IS373* - MISTRAL

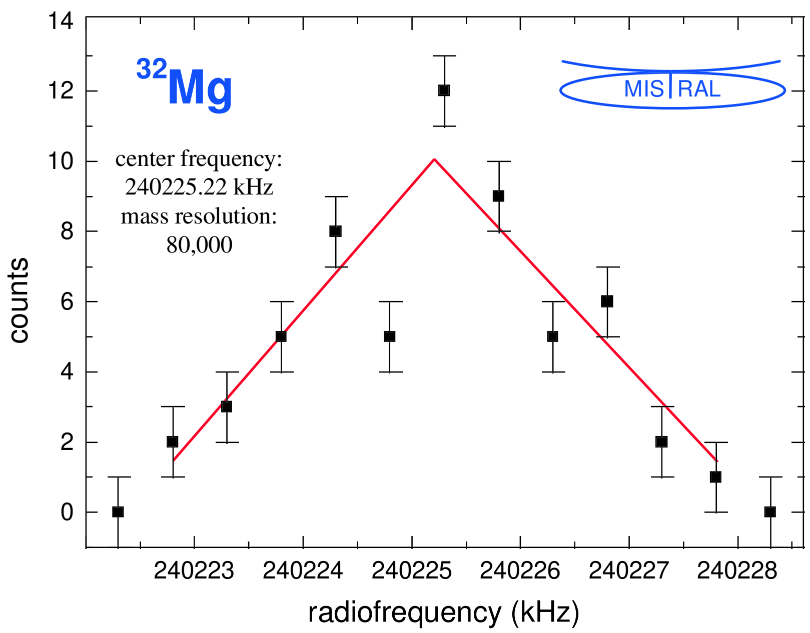
(Mass measurements at ISOLDE using a Transmission and RAdiofrequency spectrometer on-Line)

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 an annular 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 excited by a longitudinal, radiofrequency electric field. If the scanned radiofrequency corresponds to an integer-plus-one-half harmonic of the ion cyclotron frequency then the transmission signal on the detector will exhibit a sharp, high-resolution peak. When this peak position is compared to that of a calibration mass, measurements of very high precision result.

During 1999, the collaboration had a successful run during which the masses of 10 isotopes were measured including the exotic ^{32}Mg, an important candidate for verification of the persistence of nuclear shell structure at N = 20 (see recorded mass peak in the accompanying figure). These measurements were particularly challenging due to the presence of enormous isobaric contamination – a side effect of the efficient plasma ion source. The analysis of these data is still underway while the final analysis from the two 1998 runs was completed and submitted for publication in the wake of a doctoral thesis.

A further run will be scheduled in early 2000 in order to extend the measurements in this same region. Verification of the compatibility of MISTRAL data from run to run will complete the commissioning of the spectrometer at ISOLDE. A new proposal is also planned for $N = Z$ nuclides to study the Wigner energy that is related to isospin symmetry as well as measurements of super-allowed β-emitters that can allow low energy, precision nuclear physics experiments to place constraints on the standard model.



The high-resolution mass peak of ^{32}Mg produced at ISOLDE and recorded by MISTRAL. It represents the most precise mass measurement ever of this exotic nuclide that sits on a closed neutron shell (N=20).

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*originally approved as IS346, the allotted beam time was used up and the experiment now continues as IS373