EXPLORING MASSES AT THE DRIP LINE: THE MISTRAL NEW RESULTS

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The MISTRAL experiment (Mass measurement at ISOLDE/CERN with a Transmission and Radiofrequency spectrometer on–Line), is well suited for mass determination of very short–lived nuclides. 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 follow the same trajectory at constant magnetic field. The technique is rapid because the measurement duration corresponds to the time–of–flight of the ions through the spectrometer ($\sim 50\mu$s). It is also very precise since it is capable of very high resolving power ($\frac{m}{\Delta m} \sim 10^5$). The magnetic field fluctuations are small and comparisons with a reference mass are performed very frequently to eliminate field drift effects. Results have been obtained in conformity with all aspects of the projected spectrometer performance: masses of nuclides with half–lives as short as 30 ms have been measured and accuracies of $\sim 5 \times 10^{-7}$ have been achieved, despite the difficulties with isobaric contaminations in the beam. Upgrades of the apparatus are now underway to correct for residual magnetic field gradients and to reduce the emittance of the injected bean using a gas–filled linear Paul trap. The latest upgrade will allow the apparatus to measure nuclides further from the 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 in order to clarify the strength of the shell closure. The ^{30}Na ($T_{1/2} = 48$ ms) and ^{32}Mg ($T_{1/2} = 95$ ms) result shows an overbinding compared to previous measurements, indicating enhanced deformation, where $N = 20$ magicity was expected. This result is confirmed by recents calculations in the frame of the shell model of Caurier *et al.* [1]. According to this model, the island of inversion should disappear at $N = 22$ within reach of MISTRAL futur program. Recently the $N = Z$ nuclide ^{74}Rb ($T_{1/2} = 64.9$ ms) has been measured. Data are under analysis and 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 mass of ^{74}Rb, importantly 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.

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[2] J.C. Hardy and I.S. Towner, *Proceedings of The 2nd Euroconference on Atomic Physics at Accelerators: Mass Spectrometry*, (Cargèse, France, 2000). Hyperfine Interactions (in press).