BETA DECAY OF ^{82}Ga STUDIED AT THE ALTO FACILITY*

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Excited states in the $N = 50$ nucleus ^{82}Ge have been investigated via beta decay of ^{82}Ga at the ALTO facility. More than 50 new gamma transitions were identified. The preliminary results are presented in this work.

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1. Introduction

Most of the heavy elements in our universe are created via the rapid (r) and the slow (s) neutron-capture processes. Modeling the r-process requires information on the properties of neutron-rich nuclei, such as their masses, β decay half-lives, and β-delayed neutron emission probabilities, which provide essential inputs for the astrophysical r-process calculations [1]. The first r-process abundance peak is located at $A \approx 80$, and therefore this region is of special interest for the r-process. The Pygmy Dipole Resonance (PDR) interpreted as the oscillation of a neutron skin against an isospin-saturated core brings a non-negligible dipole strength at excitation energies that can be populated by β decay in neutron rich-nuclei. The way β-decay connects with PDR states in the daughter nuclei is an open question and only scarcely investigated [2]. These states are around the neutron separation energy S_n and compete with delayed neutron emission.

In this contribution, the investigation of high energy excited states in the $N = 50$ nucleus ^{82}Ge populated by the beta decay of ^{82}Ga is reported.

2. Experimental set-up

The neutron-rich Ga beam was produced at the ALTO facility operated by the IJCLab (Orsay, France) [3]. A 50 MeV electron beam was impinged on a uranium carbide target (UC_x). The fission products were diffused out of the target and laser ionized. The fission fragments were then selected by their mass-to-charge ratio using the PARRNe magnetic spectrometer. The ^{82}Ga beam was finally guided by a set of electrostatic dipoles and quadrupoles through the beamline to the BEta Decay Studies at Orsay (BEDO) detection setup [4].

The ^{82}Ga beam was implanted on an Al-coated Mylar movable tape to periodically remove the accumulated activity. The collection point was surrounded by a BC408 plastic detector covering about 74% of the solid angle and placed under vacuum for β-electrons detection.

The γ-detectors mounted around the implantation point are shown in Fig. 1. The detection setup was composed of 3 PARIS (Photon Array for studies with Radioactive Ions and Stable beams) clusters for high-energy γ detection (total efficiency $\epsilon = 1.5$ (1)% at 5 MeV) [5, 6], combined with a segmented Clover detector ($\epsilon = 0.41$ (4)% at 1.17 MeV) and a HPGe detector ($\epsilon = 2.12$ (2)% at 1.17 MeV). The FASTER digital data acquisition system was used to read out all the signals [7].

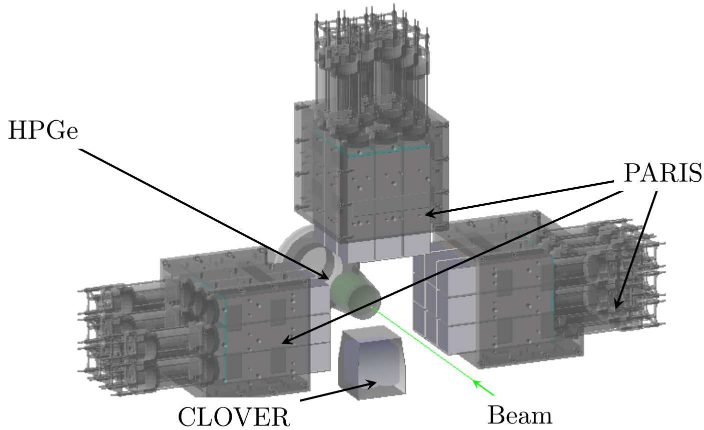

Fig. 1. A schematic view of the γ-detectors of the BEDO detection setup.

3. Experimental results

The beta-coincident γ-rays from the decay of ^{82}Ga were investigated, and 76 gamma transitions were assigned to ^{82}Ge, where 54 of them were observed for the first time.

The neutron separation threshold of ^{82}Ge is $S_n = 7.194$ (3) MeV [8], and this work revealed γ-transitions from states up to 700 keV above this value. The energy levels populated above S_n are around 7.2, 7.4, 7.8, and 7.9 MeV (Figs. 2, 3). These states decay directly to the 0^+ ground state

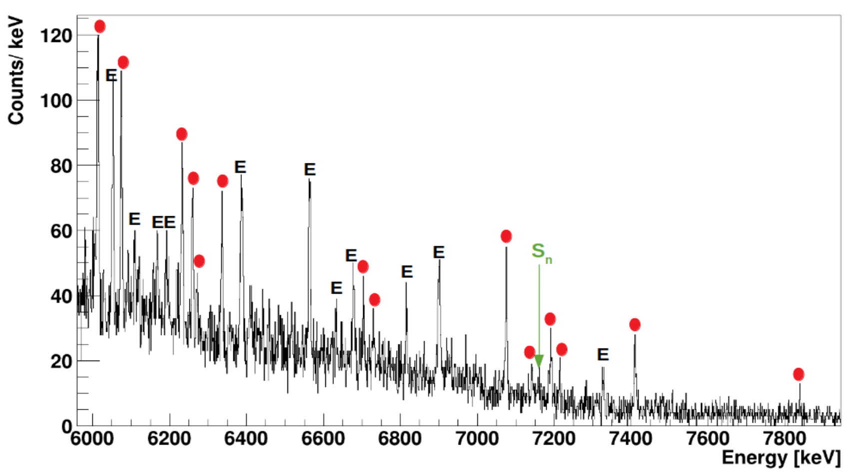

Fig. 2. (Color online) High-energy part of the β-gated γ-spectrum from the Clover detector. The identified peaks of ^{82}Ge are marked with red/black dots. The "E" represents the lines corresponding to the escape peaks.

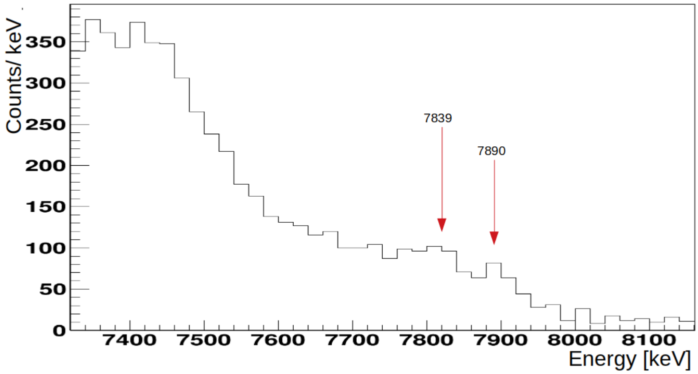

Fig. 3. Part of the β-gated γ-spectrum from the PARIS detector. The highest energy gamma-ray transitions assigned to the decay of ^{82}Ga are marked.

of ^{82}Ge, which is an argument in favor of assigning them with a 1^- spin and parity. However, the calculated log(ft) values for the feeding of these states are higher than 6, not compatible with an allowed beta transition. We remind the reader that the ground state of ^{82}Ga has a tentative $(2,3)^-$ spin and parity. Only a few log(ft) values are low enough to be compatible with feeding to 1^- states. All these states are below the neutron threshold. Theoretical calculations are needed to understand the physics behind these results better.

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