FISSION YIELD MEASUREMENTS WITH JYFLTRAP

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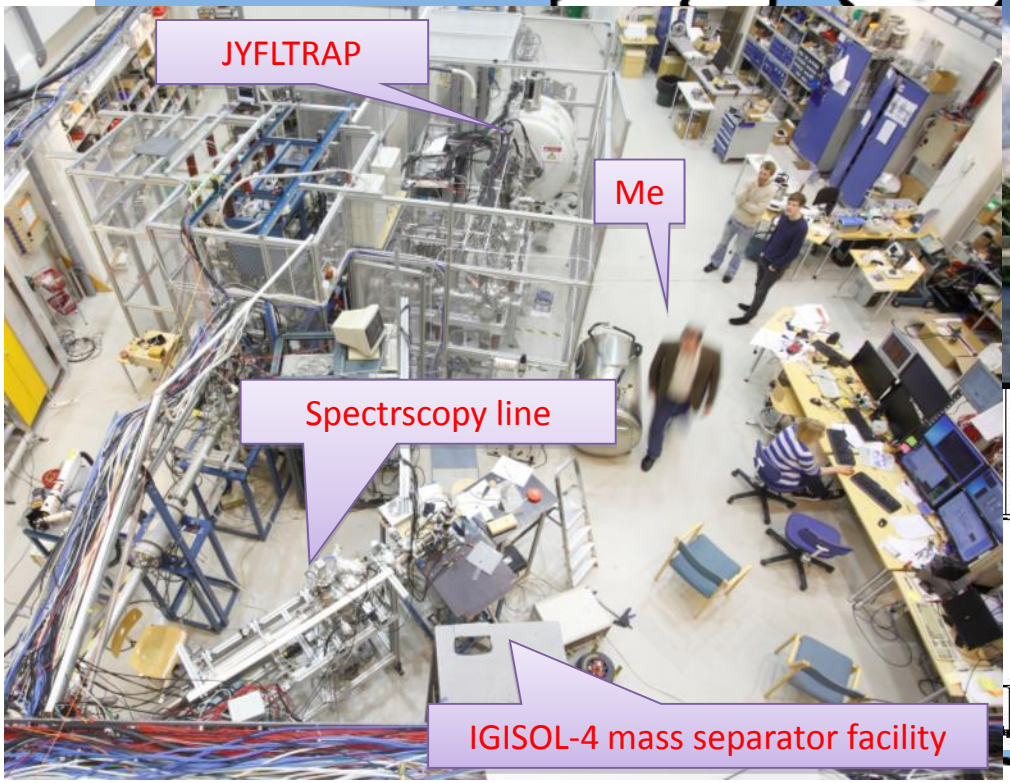
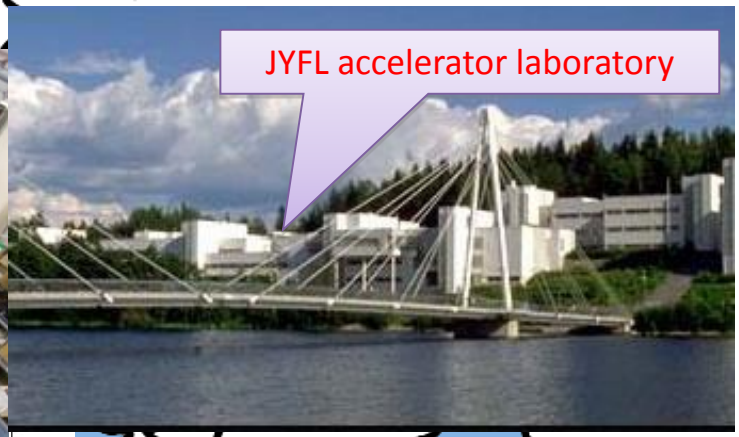
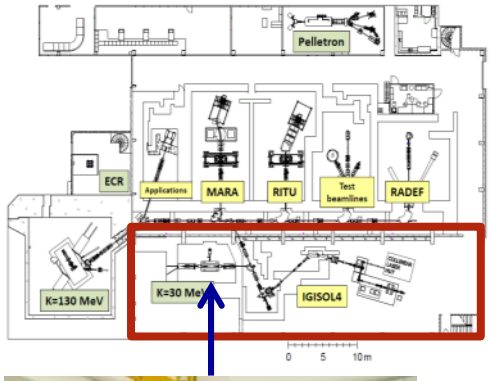
Seinäteksti Jyväskylän yliopiston vanhassa juhlasalissa (1882)

Quick orientation





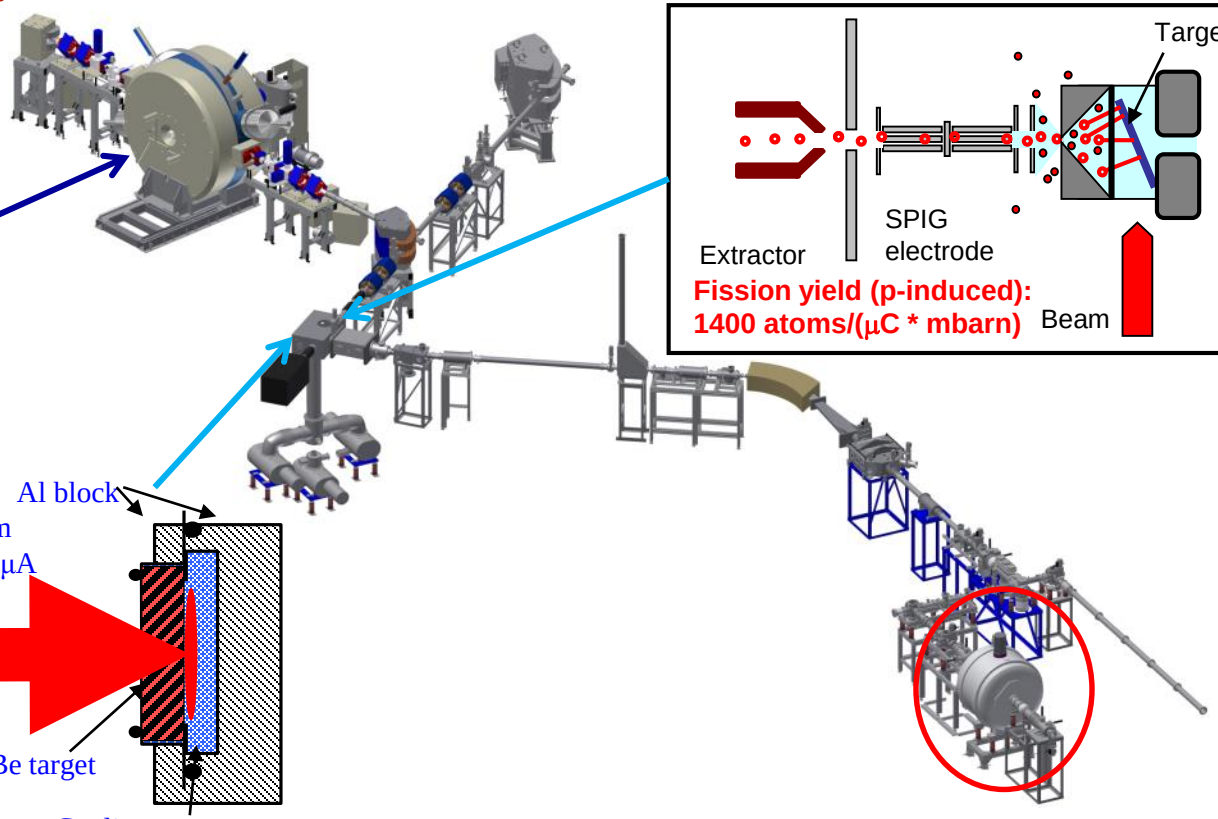
The IGISOL-4 facility at JYFL



IGISOL: Ion Guide Isotope Separator On-Line: a mass separator facility based on ion guide technique, capable making ion beams of any element

IGISOL-1: c.a. 1981 – 1991 at MC20 proton cyclotron
IGISOL-2 (1993 – 2003) and IGISOL-3 (2003 – 2010) at K-130
IGISOL-4 moved/build next to new MCC30 light ion cyclotronin an extension experimental hall in **2010-13** (still coupled to K-130). Commissioning **2012 – 2014**

Facility can provide **ultra pure beams of fission products**



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

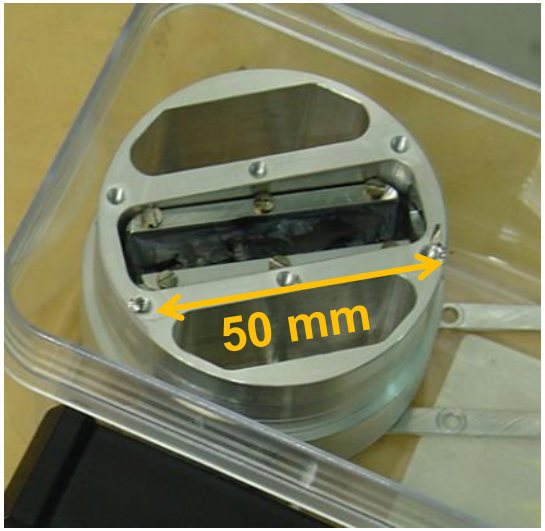
Charge state concentration: (0), +1, (+2)

