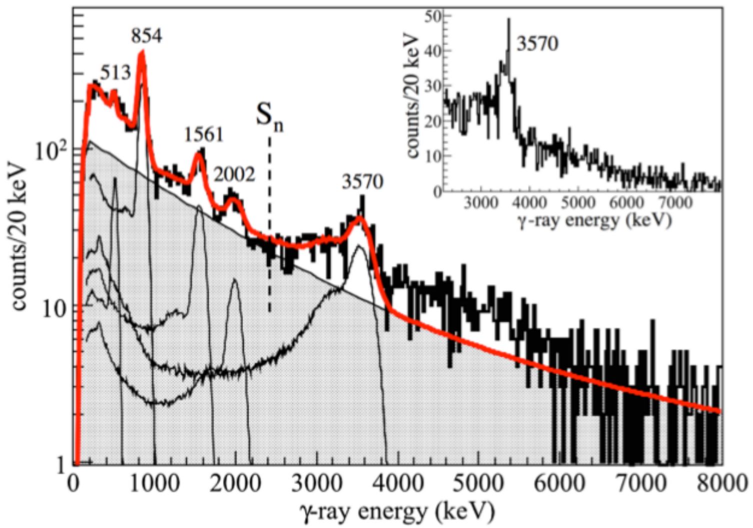
^{133}In (50) -1, (82) +2

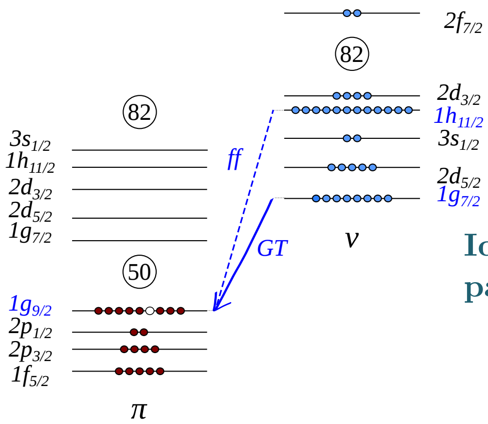
V. Vaquero et al., PRL 118, 202502 (2017)





One-neutron knockout from 134Sn





Due to nuclear structure effects, the γ-ray emission may play a significant role in β decay of nuclei in the region southeast of ^{132}Sn.

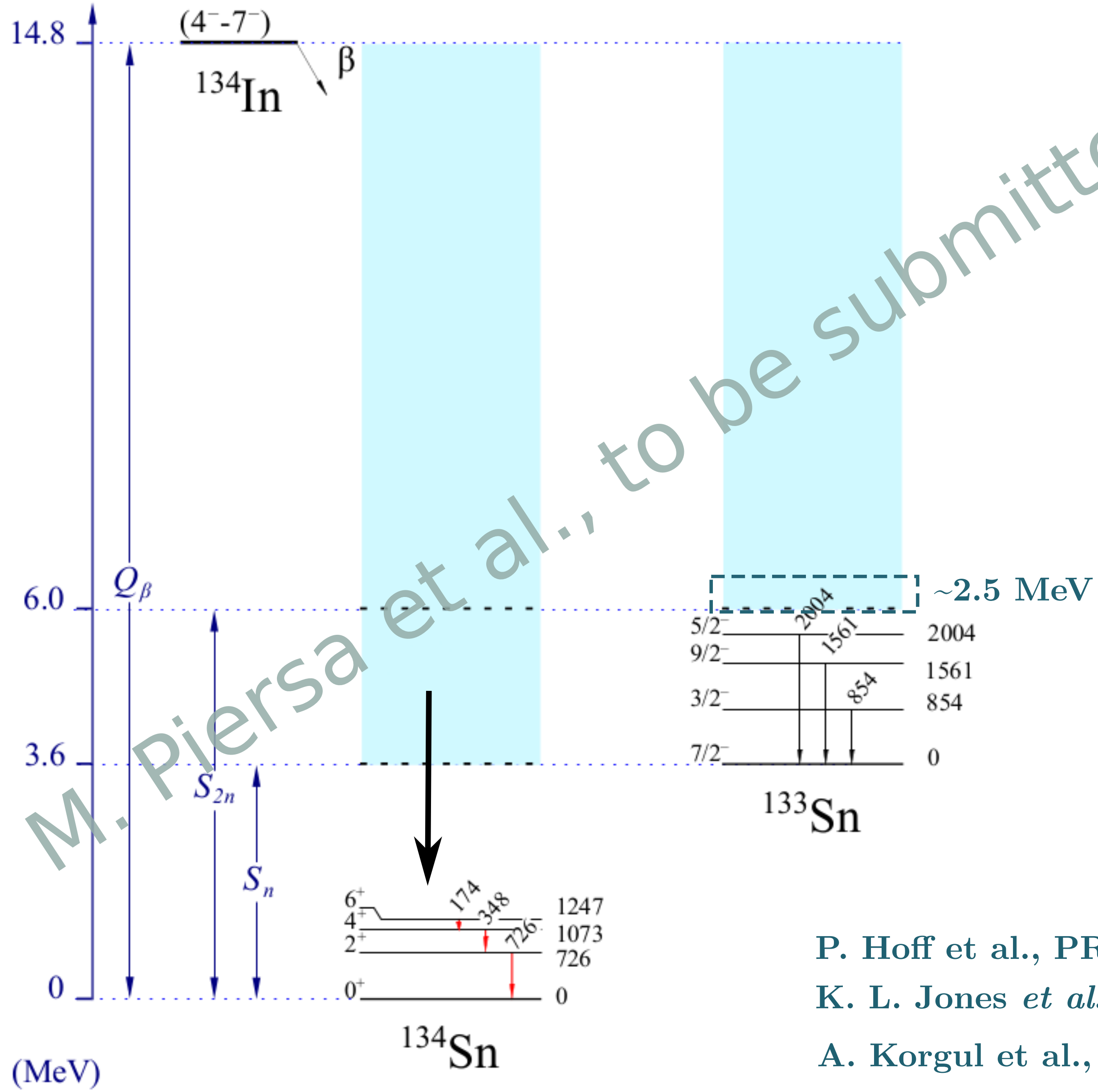
Ideal case to study Pygmy Dipole Resonance (high Qβ, opposite parity of mother and doughter nuclei, ΔJ=-1).

