IS373* - MISTRAL

(Mass measurements at ISOLDE using a Transmission and RAdiofrequency spectrometer on-Line)

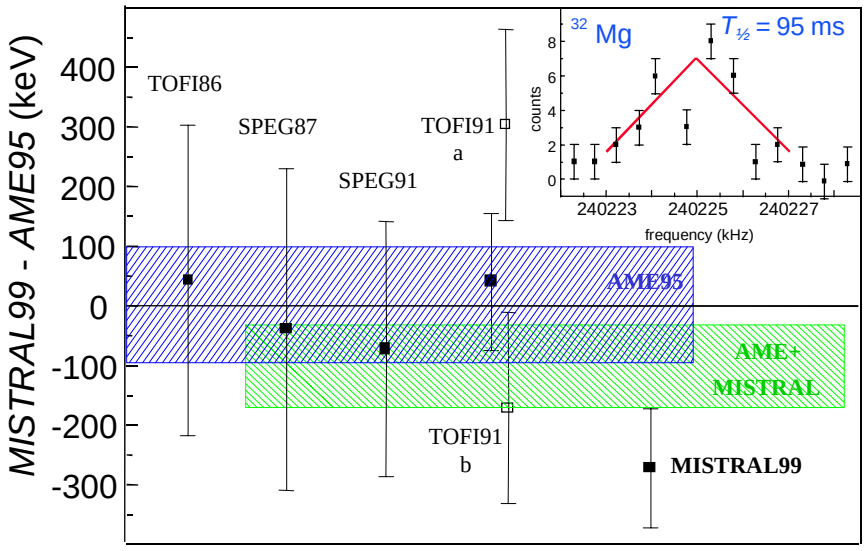
The goal of the MISTRAL experiment (CERN-EP, CSNSM-Orsay, IAP-Bucharest, GSI-Darmstadt collaboration) is to perform precision measurements of the masses of exotic nuclides produced at CERN's mass separator facility ISOLDE. MISTRAL is especially suited for this vocation due to its very rapid measurement time that gives access to the shortest-lived (i.e., most exotic) nuclides that can be produced.

The ISOLDE beam is injected into the spectrometer which is composed of a homogeneous magnetic field of 1 meter diameter and makes two turns (at the cyclotron frequency) before being directed onto a detector. At the beginning and the end of one cyclotron period the beam energy is modulated by a longitudinal, radiofrequency electric field. When the scanned radiofrequency corresponds to an integer-plus-one-half multiple of the ion cyclotron frequency, the recorded signal will exhibit a high-resolution peak, the position of which is compared to that of a calibrant mass to obtain a high-precision measurement.

The data collected during the 1999 run with the plasma ion source have now been analyzed and were the subject of the Collaboration's second doctoral thesis. Difficulties with the enormous amount of (sometimes unidentifiable) isobaric contamination limited the success of this run to only three new measurements: $^{25\text{-}26}$Ne and the exotic nuclide ^{32}Mg, an important candidate for the phenomenon of shell "openings" that happen in nuclear configurations of extreme neutron to proton number ratio. The magic number at N=20 should nomally be a shell "closure".

An attempt was made in early 2000 to improve these measurements using isobaric mass doublets directly from the ISOLDE beam but only with limited success ($^{29\text{-}30}$Mg) due to insufficient production and omnipresent contamination.

The balance of allotted shifts for comissioning the spectrometer are scheduled for 2001 when we will exploit the beam purity afforded by the laser ion source to confirm and extend the measurements to heavier Mg isotopes. In the meantime a measurement was made late in 2000 of the $N = Z$ nuclide ^{74}Rb, a super-allowed β-emitter of interest for constraining the electroweak sector of the standard model (see IS-384).



MISTRAL measurement of ^{32}Mg with respect to other values comprising the mass in the evaluation (Audi & Wapstra, 1995). The overbinding of this exotic, normally closed-shell nuclide enhances the shell "opening" effect due to nuclear deformation. (inset) The recorded, high-resolution mass peak.

*originally approved as IS346 (now completed) and continuing as IS373

The MISTRAL Collaboration (D. Lunney, spokesperson) March 15, 2001