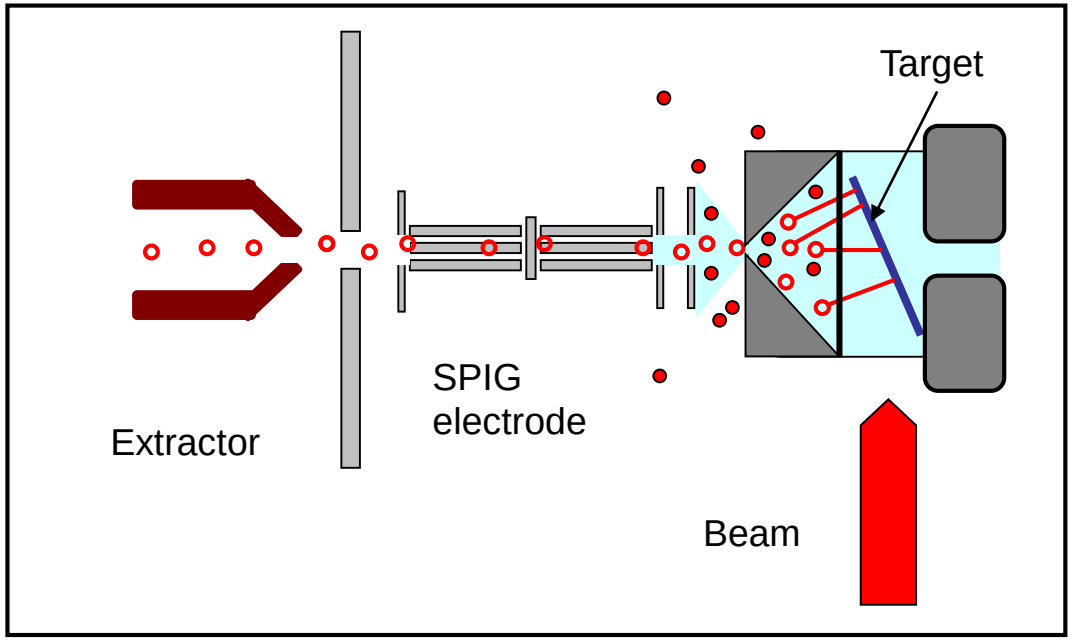
Produces ions of any element

All elements can be studied

All ions come directly from fission

Ion rate in the formed beam corresponds to the independent fission yield





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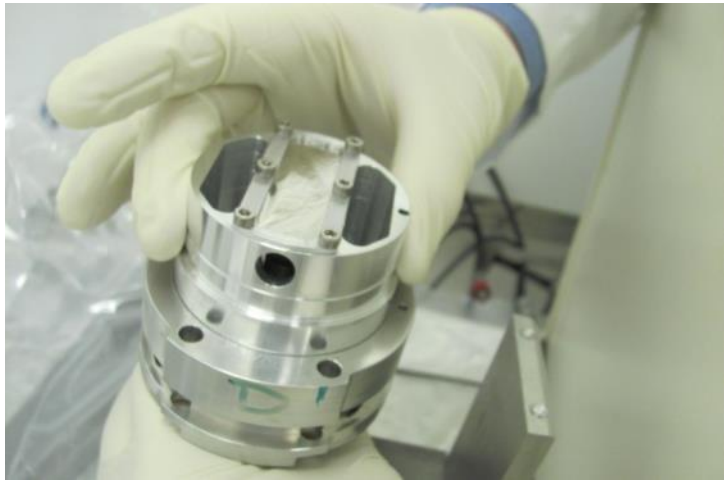
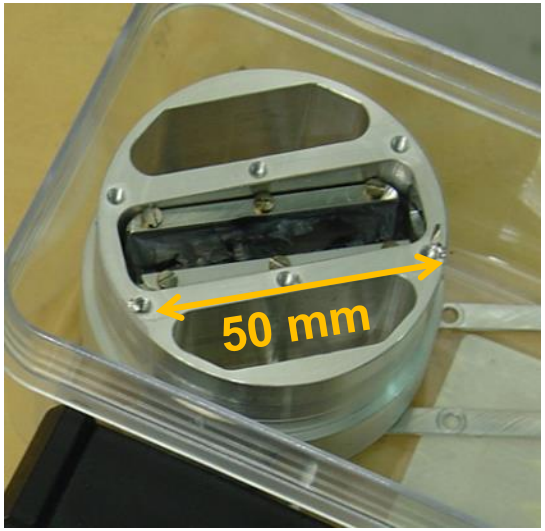
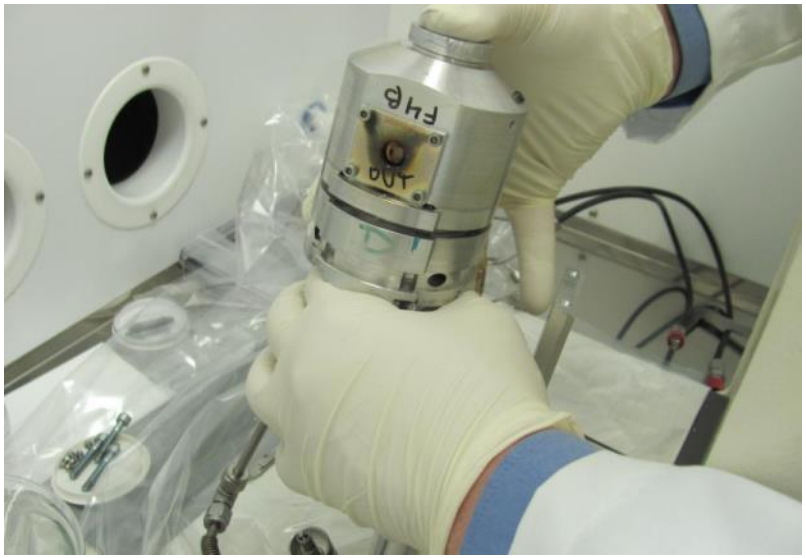
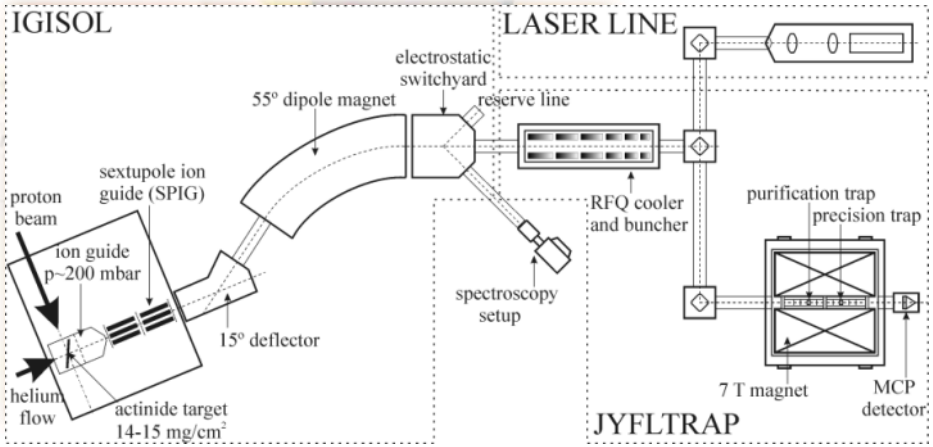
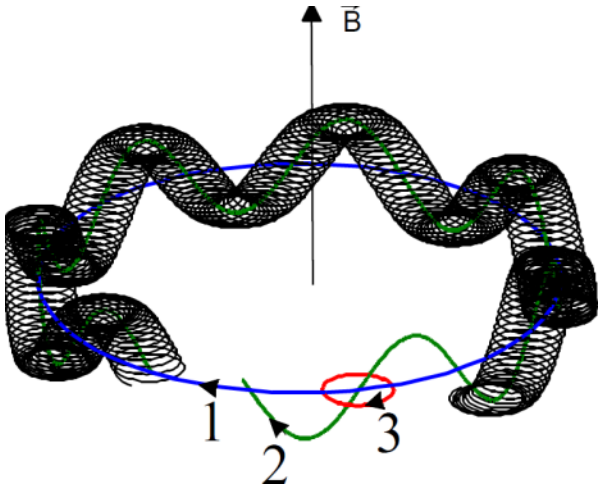


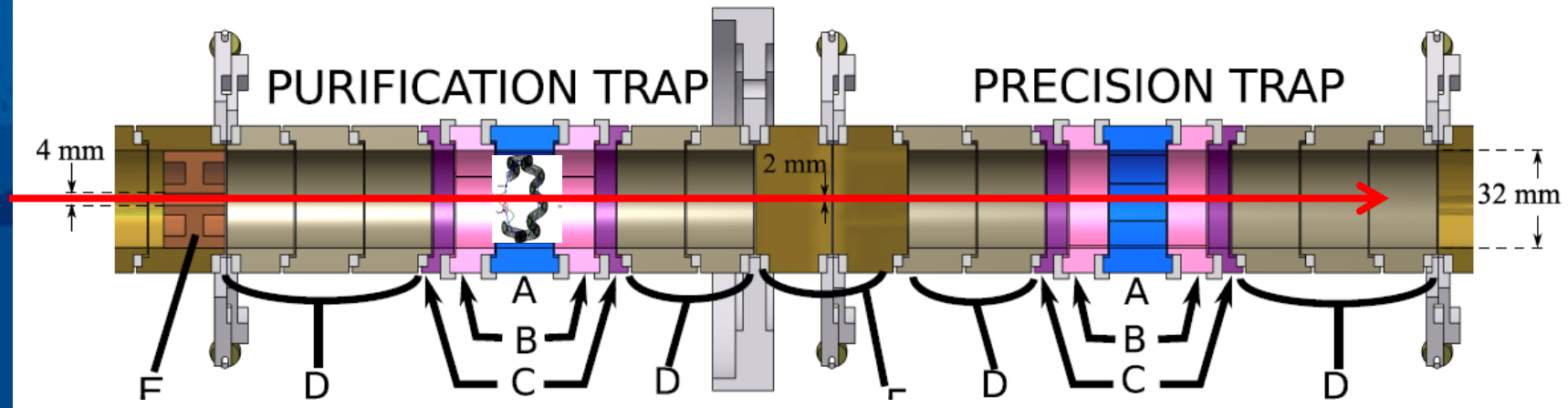




Isotopic purification with JYFLTRAP

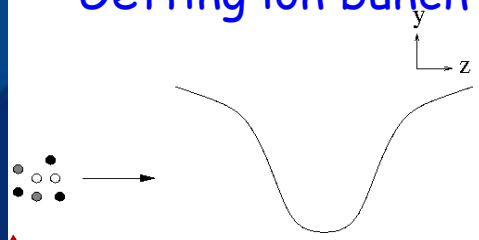




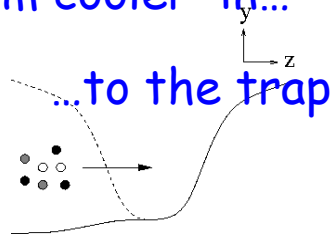


Isotopic purification with JYFLTRAP

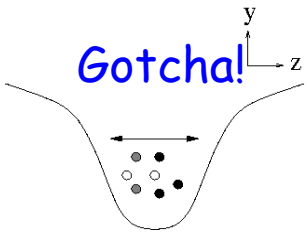
Getting ion bunch from cooler in…



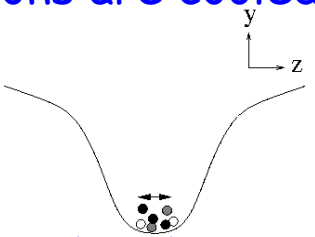
…to the trap



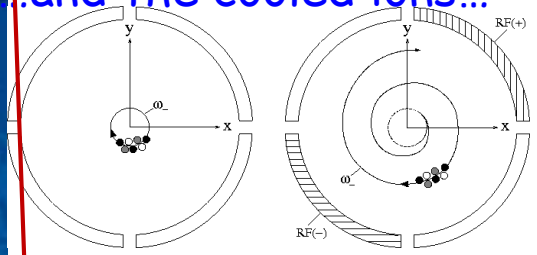
Gotcha!