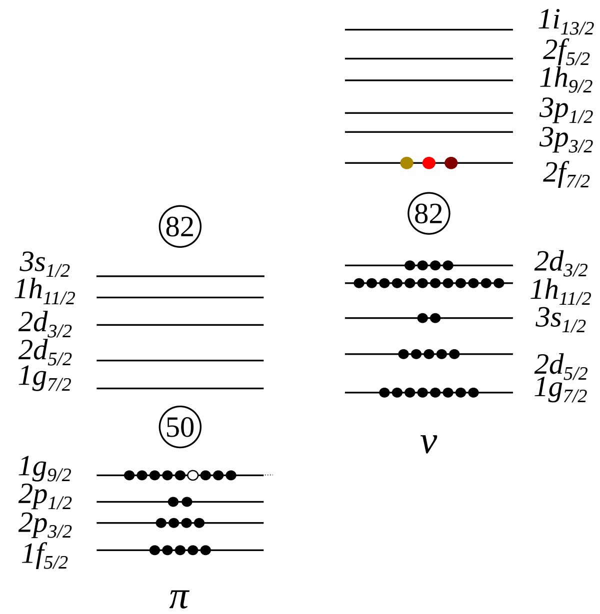
β-delayed neutrons have been measured with neutron time-of-flight technique detector (VANDLE) at ISOLDE (IS632)
(M. Madurga, Z. Xu, R. Grzywacz, UTK)

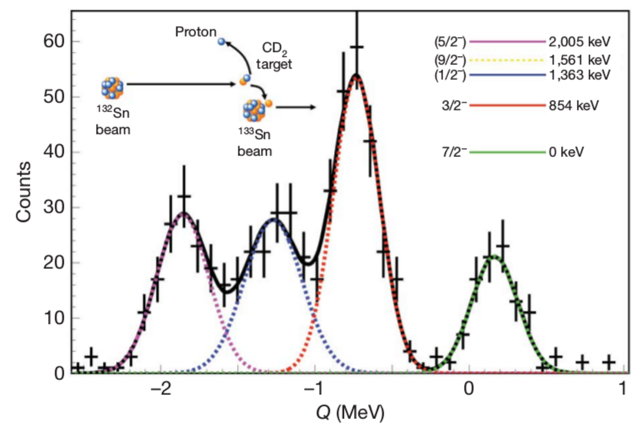
M. Piersa et al., PRC 99, 024304 (2019)

