Independent fission yields with JYFLTRAP

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Independent fission yield distributions are important as input parameters in simulations of future ISOL-based radioactive beam facilities such as EURISOL [1]. Although the initial energy of the projectiles from a driver accelerator can be high, a considerable fraction of the fission yield is due to secondary low-energy protons and neutrons. Precise measurements of nuclear charge and mass distributions of fragments in fission reactions deliver valuable information on the dynamics of the large scale collective motion of nuclear matter. The dynamical calculations, even in the minimal collective-coordinate space, are still an open problem. Reliable information on the fission fragment mass and charge distribution for a wide energy region of neutrons and protons are needed for the theoretical model development.

A new approach to determine the independent yields of fission fragments, mass separated by IGISOL [2,3] has been developed. It is based on identifying and detecting fission product ions by direct counting after separation in the purification trap of the JYFLTRAP system with a typical mass resolving power of 10^5. Due to a fast separation time of IGISOL (few ms) only directly produced ions are detected and hence independent yields measured. The whole fission yield distribution can be mapped since the IGISOL technique is applicable to all elements. As the detection of isotopes is based on ion counting, the method is so efficient that measuring of a yield of a certain isotope can be done within a few minutes. The drawback of the method is that currently it provides only relative isotope yield distributions due to slight variations of the IGISOL efficiency for different elements. Figure 1 shows the relative fission yield curves for isotopes of some highly refractory elements in 25 MeV proton induced fission of ^{238}U. These mass distributions, which represent the most complete experimental data set of the fission yield for Zr, Nb and Mo in 25 MeV proton induced fission, were measured in less than 20 hours.

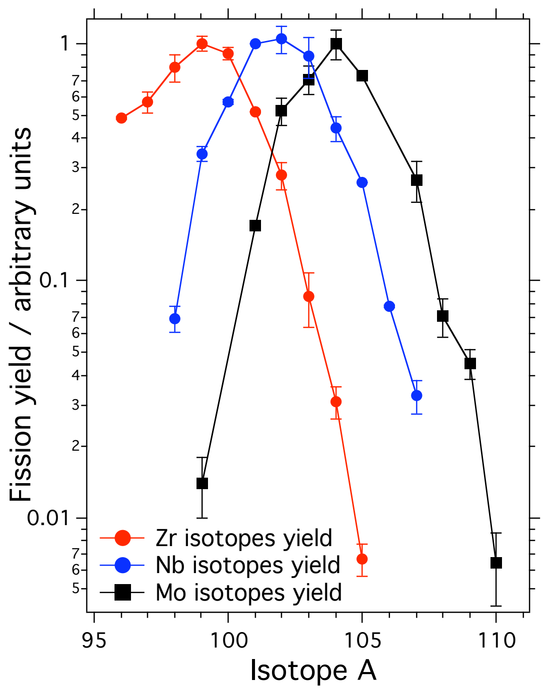

Figure 1. Isotopic distribution for Zr, Nb and Mo isotopes determined from isobaric scans after the purification trap. Yields are normalized to one for the maximum of each yield curve.

[1] The EURISOL Report, European Comission Contract No HPRI-CT-1999-50001, 2003.
[2] J. Äystö, Nucl. Phys. A 693, 477 (2001).
[3] H. Penttilä et al, Eur. Phys. J. A 25, Supplement 1, 745 (2005).