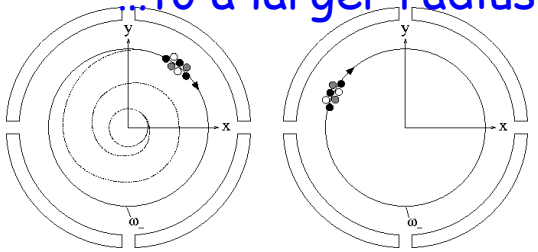
Ions are cooled…



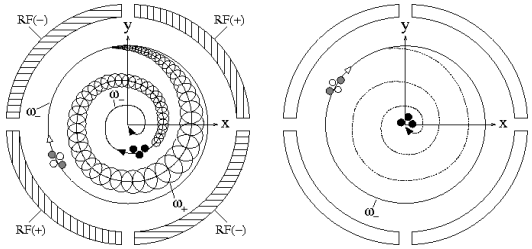
…and the cooled ions…



…to a larger radius

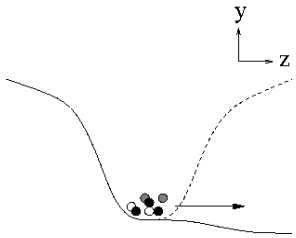


…centers the chosen ones



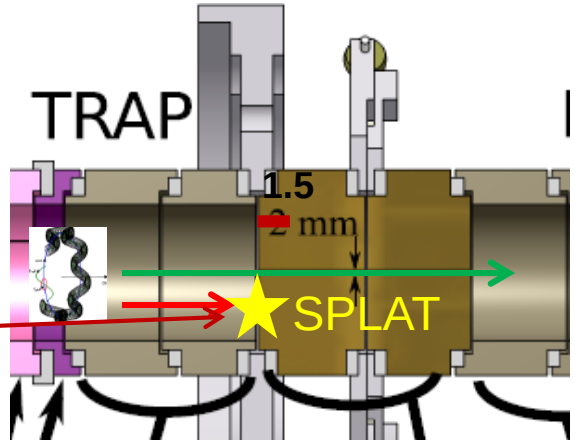
… are dipole excited first…

Mass selective quadrupole excitation…

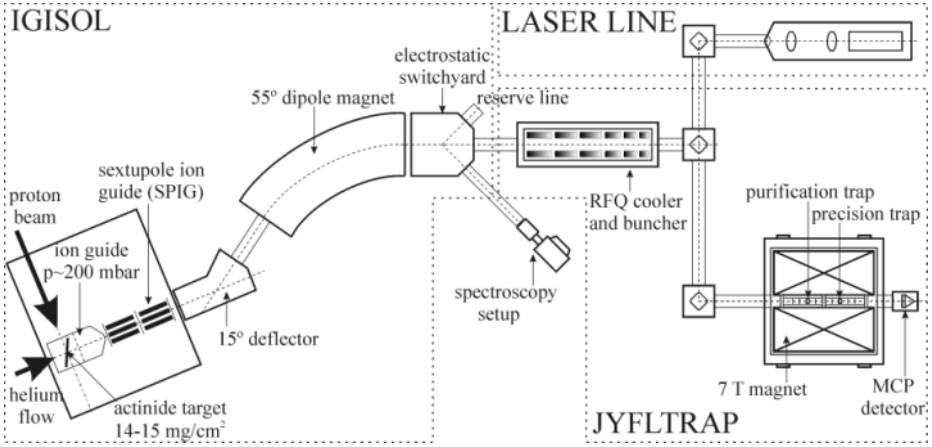


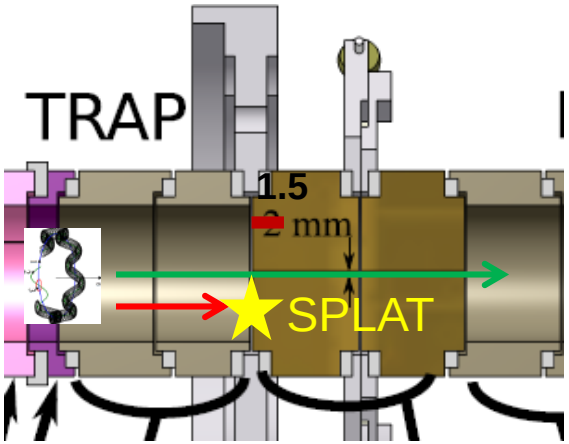
Finally,
out of the trap they go
namely,
those that go