Beta decay of ^{134}In and searching for i13/2 s.p. energy

^{134}In (50) -1, (82) +3







P. Hoff et al., PRL 77, 1020 (1996)

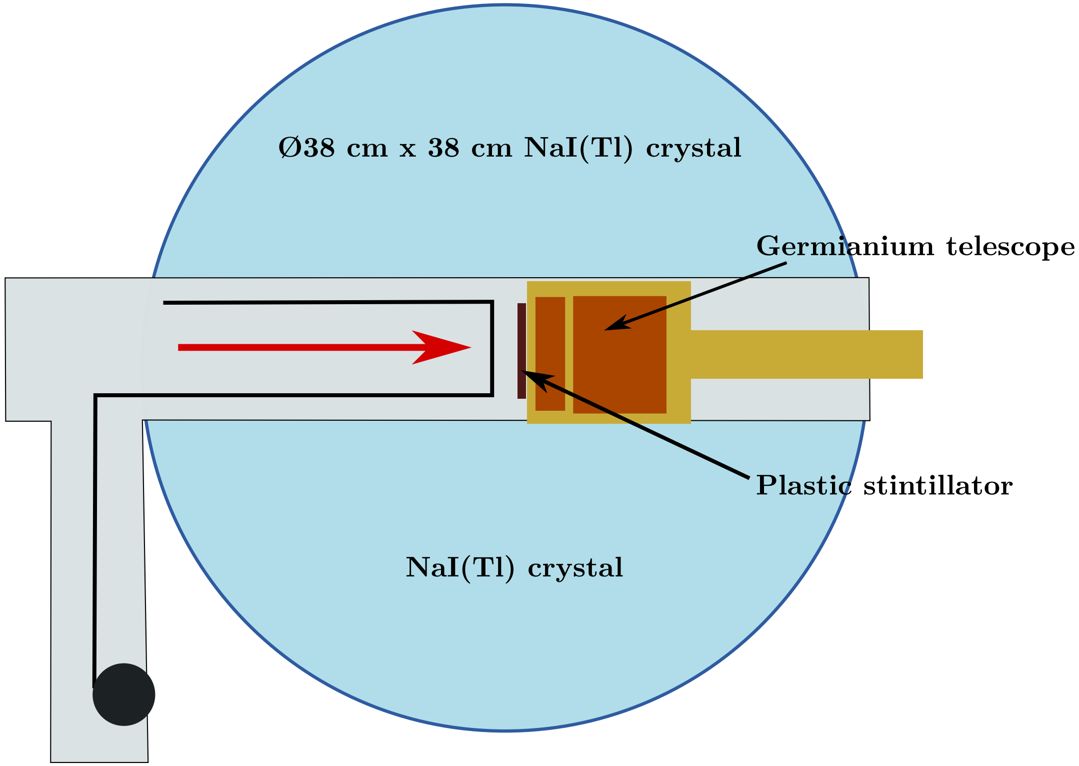
K. L. Jones *et al.*, Nature (London) 465, 454 (2010)

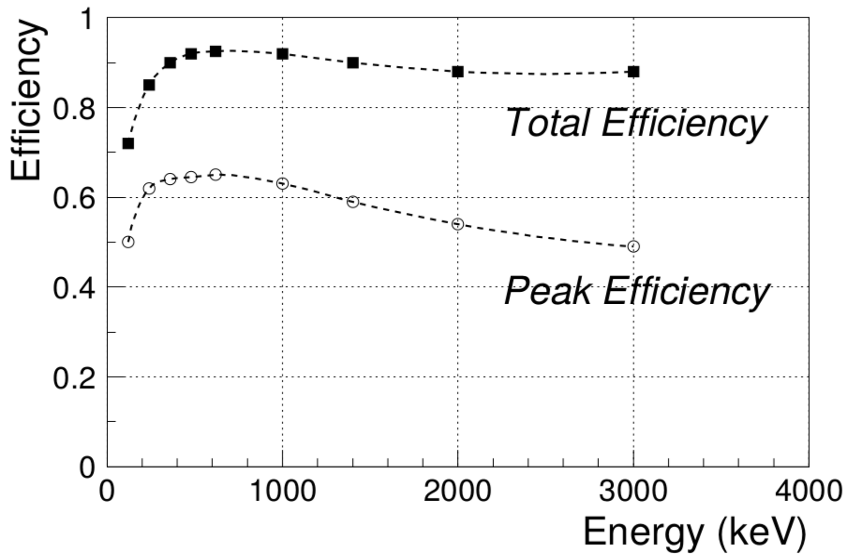
A. Korgul et al., PRC 91, 027303 (2015)

