RECENT RESULTS FROM THE MISTRAL MASS MEASUREMENT PROGRAM AT ISOLDE

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The MISTRAL experiment (Mass measurement at ISOLDE with a Transmission and RAdiofrequency spectrometer on-Line), is well suited for very short half-lived nuclides. Commissioning of the spectrometer has been completed in conformity with all the projected performances. Masses of several short-lived nuclides, including ^{30}Na and ^{32}Mg, have been significantly improved. Recently the N=Z nuclide ^{74}Rb was measured and a preliminary result is given.

1 Experimental set-up

MISTRAL is a new technique based on the rf-mass-spectrometer principle established by L. G. Smith for stable atoms [1]. It has been adapted for measuring atomic masses of very short-lived nuclides [2]. Mass determination results from comparing the cyclotron frequencies of two ionic species orbiting alternately in a homogeneous magnetic field. The kinetic energy of the ionic beams is modulated at both extremities of a full revolution by a rf signal. As the two modulations interfere, a series of sharp transmission peaks is obtained when the rf frequency is swept. The ISOLDE separator beam (60 keV) is injected directly into the spectrometer alternately with a stable beam used as a mass reference. Both beams are injected on the same trajectory at constant magnetic field. Since the measurement duration is limited by the time of flight of the ions through the spectrometer ($\sim 50\mu s$) the technique is rapid. Even though a calibration to correct for small frequency deviations has to be applied, an accuracy of $\sim 5\times10^{-7}$ is reached. The method has a sensitivity of about 10^3 ions per pulse delivered by the separator. In spite of a resolving power of $\frac{m}{\Delta m}\sim 10^5$, difficulties can occur in case of isobaric contamination.

2 Results

Accurate mass determination in the area N=20 of the nuclidic chart is important for clarification of the strength of the shell closure. Neutron rich isotopes of Na were measured with a surface ionization source out to ^{30}Na ($T_{\frac{1}{2}} = 48ms$)[4]. In Table 1 the measured mass, mass excess and deviation from the AME95[3] mass table are given. In the same area of the chart ^{25}Ne, ^{26}Ne and ^{32}Mg were measured using a plasma ion source [5] (Table 1). The non-selectivity of such a source was responsible for difficulties with isobaric contamination of the beam. For that reason a new measurement will be undertaken this year on neutron rich Mg isotopes with a selective laser ion source. As for ^{30}Na, the ^{32}Mg result shows an overbinding compared to previous measurements, indicating an enhancement of the binding energy and consequently a weakening of the normally stabilization effect of the N=20 shell closure.

Recently the N=Z nuclide ^{74}Rb has been measured using a surface ionization source. A preliminary result is given in (Table 1). It will contribute to constrain the Q-value of the $0^+ - 0^+$ decay, of importance for testing the electroweak sector of the standard model.

Table 1: MISTRAL mass measurement results. The ^{74}Rb mass is preliminary.

Nuclide	mass (u)	mass excess (keV)	MISTRAL-AME95 (keV)
^{25}Ne	24.997707 (32)	-2136 (30)	-77
^{26}Ne	26.000461 (33)	429 (30)	0
^{26}Na	25.992630 (9)	-6864 (8)	38
^{27}Na	26.994080 (16)	-5514 (15)	66
^{28}Na	27.998935 (17)	-991 (16)	42
^{29}Na	29.002868 (17)	2672 (16)	53
^{30}Na	30.009041 (22)	8429 (20)	-173
^{32}Mg	31.998858 (113)	-1063 (105)	-268
^{74}Rb	73.944348 (107)	-51836 (100)	-116

References

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