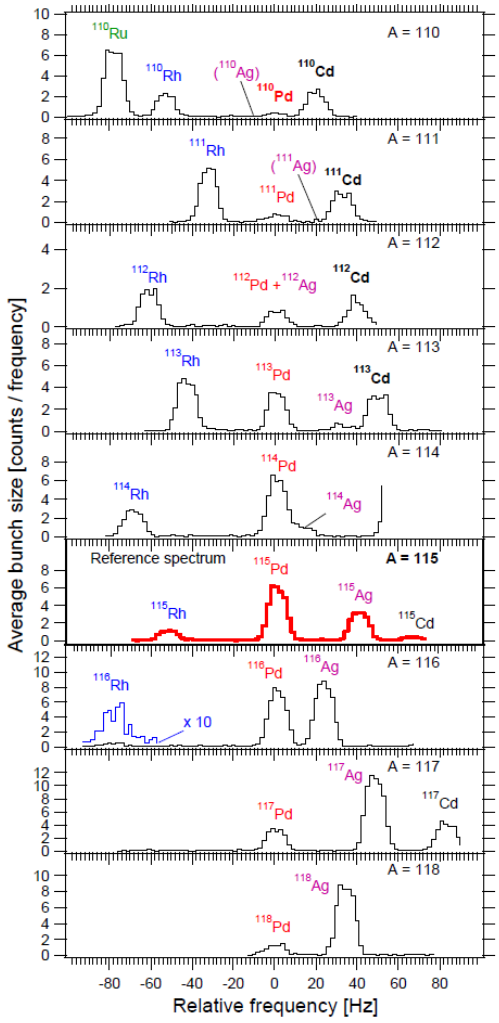
> 70 ms, typical 600 ms



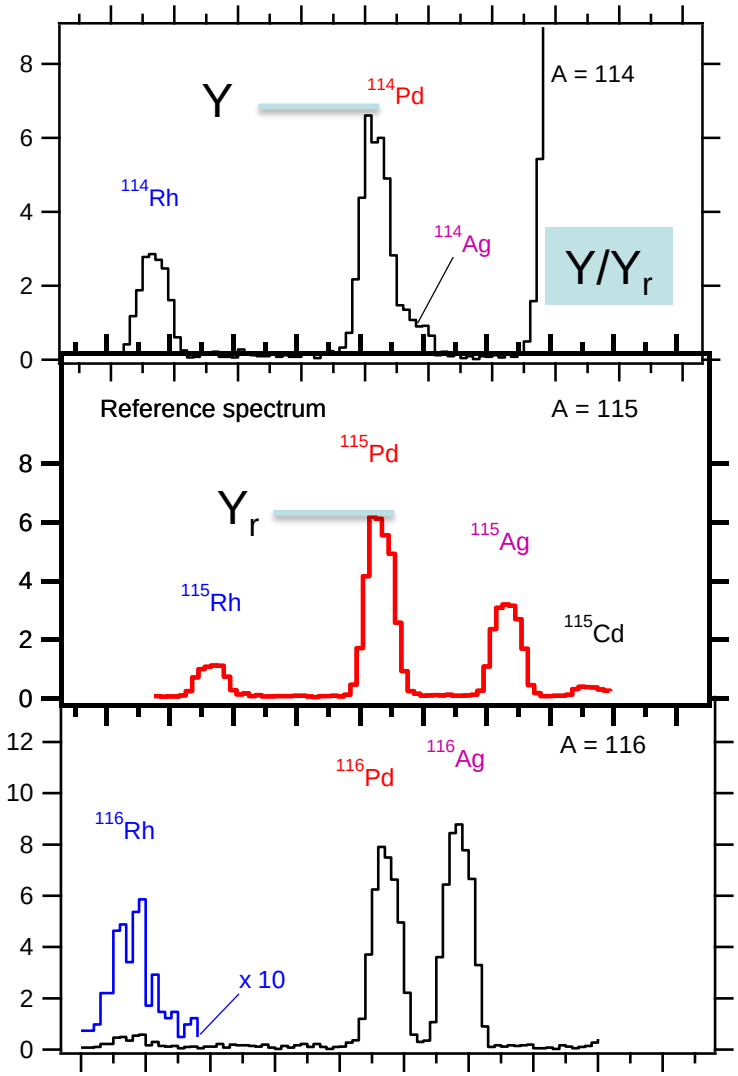
Isotopic purification with JYFLTRAP

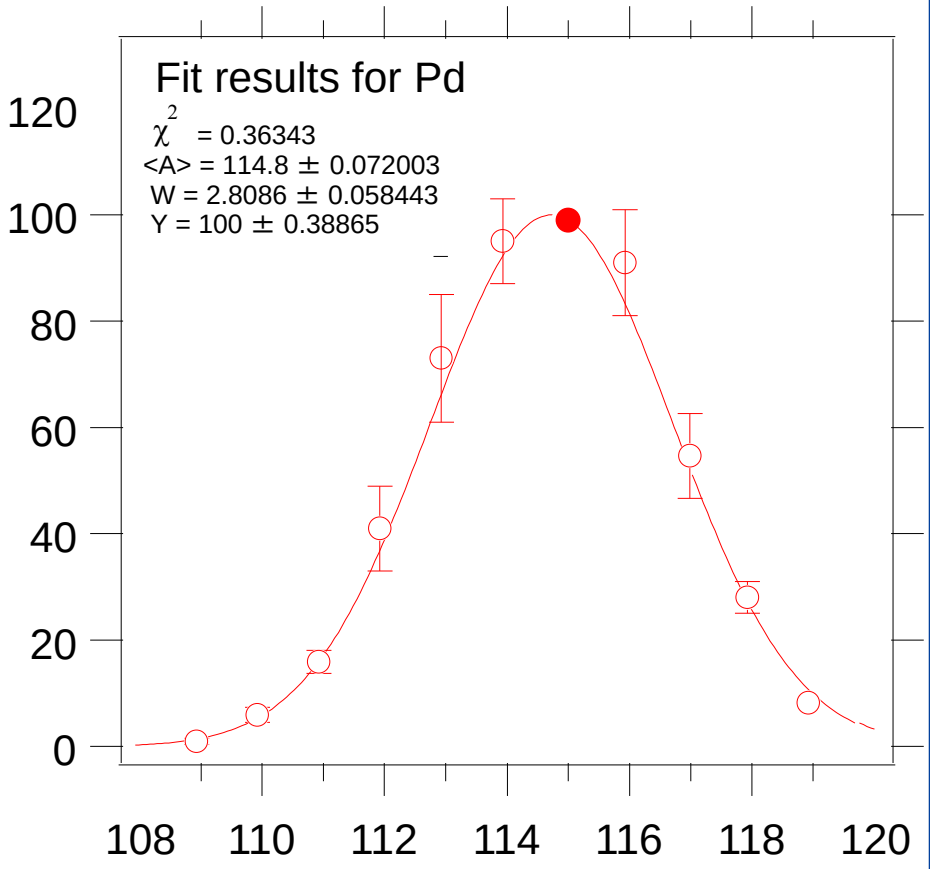




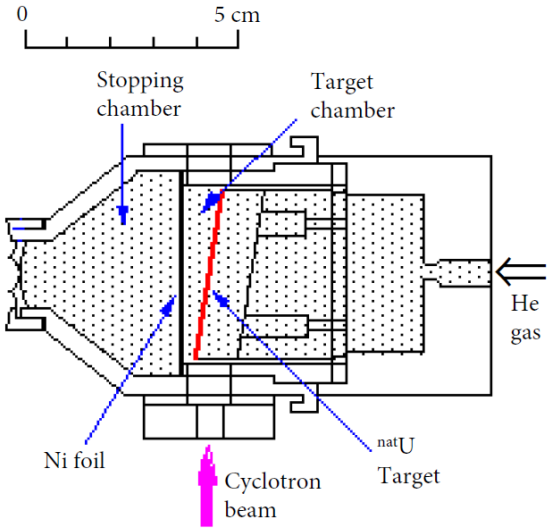


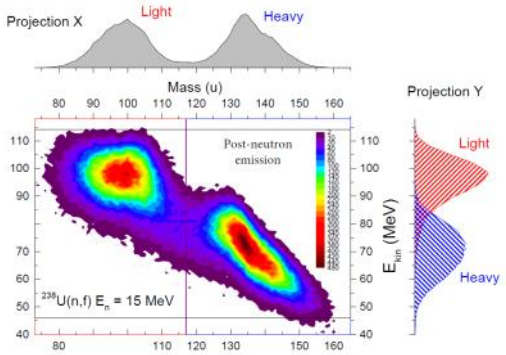
From mass spectra to yield distribution





Mass dependency of the stopped ions

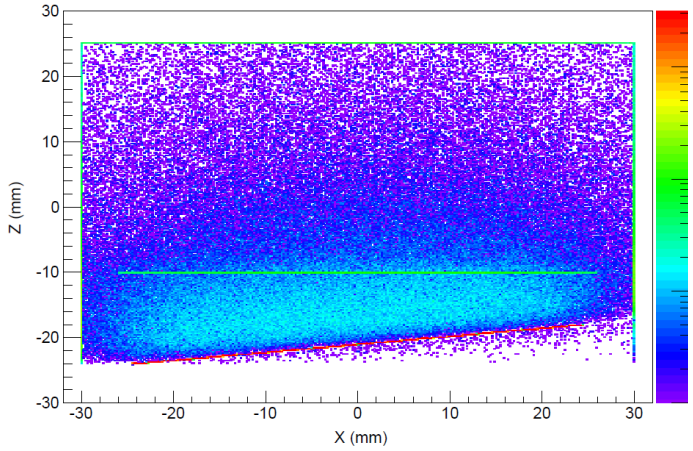




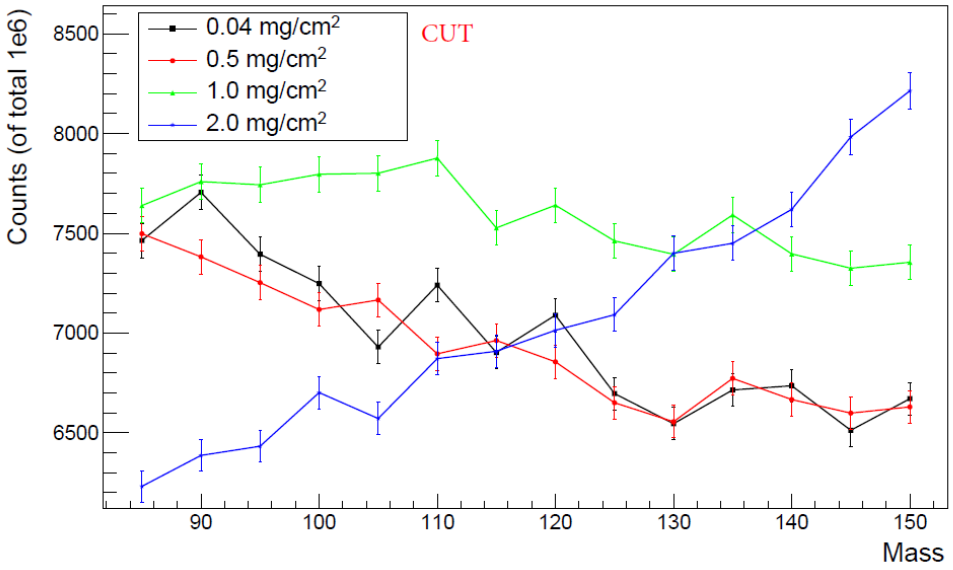
Simulations made by Uppsala Universitet collaboration

http://arxiv.org/abs/1409.0714

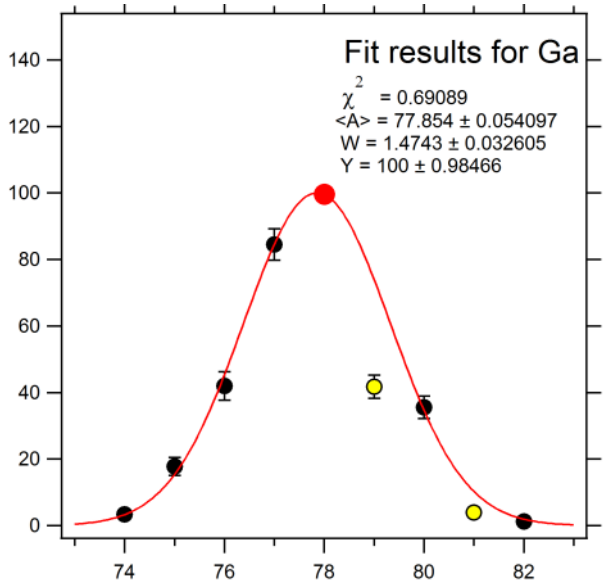
a

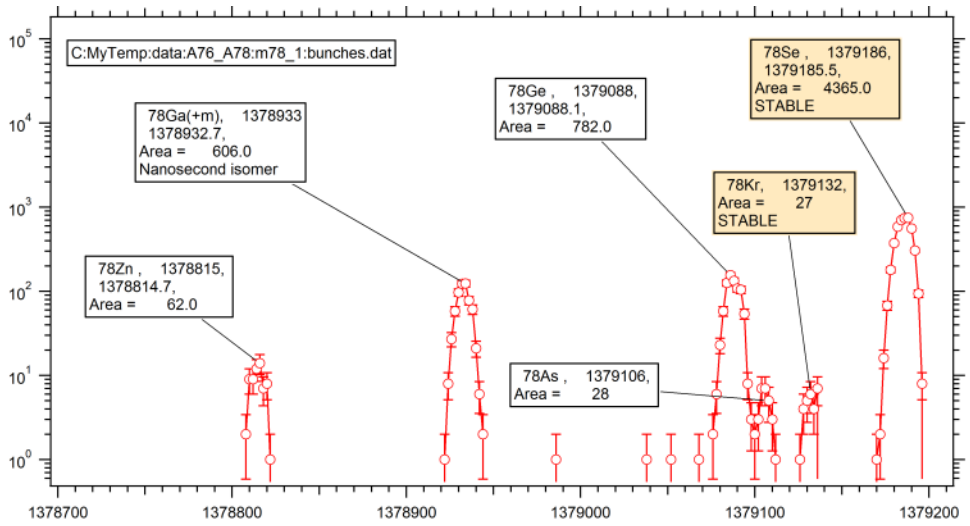


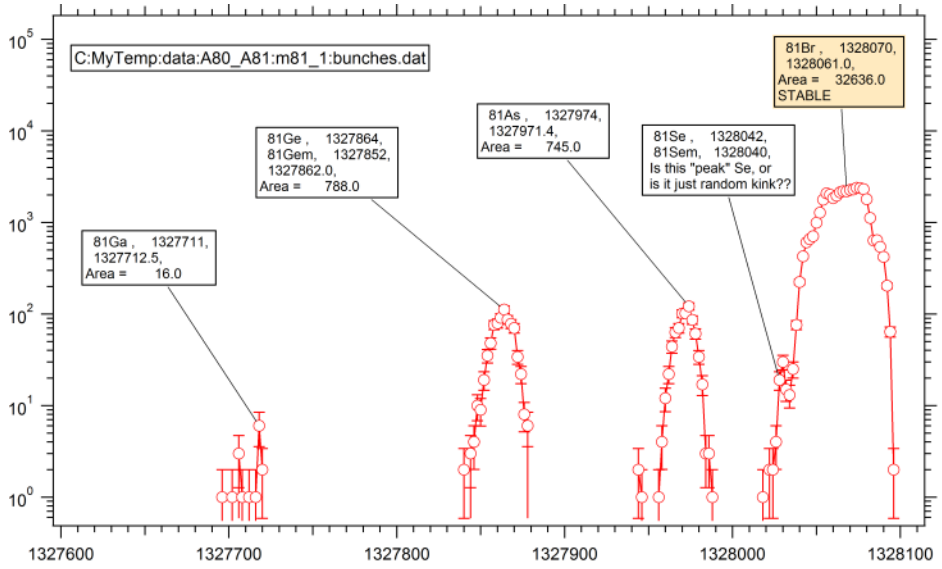
Stopped ions as a function of Ni foil thickness



Impact of stable isotope ions







Space charge in the trap is an issue for yield measurements.

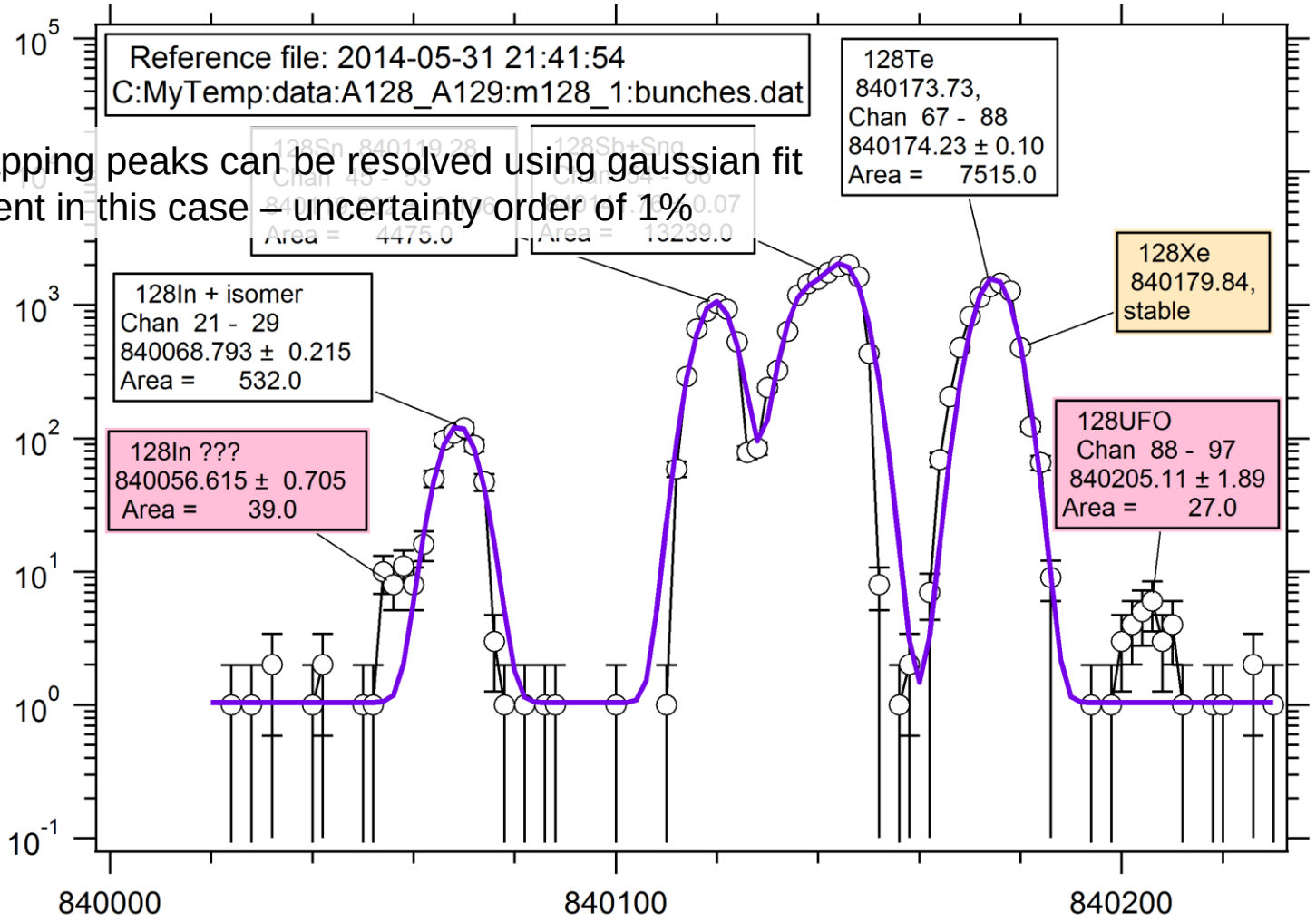
Reduce amount of stable ions:
- better purified system