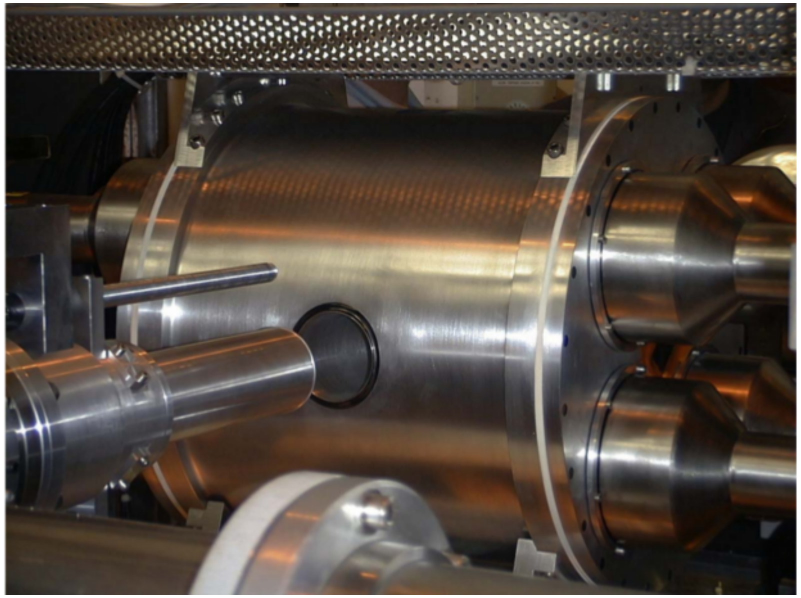
M. Piersa, ISOLDE Workshop and Users meeting, Dec 5-6, 2019

