New results from combined isochronous mass spectrometry experiments with 238 U fission fragments at the FRS-ESR facility *

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The established correlation matrix method [1] has been applied to two different isochronous mass spectrometry (IMS) experiments. The analyzed experiments were performed with uranium fission fragments, but differ in the usage of the $B\rho$-tagging method [2].

In IMS experiments the storage ring can only be tuned to be isochronous for one specific mass-to-charge ratio (m/q). Particles with different m/q are only isochronous in a very limited $B\rho$ region. For these other m/q and large $B\rho$ deviations the mass accuracy of the method is reduced. In order to overcome this problem the $B\rho$ tagging technique uses slits at a high dispersive region in the FRS to accept only particles with a relative $B\rho$ deviation of 10^{-4}. This increases the mass accuracy but decreases the transmission efficiency. Besides the experimental differences in both experiments also the analyses of the data have been performed with different restrictions to the accepted data.

In previous analyses of the data in [3] and in [4] [5] additional restrictions were imposed on the measured data by removing events with poor isochronicity which then achieved a high mass accuracy down to a few 100 keV. In the new analysis there are no restrictions to both data sets and also single particles could be analyzed. Taking also single particles into consideration very exotic nuclei could be analyzed in the new method for the first time. In order to be able to achieve a reasonable error for those nuclei, which did not fulfill the conditions in each single experiment in the first place, both data sets have been combined [6].

Combining the two experimental data sets the masses of more than 15 nuclides could be analyzed for the first time (figure 1).

A special relevance for nuclear astrophysics has the mass of ^{130}Cd because this nuclide is a candidate for an r-process waiting point. The mass of this nuclide has a large impact on network calculations for nuclear astrophysics to explain the solar abundances of elements.

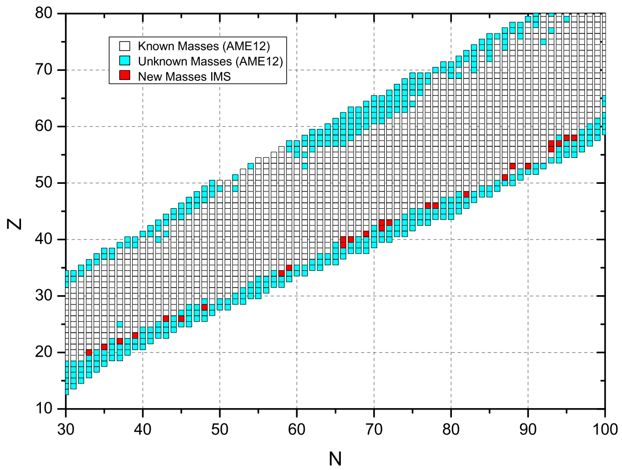

Figure 1: Figure 1: The chart of nuclides indicating nuclides with known in [7] (white), unknown (blue) and newly measured (red) masses.

References

[1] T. Radon et al., Phys. Rev. Lett. 78, (1997), p.4701-4704

[2] H. Geissel et al., Hyperfine Interactions 173, (2006), p.55-60

[3] M.Matos, PhD Thesis, JLU Giessen, (2004)

[4] R. Knöbel, PhD Thesis, JLU Giessen, (2008)

[5] B. Sun, Phys. Lett. B 688, (2008), p.294-297

[6] M. Diwisch, PhD Thesis in preparation, JLU Giessen, (2015)

[7] M. Wang, Chin. Phys. C, 36, (2012), p.1603-2014

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