Lower ion rate:
- ratio may kill yield anyway

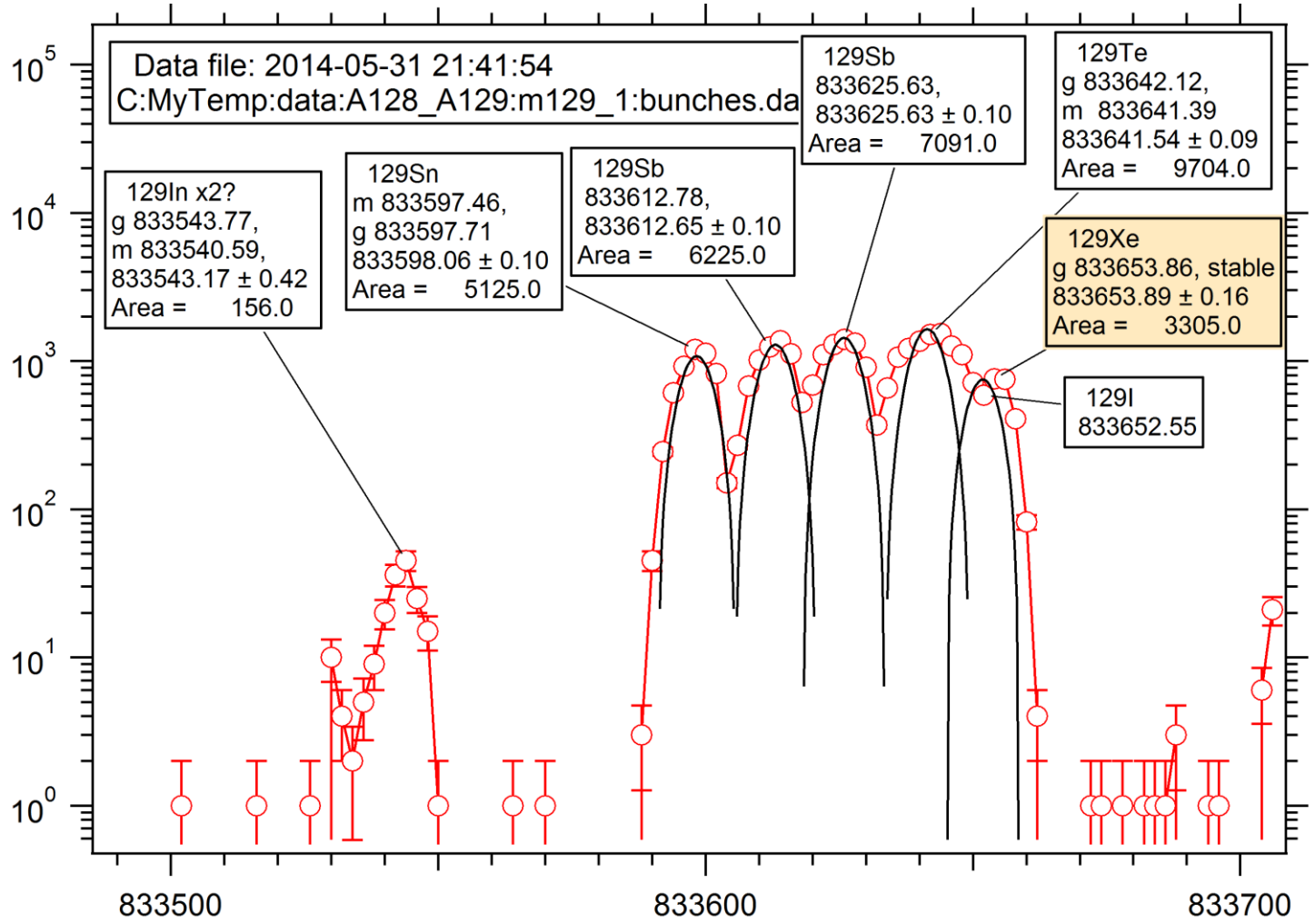
Pre-selection:
- installing MR-TOF

Limits of resolving: overlapping isotopes

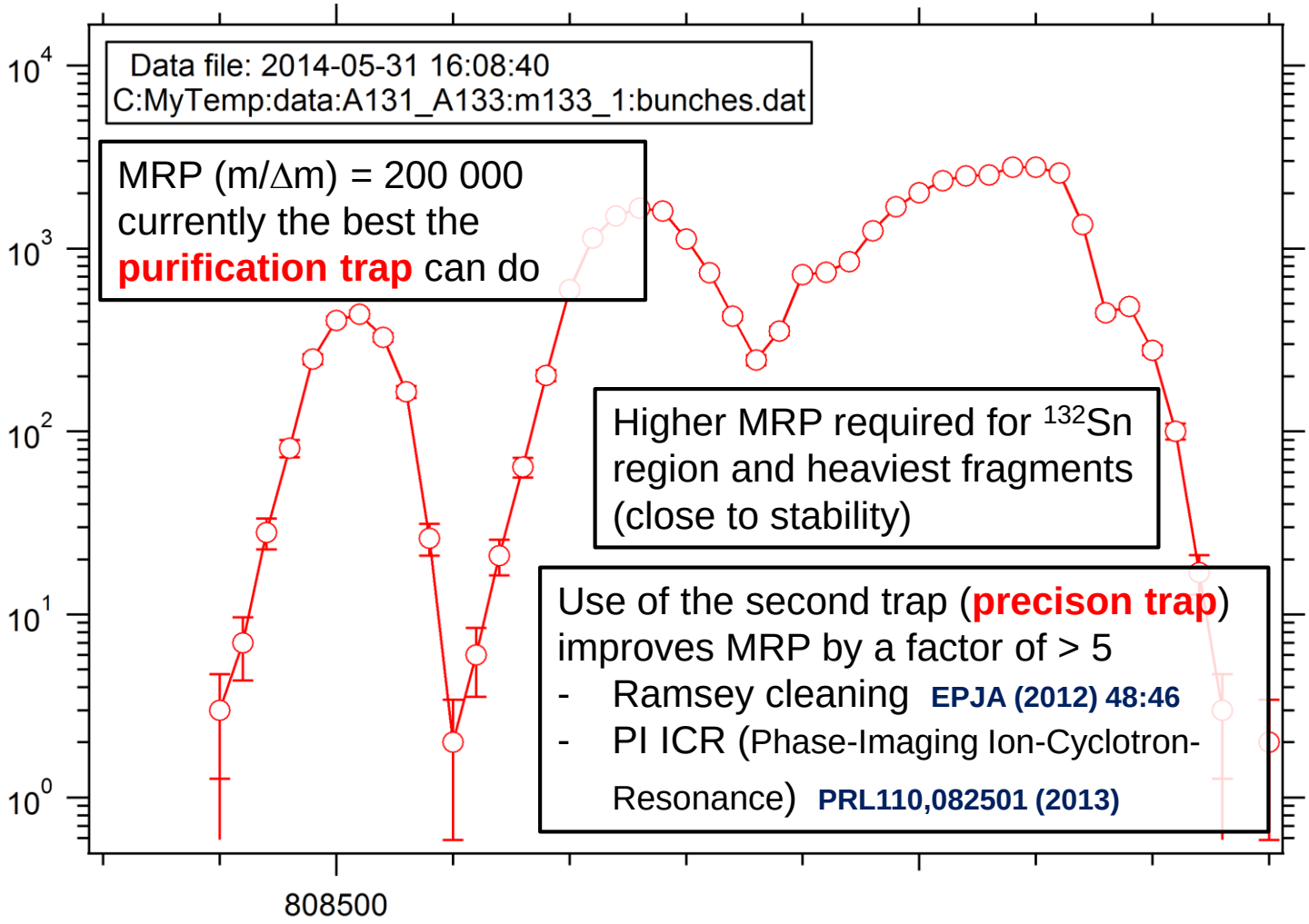
Overlapping peaks can be resolved using gaussian fit
Sufficient in this case – uncertainty order of 1%