Technique

1.4 GeV proton beam on a UCx target + neutron converter
RILIS ion source to selectively ionise the In isotopes
LUCRECIA

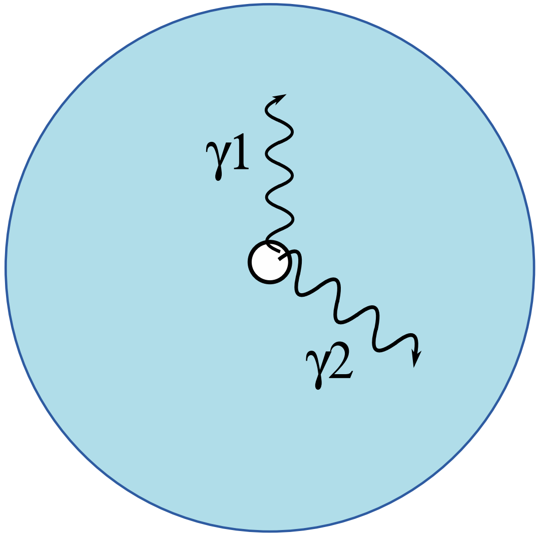


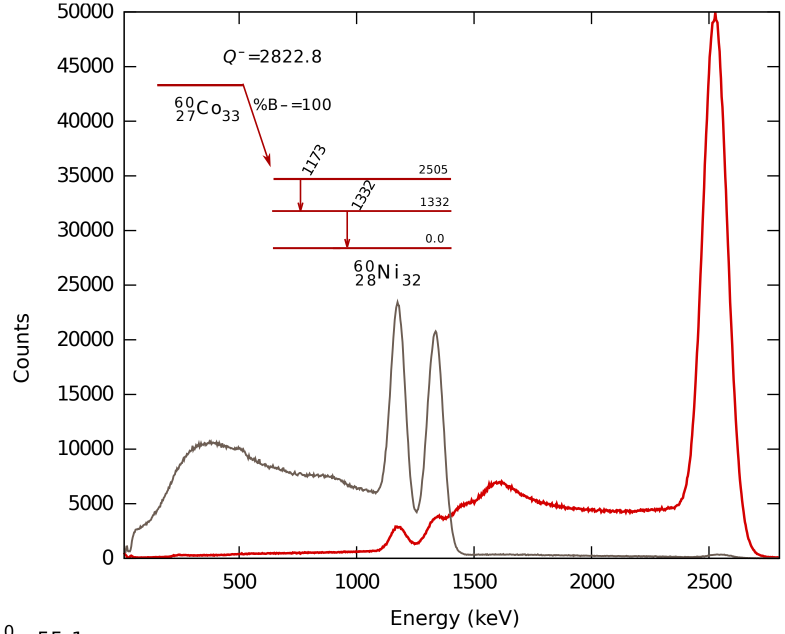


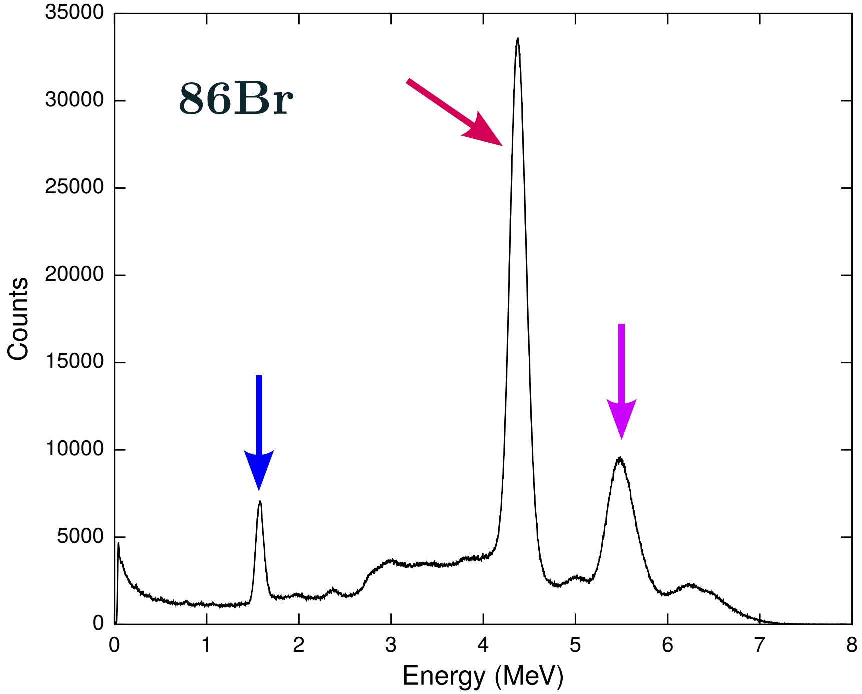


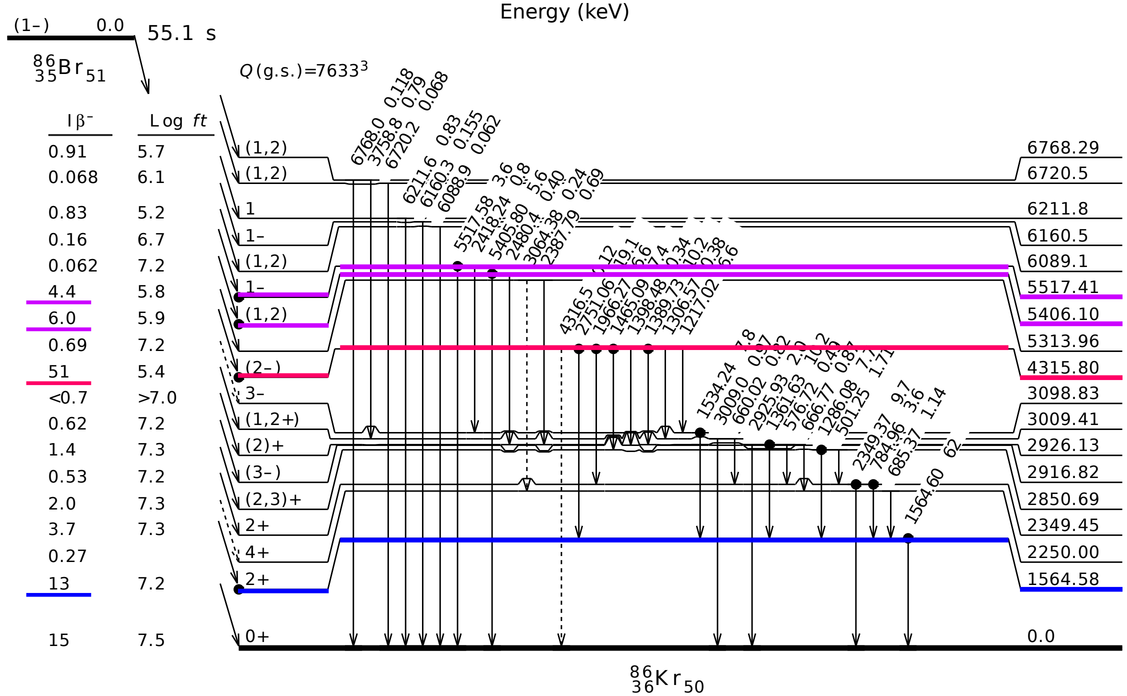
B Rubio et al 2017 J. Phys. G: Nucl. Part. Phys. 44 084004

