Experimental and theoretical studies of exotic nuclei at ISOLDE

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ISOLDE: the RIB facility at CERN

Strong commitment of the collaboration for the implementation of HIE-ISOLDE project
IS530:
Beta decay of $^{34}$Mg measured at ISOLDE

Scientific Motivation:
- $^{34}$Mg – the heaviest in the “Island of Inversion”
- Scarce information on $^{34}$Mg
- No Level Scheme available for $^{34}$Al
IS530: The experimental setup

- Structure – based on OSIRIS (Bucharest)
- 3 CLOVER detectors (Bucharest)
- 1 HPGe detector (90%) (Strasbourg)
- 5 LaBr$_3$ detectors (4 Legnaro, 1 Bucharest)
- $\sim 4\pi$ plastic scintilator (Bucharest)
- 3 neutron detectors (DEMON, Strasbourg)
- Tape station (Strasbourg)

Data taking: September 2012
ROmanian array for SPectroscopy in HEavy ion REactions

Two configurations:

- Mixed array with 14 50% HPGe detectors with BGO shields and 11 LaBr$_3$(Ce) scintillators
- 25 HPGe detectors array
Preliminary Results from IS530

- New Level Scheme for $^{34}$Al (previously unknown) via $\beta$-γ-γ coincidences
- Measured a half-life of 63(1) ms for $^{34}$Mg
Preliminary Results from IS530

- Analysis of “double-hit” type events lead to 19.3(7) ns half-life of $0_2^+$ level in $^{34}$Si
- Improved level scheme for $^{34}$Si
$^{80}\text{Ga}$ – a tough test for shell-model interactions

R. Lica et al.  
_to be published_

\[ B(\text{M2; } 1^+ \rightarrow 3^-) \text{ [W.u.]} \]

- **Exp:** 0.60(2)
- **JJ44BPN:** 0.22
- **JUN45:** $\sim 10^{-4}$
Shape coexistence phenomena in neutron-rich A~100 nuclei

Structure and $\beta$-decay properties using complex Excited Vampir beyond-mean-field model

- large model space for both protons and neutrons:

  $1p_{1/2} \ 1p_{3/2} \ 0f_{5/2} \ 0f_{7/2} \ 2s_{1/2} \ 1d_{3/2} \ 1d_{5/2} \ 0g_{7/2} \ 0g_{9/2} \ 0h_{11/2}$

- renormalized G-matrix (Bonn A potential)

structure and $\beta$-decay: $N=58$ critical number

$^{102}\text{Tc}_{59} \rightarrow ^{102}\text{Ru}_{58}$

$^{104}\text{Tc}_{61} \rightarrow ^{104}\text{Ru}_{60}$

- Isolde workshop, CERN, Dec. 2013 (talk)
- HNPS2013, Athen, May 2013 (invited talk)
- NSP2013, Padova, June 2013 (invited talk)
- EPJ Web of Conf., 2013
The ISCC agreed to the construction of a **fixed decay spectroscopy station IDS (ISOLDE Decay station)** on a dedicated beam line.

An international collaboration including groups from **Belgium, Romania, France, Spain** is presently formed to carry on the project.

Since the most complete and complex decay spectroscopy setup recently used at ISOLDE is **that used for the IS530 experiment**, this is proposed as starting point for the fixed decay station.
ISOLDE Decay Station Phase 1

- Frame from Osiris available at IFIN Bucharest
- Tape station available from KU Leuven
- Miniball triple
- Plastic scintillators mounted around the implantation point
- 2 HPGe clovers from IFIN-HH Bucharest
- 2 HPGe clovers from KU Leuven
- 1 Miniball triple cryostat from KU Leuven
- LaBr$_3$(Ce) detectors from IFIN-HH and Univ. Complutense Madrid
In view of HIE-ISOLDE

An addendum for the $^{34}$Mg experiment using IDS will be submitted in February 2014

IDS proposals to INTC in October 2013

- Decay of $^{150,151,152}$Cs
- Decay of $^{207}$Hg
- Decay of $^{123,125}$Ag
- Decay of $^{31}$Ar
- Study of $^{211,213}$Tl, $^{213}$Pb
- $0^+$ and $2^+$ states in $^{68}$Ni

Secure the Romanian contribution to the experimental infrastructure of the ISOLDE Decay Station and the first-rank position inside the collaboration