

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Status report to the ISOLDE and Neutron Time-of-Flight Committee

IS530: Properties of low-lying intruder states in ^{34}Al and ^{34}Si sequentially populated in beta-decay of ^{34}Mg

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Abstract

A report on the status of the IS530 experiment is presented along with a list of preliminary results. In order to improve the existing statistic and reach all the goals of the original proposal, we request the allocation of the remaining shifts plus some additional time through an adjacent addendum.

Remaining shifts: 7 shifts

1. Motivation and technique:

New information on heaviest nucleus (^{34}Mg) of the $N\sim 20$ “island of inversion” and its daughters will be obtained, contributing to understanding of normal and intruder states competition in this intensively studied region of the nuclear chart. The absence of previous beta-gamma experiments on ^{34}Mg and the recent evidence for low-lying long-lived



(26 ± 1 ms) isomer in ^{34}Al [1] feeding through β -decay the 0_2^+ state in ^{34}Si are the main experimental arguments in favour of the proposed study. Indeed, the new isomer in ^{34}Al is most probably an $1+$ state based on the intruder configuration rather close near the $4-$ ground state of ^{34}Al of normal configuration. The β -decay of the ^{34}Mg $0+$ ground state is, therefore, expected to populate the $1+$ isomer stronger than $4-$. Thus, beside a first level scheme in ^{34}Al , complementary information will be obtained in ^{34}Si double-magic nucleus, compared to previous measurements of $^{34}\text{Al}(4-) \rightarrow ^{33,34}\text{Si}$ transition [2, 3]. In particular, the aim is to measure the intensity of the $2^+ \rightarrow 0_2^+$ transition in ^{34}Si in order to extract the $B(E2; 2^+ \rightarrow 0_2^+)$ to better understand how the deformation evolves from ^{36}S towards ^{32}Mg .

2. Performed studies:

The IS530 experiment was performed in September 2012. The beam intensity was comparable with ISOLDE database estimate and beam purity very high such that the LIST mode (giving anyway very low intensity) was not necessary. The main results of data analysis performed so far by two master students in Bucharest are the following:

- new beta-time for ^{34}Mg : 63 ± 1 ms instead of 20 ± 10 ms [4]
- strong population of previously discovered ($1+$) isomer in ^{34}Al and 10 new states above it such that a first level scheme of ^{34}Al was established.
- surprisingly, no direct or indirect feeding was observed to the known $4-$ state in ^{34}Al , raising the question of which of the two beta decaying states in ^{34}Al is actually the ground state. Following this result, a mass measurement at ISOLTRAP was proposed and accepted by INTC for the two states
- the decay toward ^{34}Si also revealed 2 new states in this nucleus
- the absence of neutron coincidences, despite the low neutron efficiency (0.1%), was clearly confirming the assignment of new transitions in ^{34}Al and ^{34}Si (just because transition with much lower intensities in ^{33}Al and ^{33}Si were indeed observed in coincidence with neutrons)
- relative intensities in the two beta-decay schemes were determined, while the absolute intensities are still to be worked out. Theoretical estimates for $^{34}\text{Al}(1+)$ decay scheme presented in the proposal are in good agreement with measured data.

Accepted isotopes: ^{34}Mg

For future plans and beam request, see separate addendum.

References:

- [1] F. Rotaru et al., Phys. Rev. Lett. 109, 092503 (2012)
- [2] S. Numella et al., Phys. Rev. C 63, 044316 (2001)
- [3] S. Pietri, PhD thesis, Universite de Caen (2003)
- [4] M. Langevin et al., Nucl. Phys. A 414, 151 (1984)

Appendix

Theses

S. Toma, Master Thesis, University Politenica of Bucharest, 2013

Workshops/Conferences

R. Lica et al., presentation at ISOLDE workshop 25-28 Nov 2013