Technique



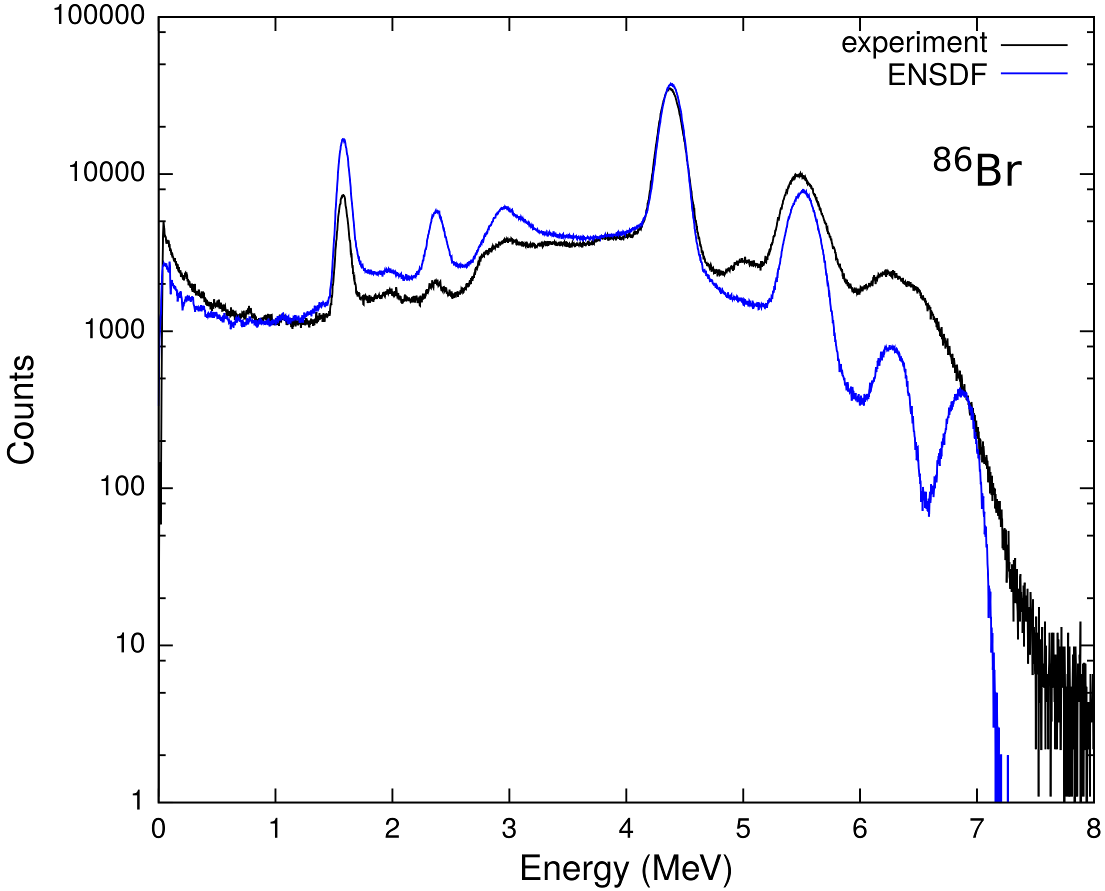


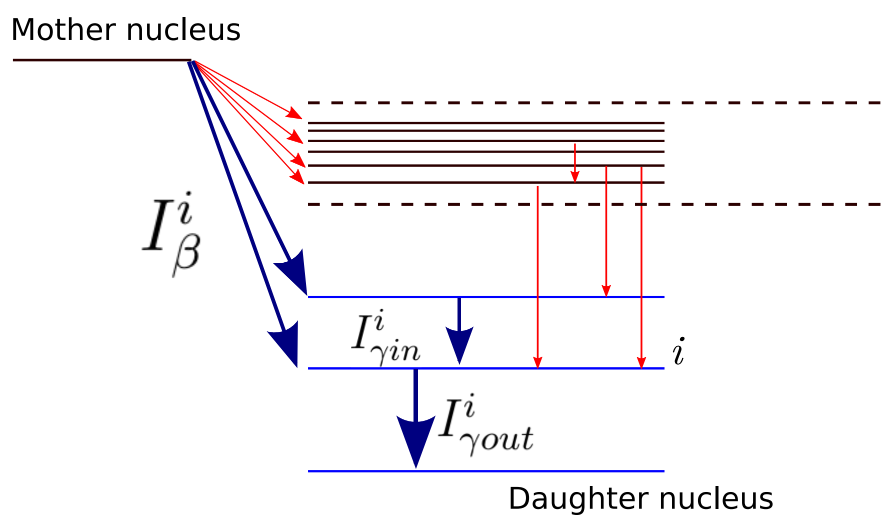




A. Fijałkowska, PhD thesis, University of Warsaw (2016)

Technique





The spectrum corresponds
to the excited levels and their feeding

Sensitivity to weak β feedings
at high excitation energy

The levels deexcitation paths are taken from high resolution
data, where available