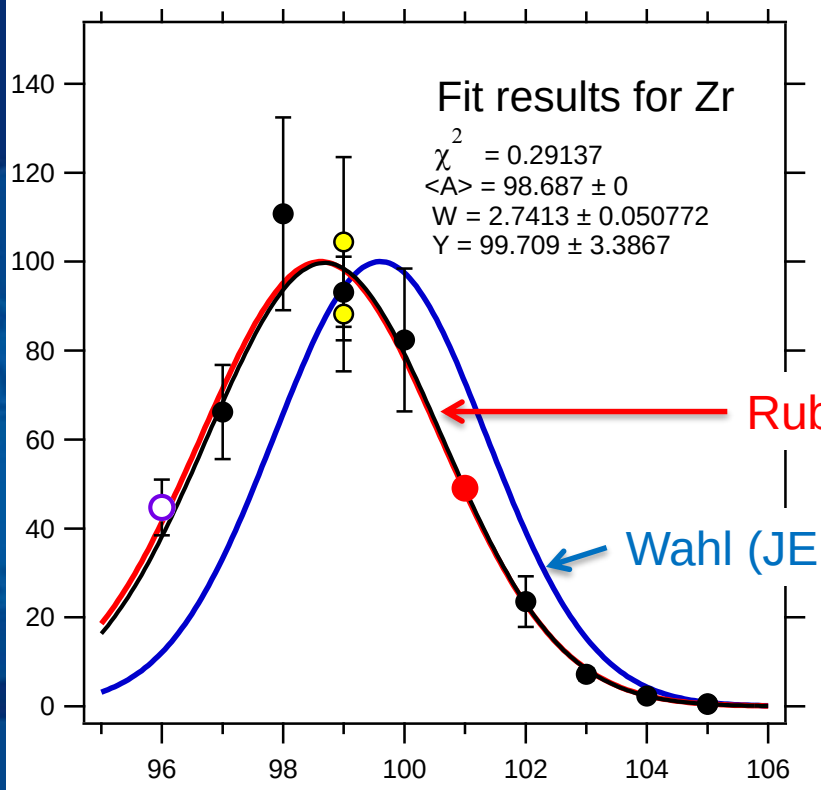
Even more challenging resolving by fit



Task for a fit master – at limits of the first trap

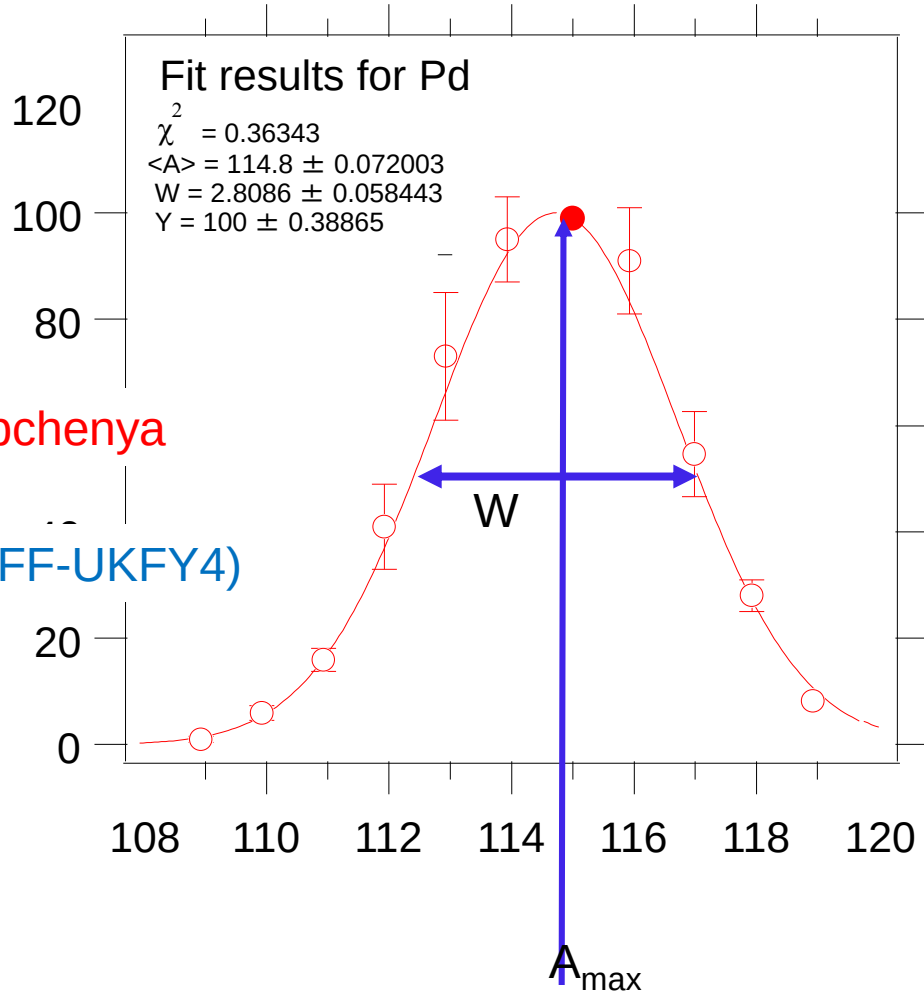


Presenting the results

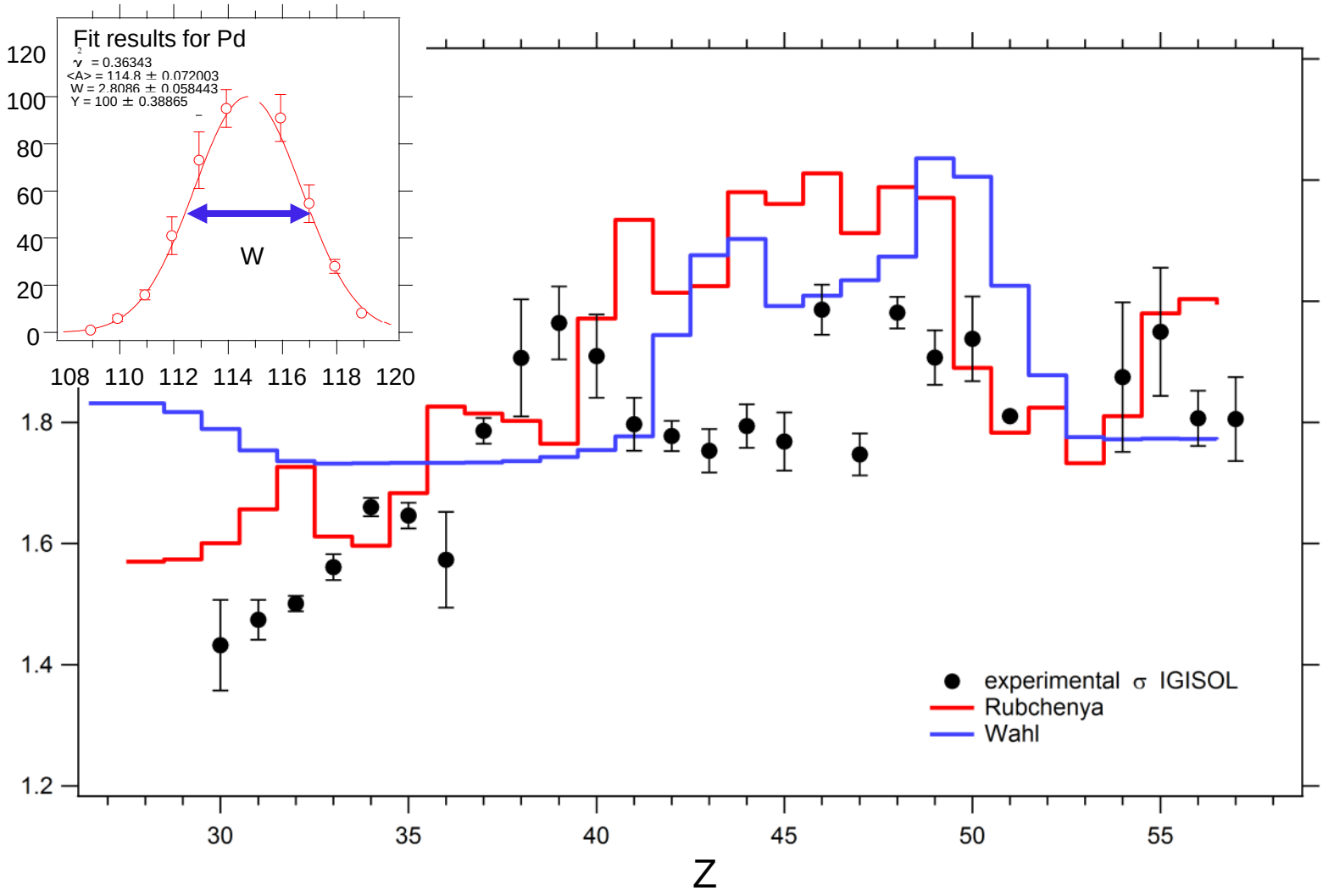


Rubchenya

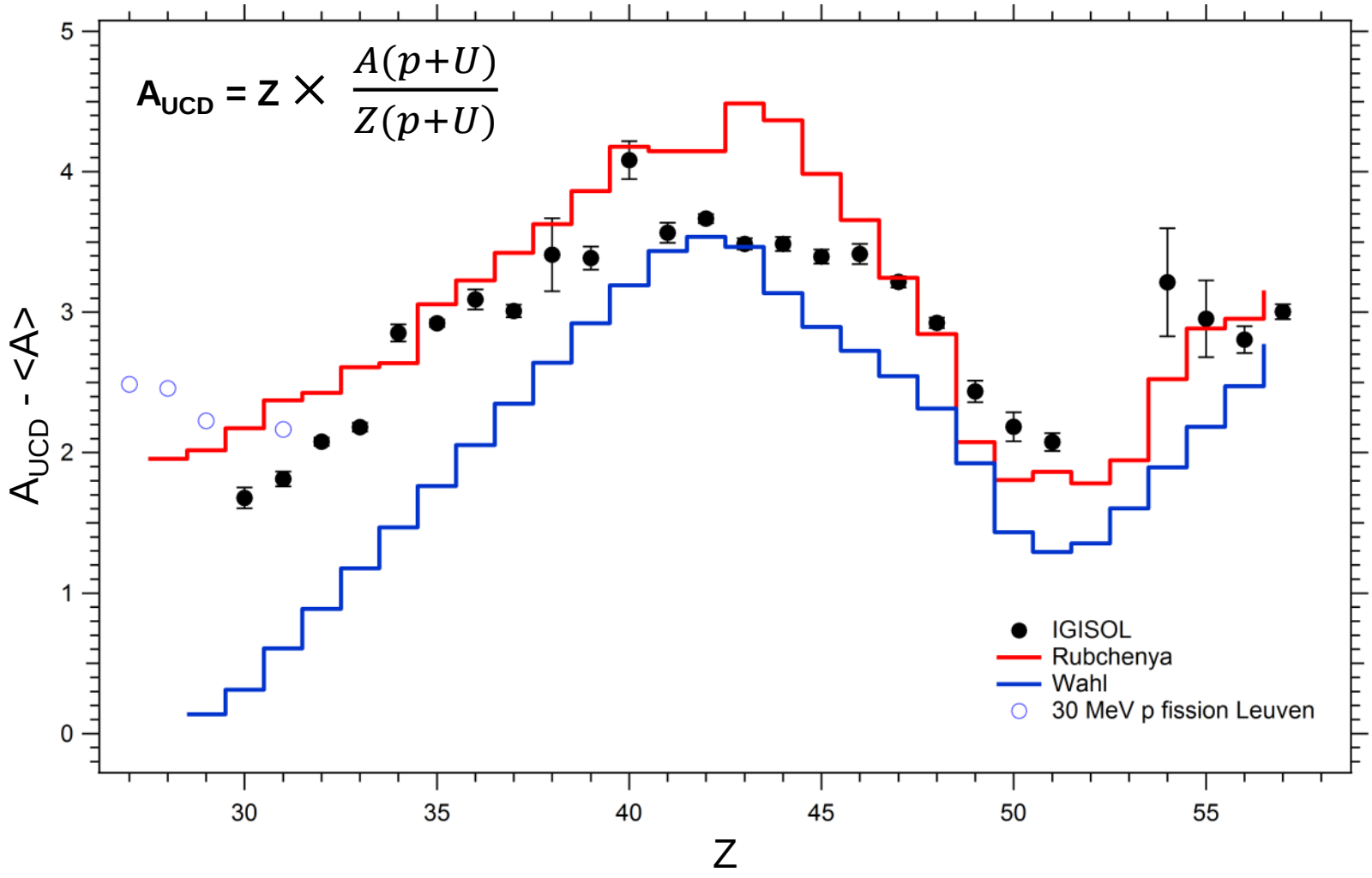
Wahl (JEFF-UKFY4)



