MEASURING MASSES NEAR THE DRIP LINES : NEW MISTRAL RESULTS

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The MISTRAL experiment (Mass measurements at ISOLDE/CERN with a Transmission and Radiofrequency spectrometer on–Line), was built with the aim to determine masses of very short-lived nuclides with an accuracy of a few 10^{-7}. Masses are determined by measuring the cyclotron frequency of an ion in a homogeneous magnetic field. The ISOLDE separator beam (60 keV) is injected directly into the spectrometer alternately with a stable beam used as a mass reference. Both beams must follow the same trajectory into the same magnetic field. The measurement duration corresponds to the time-of-flight of the ions through the spectrometer ($\sim 50\mu$s) so that the limitation only comes from the ISOLDE production. Comparisons with the reference mass are performed very frequently to eliminate field drift effects. Results have been obtained for nuclides with half-lives as short as 30 ms. Accuracies of $\sim 5 \times 10^{-7}$ have been achieved thanks to the high resolving power ($\frac{m}{\Delta m} \sim 10^5$).

Upgrades of the apparatus are now underway to correct for residual magnetic field gradients and to reduce the emittance of the injected beams using a gas-filled linear Paul trap. The main purpose of this last upgrade is to improve the sensitivity of the apparatus, which is presently ~ 1000 ions/s, in order to measure masses of nuclides still further from stability.

Masses of several nuclides near the island of inversion around $N = 20$ (neutron rich isotopes of Na, Ne, and Mg) have been significantly improved. The ^{30}Na ($T_{1/2} = 48$ ms) and ^{32}Mg ($T_{1/2} = 95$ ms) results show an overbinding compared to previous measurements, indicating an enhanced deformation, while $N = 20$ magicity is observed near the stability. This observation is in agreement with recent calculations in the frame of the shell model by Caurier *et al.* [1]. According to this model, the island of inversion should disappear at $N = 22$ within reach of the future MISTRAL program.

Recently the $N = Z$ nuclide ^{74}Rb ($T_{1/2} = 64.9$ ms) has been measured. Data will be presented at this conference. This measurement will contribute to constrain the Q–value of the super–allowed $O^+ - O^+$ β–decay which is important for testing the electroweak sector of the standard model [2]. The new mass of ^{74}Rb, greatly improved by MISTRAL, combined with that of ^{73}Rb (derived from ^{73}Kr by Coulomb displacement energy) allows to assess the Wigner effect of N=Z nuclei. The Wigner energy term at high A will be discussed.

References

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