J. L. Tain and D. Cano-Ott, NIM A 571, 728 (2007)
J. L. Tain and D. Cano-Ott, NIM A 571, 719 (2007)
A. Fijałkowska, PhD thesis, University of Warsaw (2016)

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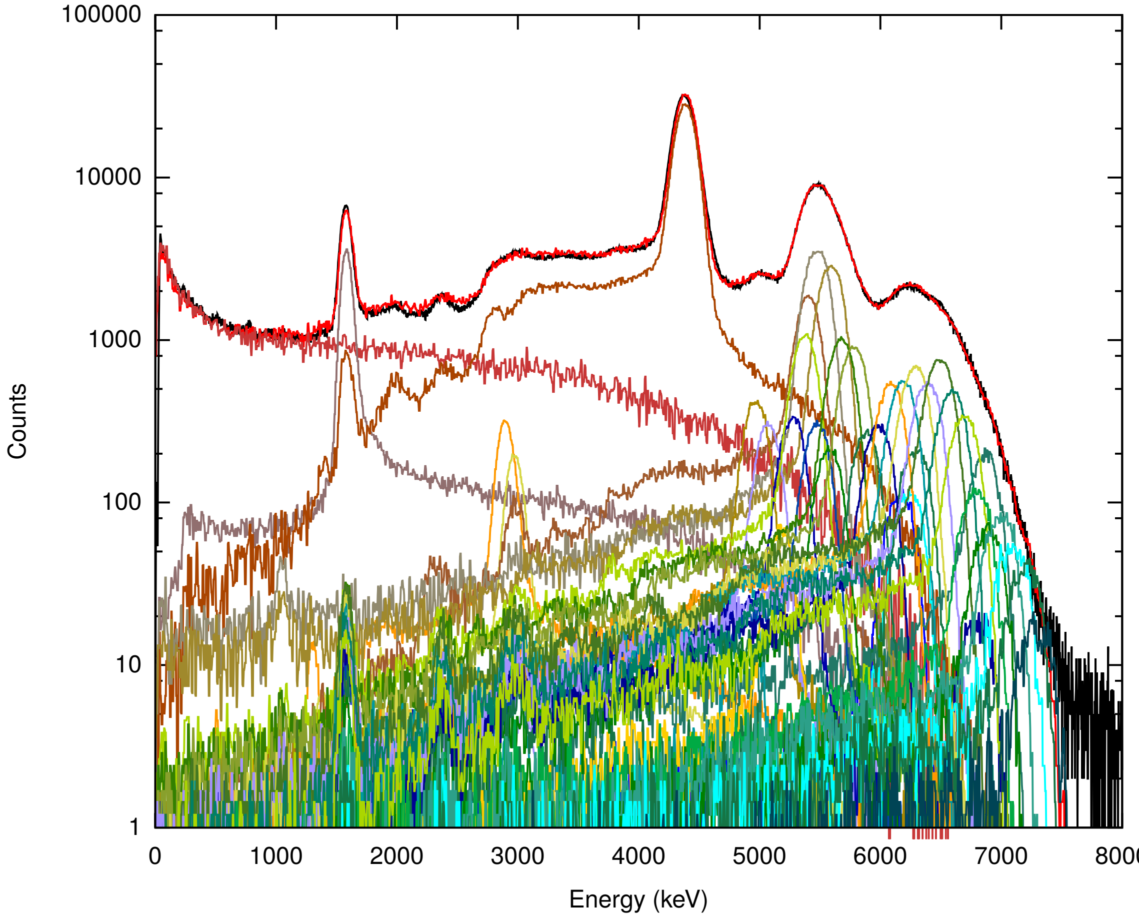