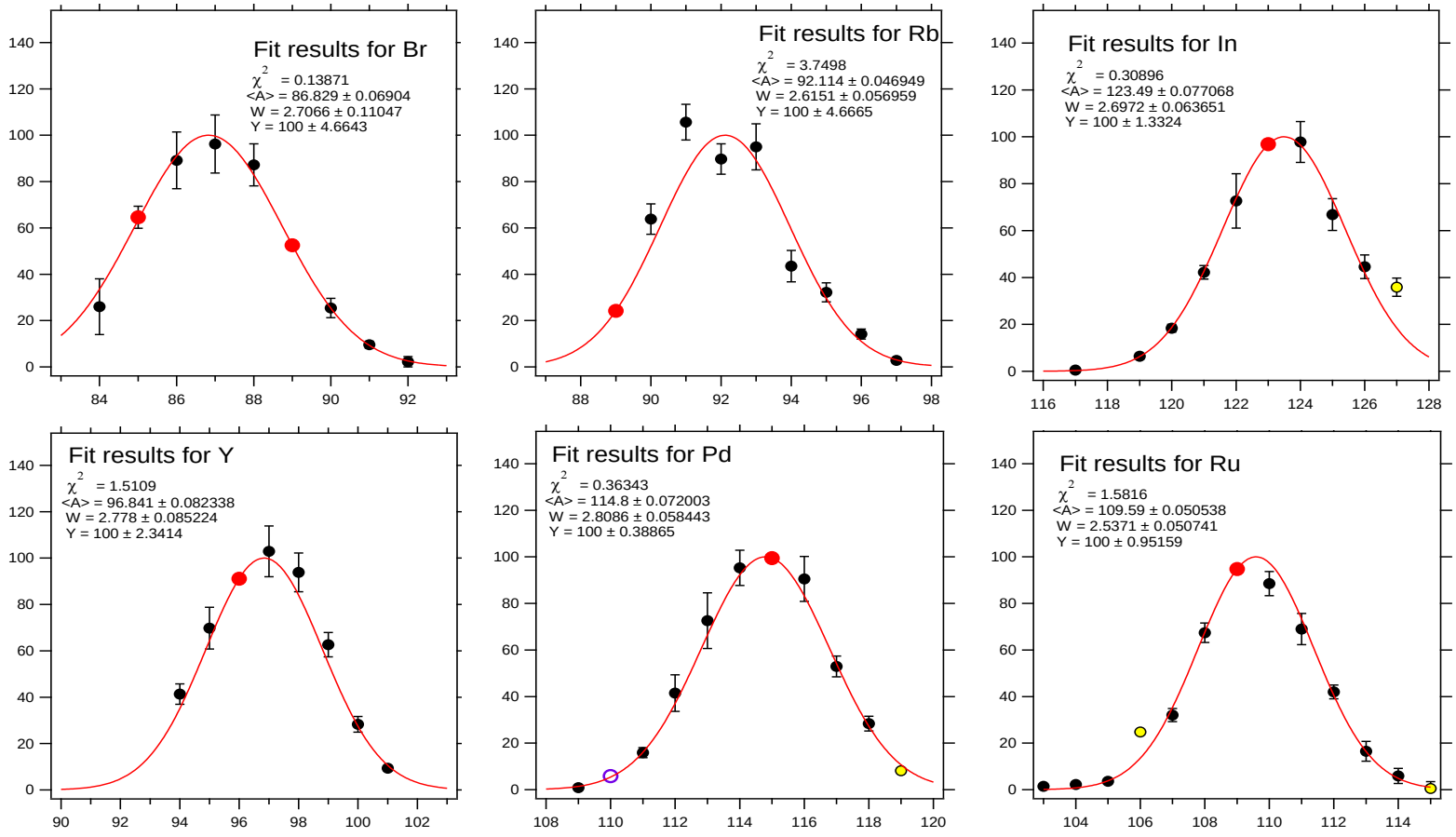
25 MeV p + ^{nat}U fission : widths



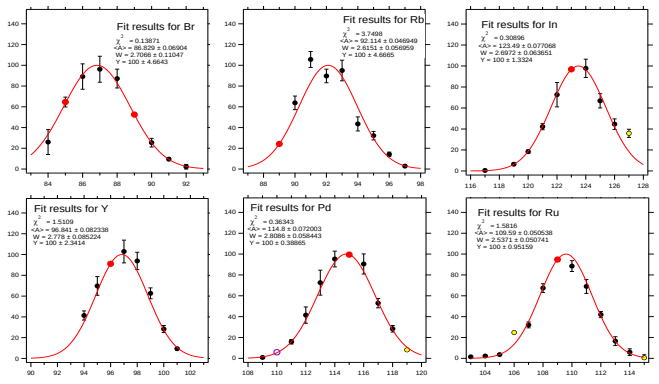
25 MeV p + ^{nat}U fission : centroids

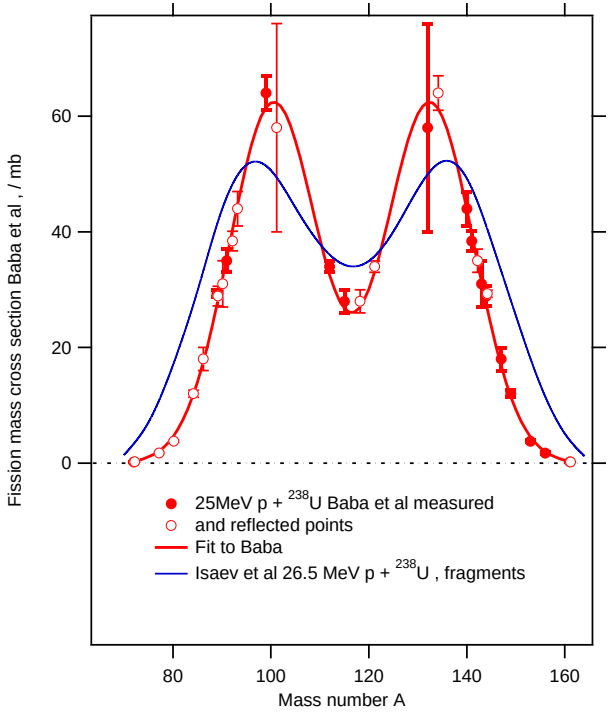


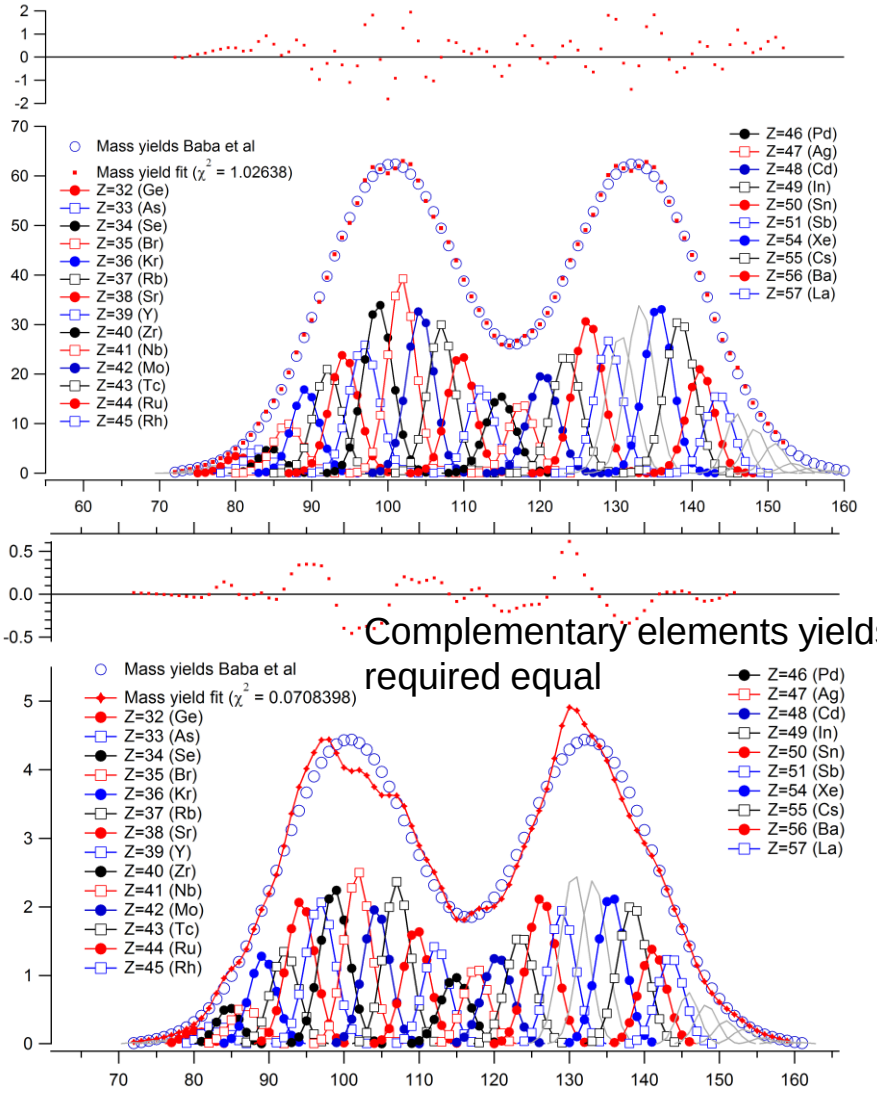
From isotopic yields to absolute yields?



Independent absolute yields?

