BETA DECAY OF THE MOST NEUTRON-RICH ISOTOPES CLOSE TO ^{78}Ni*

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In an experiment at the HRIBF, Oak Ridge National Laboratory, USA, we have investigated excited states in ^{86}Se populated in the beta-decay of ^{86}As. Several new transitions were identified. Preliminary results are presented.

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1. Introduction

The study of the structure of excited states in the most neutron-rich selenium isotopes, in particular ^{86}Se, has attracted considerable attention in recent years both from experiment and theory point of views [1, 2]. With the exclusion of very early work in which the first excited 2^+ state was identified through beta-decay of ^{86}As [3], later studies focused on higher-spin excited states populated in prompt fission. Here, we report on the investigation of low-lying excited states in ^{86}Se populated in the beta decay of ^{86}As.

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2. Experiment

A neutron-rich radioactive beam of mass 86 was produced in the proton-induced fission of ^{238}U. A proton beam accelerated to 54 MeV by the ORIC cyclotron at the HRIBF facility, Oak Ridge-TN, USA [4], impinged on a $^{238}UC_x$ target. The fission fragments diffused out of the target and were ionized to charge state +1 in the IRIS-2 ion source. Ion source chemistry was used to suppress isobaric contaminants and obtain almost pure germanium and arsenic beams [5]: H_2S gas was added to the ion source, and molecular beams of GeS^+ and AsS^+ were extracted from the ion source. Two-stage mass separation at mass $A + 32$ and A, respectively, allowed for suppression of the vast majority of isobaric contaminants. The purified isobaric radioactive beam was then directed to the measuring station LeRibss, where the detection set-up was installed. In figure 1, a schematic representation of the radioactive beam production and purification is shown, see also [6].

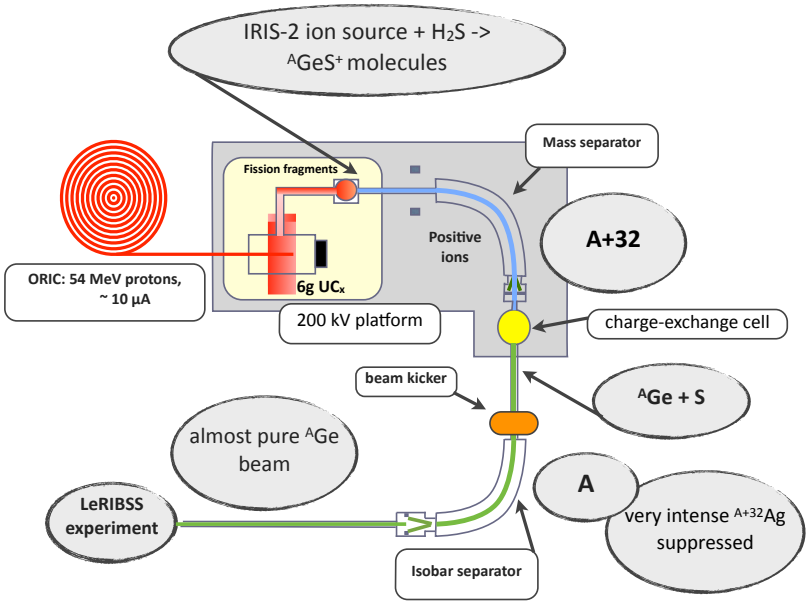

Fig. 1. Schematic view of the experimental method used at the HRIBF to produce almost pure beams of neutron-rich germanium and arsenic isotopes [4].

The beam was implanted onto a movable tape in the center of the detection set-up. The tape was utilized to periodically remove the activity from the implantation point, thus suppressing longer-lived daughter activities. The detection set-up surrounded the implantation point and consisted

of two plastic scintillators to detect beta-particles and 4 clover detectors in close geometry for gamma-ray detection. The beta efficiency amounted to about 50%, while the gamma efficiency was 6% at 1.3 MeV. All the signals were read-out by a fully digital data acquisition system [7, 8].

3. Results

The investigation of beta-coincident gamma-rays from the decay of ^{86}As allowed for a clear identification of several new transitions in ^{86}Se at 694.5(3), 839.3(3), 1504.0(3), 1667.9(5) and 3531.9(5) keV. A few more transitions were tentatively assigned to deexcitations in ^{86}Se on the basis of weak beta–gamma–gamma coincidences. These are the 973.2(5), 1399.3(5), 1943.8(5) and 3025.4(5) keV transitions. The 973 and 1399 keV lines were assigned also on the basis of level-energy differences and of the half-life value of 0.62(24)s for the 973 keV transition ($T_{1/2}(^{86}As)$= 861(64) ms). Moreover, the 1399 keV line was observed in the beta-delayed neutron–gamma decay of ^{87}As [9]. With the help of beta–gamma–gamma coincidences, a preliminary partial level scheme of ^{86}Se could be reconstructed, see figure 2.

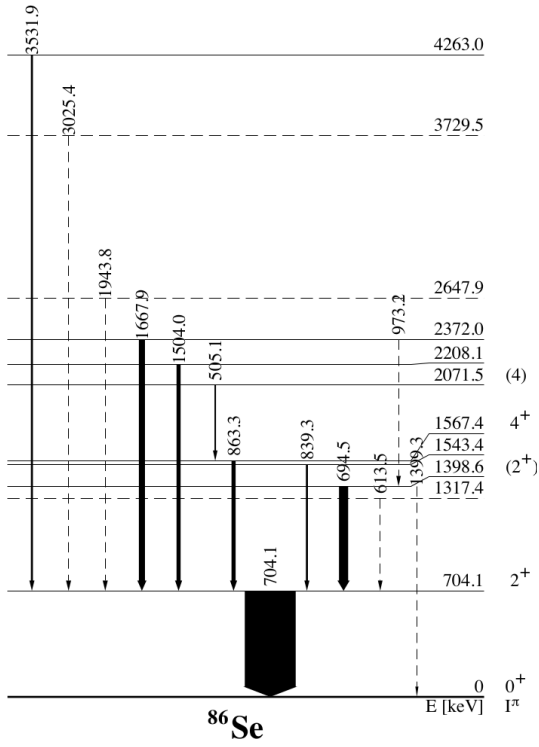

Fig. 2. Partial level scheme of ^{86}Se as obtained in this work.

Previous work of Kratz *et al.* [3], Jones *et al.* [2] and Czerwiński *et al.* [1] determined spin and parity for the 704, 1567 and 2072 keV excited states in ^{86}Se, respectively. If we take into account the observation of the cross-over transition deexciting from the 1398.6 level directly to the $I^\pi = 0^+$ ground state, tentative $I^\pi = (2^+)$ can be inferred to this level.

4. Summary

In summary, we have measured the partial level scheme of ^{86}Se as populated in the beta decay of ^{86}As. Several new beta-delayed gamma-transitions were identified and the properties of new excited states in ^{86}Se were deduced.

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