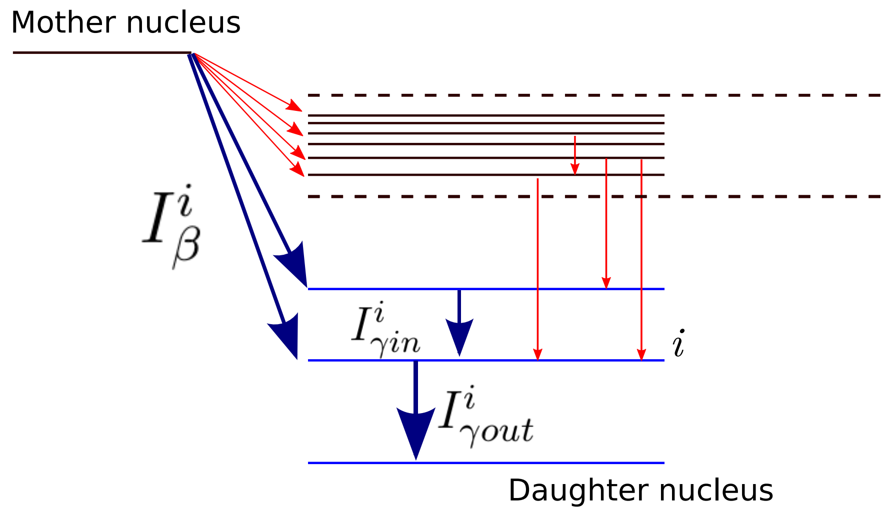

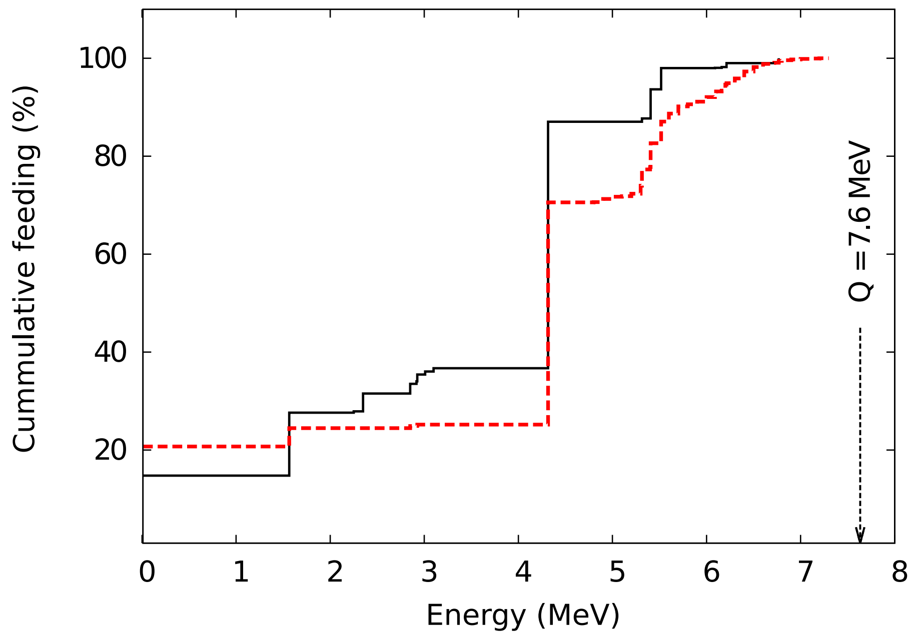

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A. Fijałkowska, PhD thesis, University of Warsaw (2016)

Beam time request

1.4 GeV proton beam with 2 μA intensity impinging on a UCx target equipped with neutron converter

Count rates took from previous experiments (IS610)

A 70% beam transmission to the LUCRECIA

The total γ-ray and β detection efficiencies assumed as 80% and 40%

Assumed 1M (A=131 – 133) and 200k (A=134) events in the β − γ spectrum

2 additional shifts are requested for the measurement of the daughter activities

1 additional shift to measure the β decay of ^{131}In - pilot beam for fine-tuning the experimental setup and a comparison with high-resolution data.

	Yield (ions/μC)	Intensity at LUCRECIA (ions/s)	Requested shifts
^{134}In	**50**	**70**	**8**
^{133gs}In	**900**	**1300**	**3**
^{133m}In	**400**	**560**	**7**
^{132}In	**$2 \cdot 10^4$**	**$5 \cdot 10^3$**	**1**
^{131}In		**$5 \cdot 10^3$**	**1**

Total: 20 + 2 = 22 shifts

Beam contamination

IS610, 2016 and 2018

^{134}In

No γ rays from the β decay of ^{134gs}Cs.

127 keV γ rays from ^{134m}Cs Isomeric Transmission cut out by coincidence requirement with the beta particle

^{133}In

^{133}Cs is stable, no γ rays form the β decay of ^{133}Ba

^{132}In

The number of nuclei 132Cs:132In is about 700:1.
However, observed activity 132Cs:132In is about 1:4000.

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THANK YOU