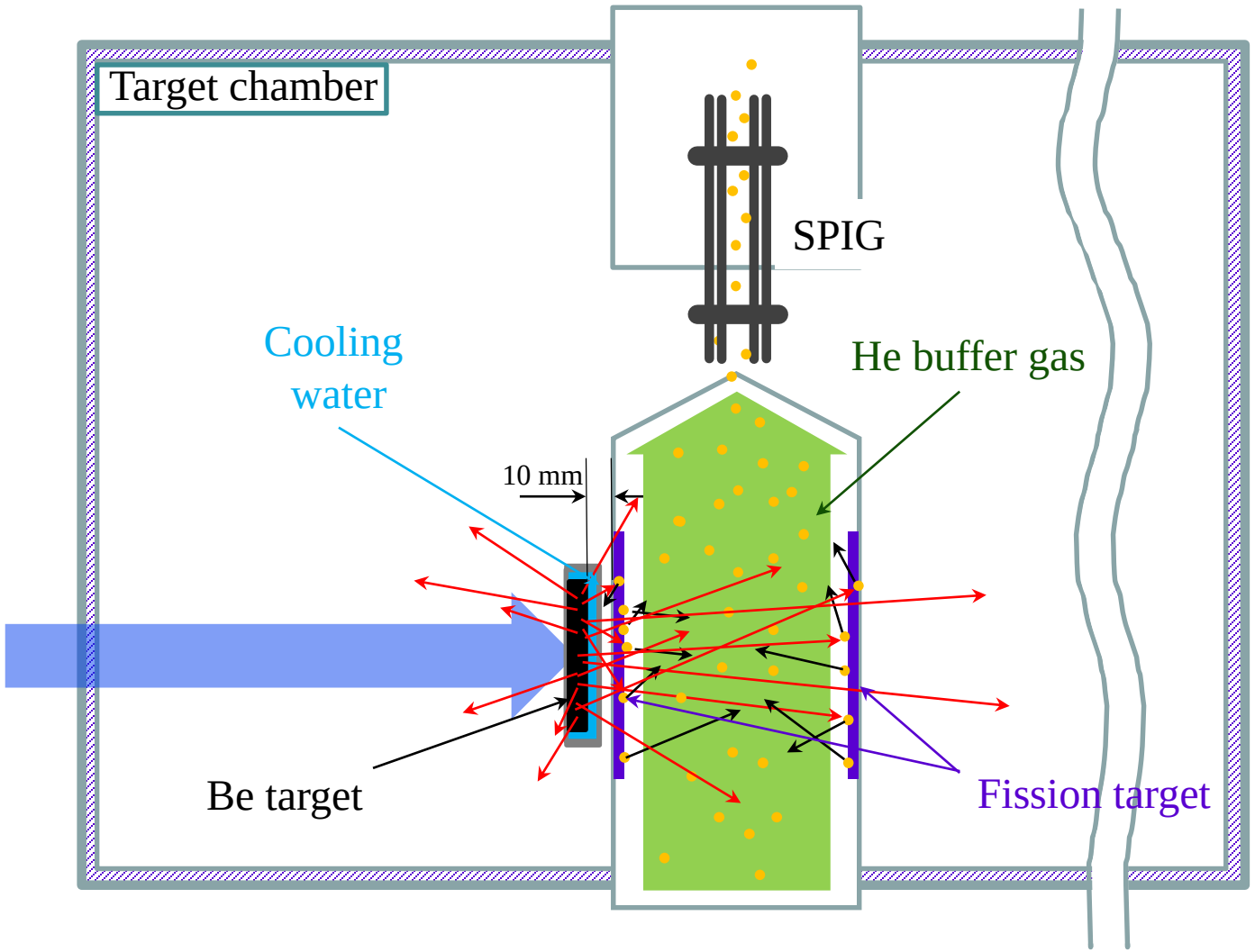




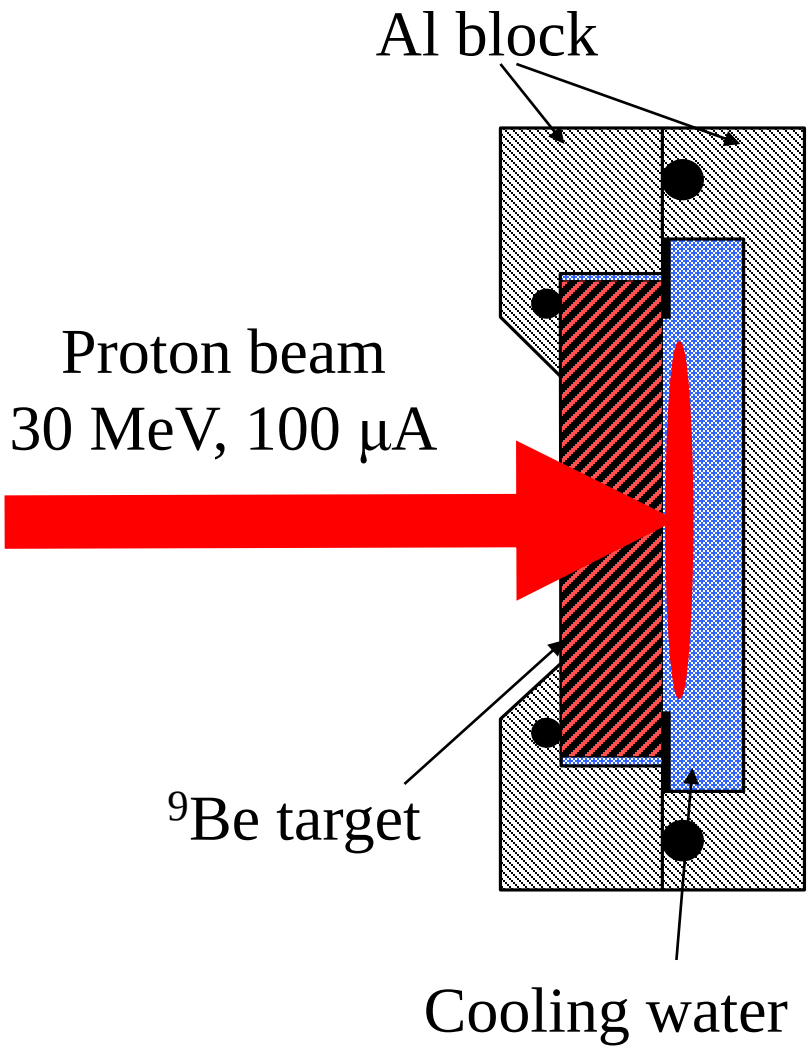


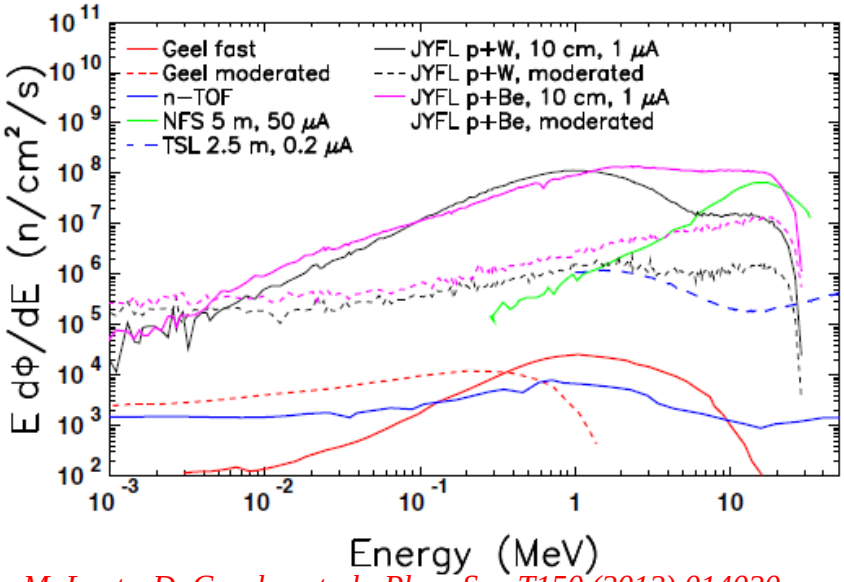
Complementary elements yields required equal

Future: neutron induced fission - concept

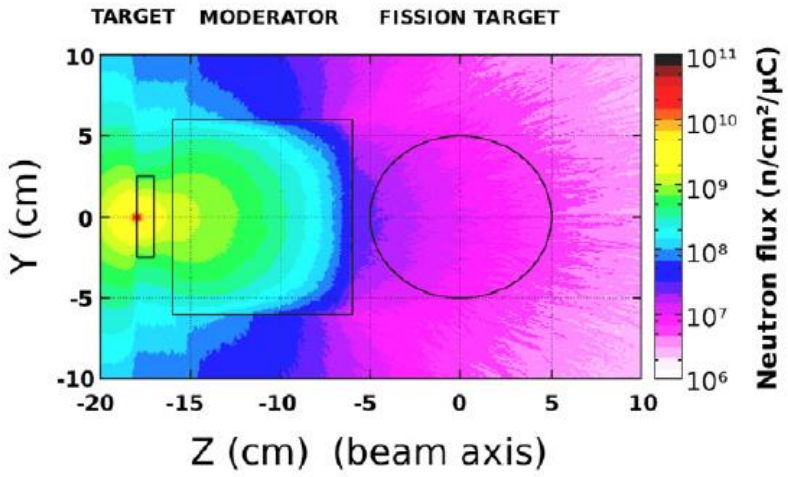


Neutron converter design

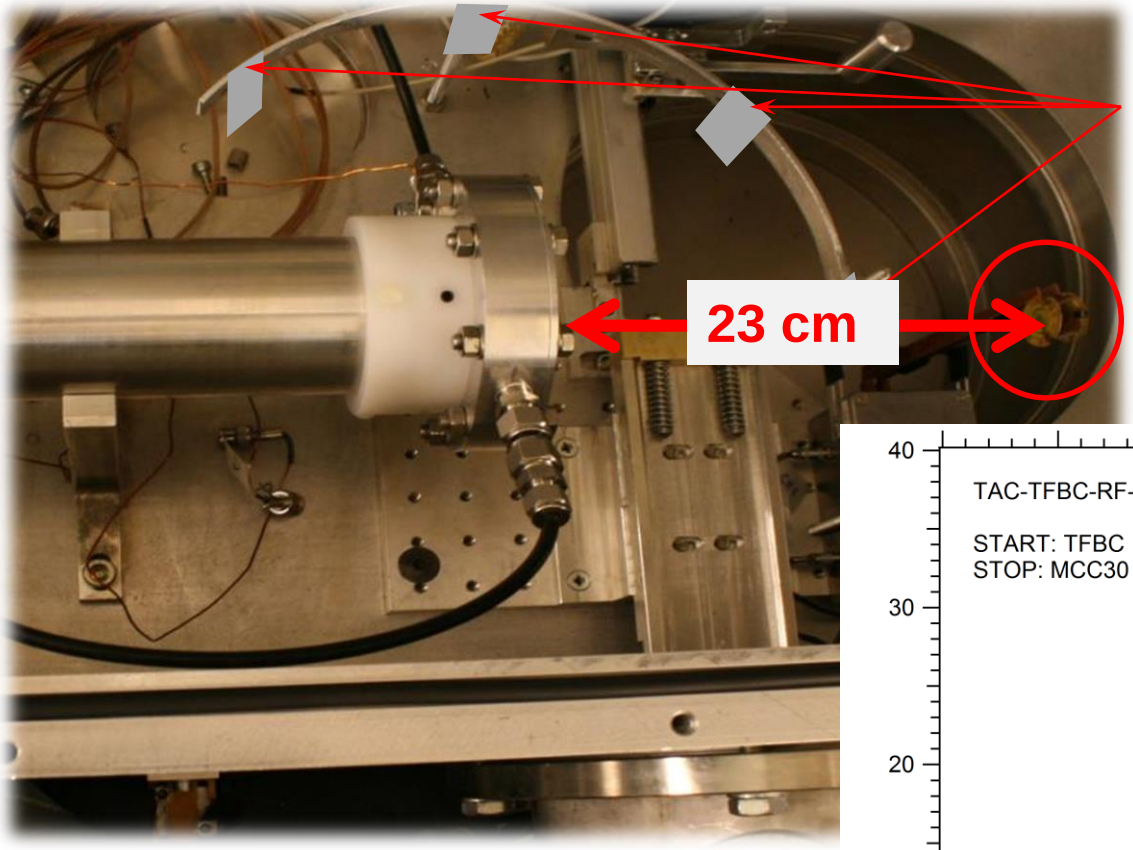




M. Lantz, D. Gorelov et al., Phys. Scr. T150 (2012) 014020

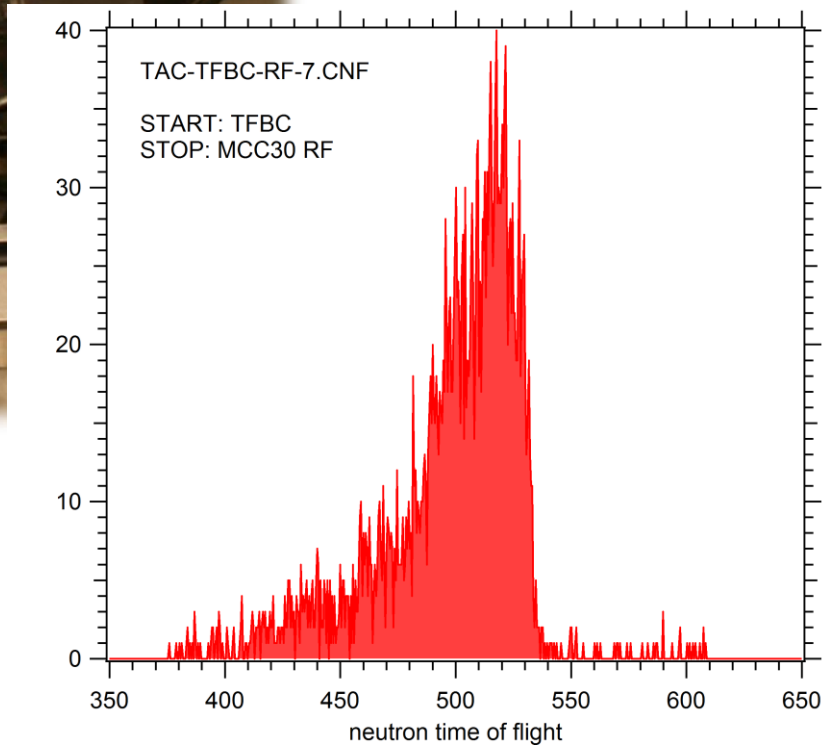


Neutron converter flux test (March 2014)



NAA target positions

TFBC with ^{238}U target



IGISOL group and relevant collaboration:

JYFL-IGISOL: H. Penttilä, A. Jokinen, I.D.Moore, J. Äystö, V.A. Rubchenya, S. Rinta-Antila, V. Kolhinen, T. Eronen, A. Kankainen, A. Voss, D. Gorelov, J. Hakala, V. Simutkin, V. Sonnenschein, I. Pohjalainen, J. Koponen, J. Reinikainen

Uppsala University: A. Al-Adili, K. Jansson, M. Lantz, A. Solders, C. Gustavsson, A.Mattera, A. V. Prokofiev, V. Rakopoulos, D.Tarrío, S. Wiberg, M.Österlund, S. Pomp

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