Mass Measurement of ^{80}Y and ^{80}Zr with SARA ◇

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The data analysis of our A=80 mass measurements [1] is completed now and therefore we present the final results.

1. Experiment

The second cyclotron of SARA (Système Accélérateur Rhône-Alpes) of the ISN (Institut des Sciences Nucléaires) in Grenoble was used as a time-of-flight (TOF) mass spectrometer.

Secondary ions with $m/q = 80/27$ were produced by the fusion evaporation reaction ^{58}Ni + ^{27}Al and the time of flight through the cyclotron was determined with a channel-plate detector placed in front of the second cyclotron and the ΔE–signal of the solid-state telescope placed at the exit of the cyclotron. Furthermore this ΔE–E solid-state telescope was used for the Z-identification of the accelerated isobars.

2. Results

Using the well known mass of ^{80}Sr (m_{atom} = 79.924525(9) u [2]) as a reference, we obtained the masses of ^{80}Rb, ^{80}Y and ^{80}Zr. For ^{80}Rb we obtained a mass value of 79.922522(55) u, corresponding to an accuracy of $3.8 \cdot 10^{-8}$ compared to the well known value given by Audi and Wapstra [2].

Concerning ^{80}Y, 181 events were identified and the following mass value was obtained:

$$m_{\mathrm{atom}}(^{80}\mathrm{Y}) = 79.934320(180)\ \mathrm{u}$$

Fig. 1 compares this value to the mass predictions of Audi and Wapstra [2] (extrapolated from systematic trends) and the model predictions of Möller et al. [3], Jänecke and Masson [4], Aboussir et al. [5], and Duflo and Zuker [6,7]. The experimental value differs from the old experimental value of ^{80}Y [8,9] by 2.2 MeV.

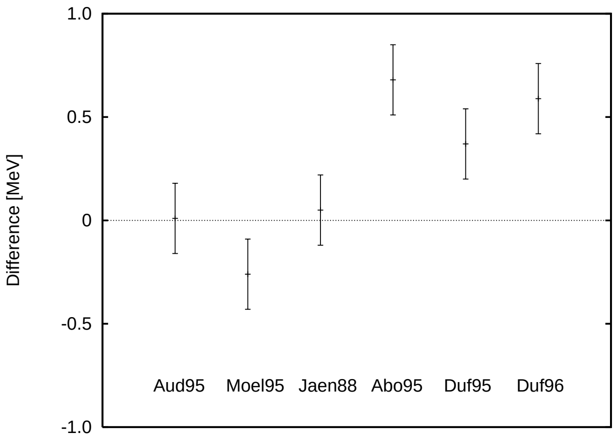

Fig. 1: Comparison between the new ^{80}Y mass value from our experiment and the mass predictions of Audi and Wapstra [2] and the different mass models [3–7]. $\Delta m = m_{\mathrm{pred}} - m_{\mathrm{exp}}$. The errors are only the experimental ones.

Due to the small production cross section only 1 event of ^{80}Zr was measured in a real measuring time of about 80 hours. This event is located in the ^{80}Zr area of the ΔE–E spectrum and it has the expected time of revolution. Taking this into account we calculated a probability of 0.999975 for the correct identification of this ^{80}Zr event.

Assuming the same peak width for ^{80}Zr (in the time-of-revolution spectrum) as measured for ^{80}Sr during this measurement, we got the following mass value:

$$m_{\mathrm{atom}}(^{80}\mathrm{Zr}) = 79.940400(1600)\ \mathrm{u}$$

This is the first experimental mass value for ^{80}Zr. Fig. 2 compares it to the mass predictions of Audi and Wapstra [2] (extrapolated from systematic trends) and the different mass models.

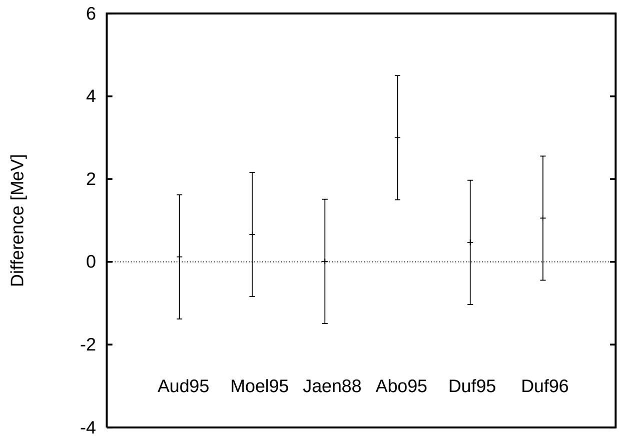

Fig. 2: Comparison between the new ^{80}Zr mass value from our experiment and the mass predictions of Audi and Wapstra [2] and the different mass models [3–7]. $\Delta m = m_{\mathrm{pred}} - m_{\mathrm{exp}}$. The errors are only the experimental ones.

References

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