Investigations of magnetic moments in Coulomb fission

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Magnetic moments present an important tool to study the single-particle character of excited states. They are directly related to the g factor and provide a crucial test for the wave functions of particular states predicted by theoretical models. One experimental requirement for the measurement of g factors is the spin alignment of the nuclear ensemble that is obtained in the reaction populating a nucleus of interest. In this experiment, Coulomb fission is used to produce the nuclear alignment, and the magnetic moments of isomeric states are investigated.

The region around the doubly magic ^{132}Sn has been of prime interest in the past decades owing to its importance from the perspectives of astrophysics and nuclear structure. The investigation of nuclei with few valence particles is interesting because several isomeric structures emerge in them. For example, the three-proton-hole $Z = 47$ isotopes ^{124,125}Ag have isomers based on the unique parity orbitals $\pi(0g_{9/2})$ and $\nu(0h_{11/2})$.[1)]

The experiment is performed at the RIBF using the BigRIPS spectrometer. A primary ^{238}U beam at an energy of 345 MeV/nucleon impinged on a thin ^{184}W production target with an average beam intensity of approximately 100 particle nA. The momentum distribution is selected with slits at the F1 focal plane. The nuclei of interest are separated and identified using the BigRIPS separator.[2)] The secondary ions are stopped in a 3-mm-thick Cu host at the F8 focal point. The detection setup consisted of four high-purity Ge (HPGe) and two $LaBr_3$(Ce) detectors, arranged with each detector type at 90° with respect to each other. To measure the magnetic moments, the TDPAD method is used; it has been applied successfully at the RIBF.[3–5)]

In the experiment, approximately $5 \cdot 10^6$ ions of ^{124}Ag and approximately $3 \cdot 10^6$ ions of ^{125}Ag are identified in each of the experimental settings. The particle identification (PID) of these secondary ions is achieved after the identification and tracking detectors are fully calibrated offline. The spectroscopy could be performed after calibration and various corrections of the γ-ray detectors in energy and time. Figure 1 shows the delayed γ-ray energy spectrum of all Ge detectors with a PID gate for the ^{125}Ag ions. All transitions below the known $(17/2^-)$ isomer can be identified. For the TDPAD analysis, a good in-beam time resolution is essential. The setup is optimized using ^{60}Co and ^{152}Eu sources, with a typical resolution of 8(1) ns (FWHM) achieved by the detectors in the range of interest. This corresponds to a resolution of 12(1) ns in-beam for the same detector, *e.g.*, for the 670 keV transition in ^{125}Ag. As an example, the inset of Fig. 1 shows the time-resolution spectrum for one of the HPGe detectors, demonstrating the capabilities of this setup. The analysis of the magnetic moment from the oscillation pattern is currently in progress. Therefore, it is necessary to have spin alignment, which will be shown by measuring the magnetic moment of a known calibration case.

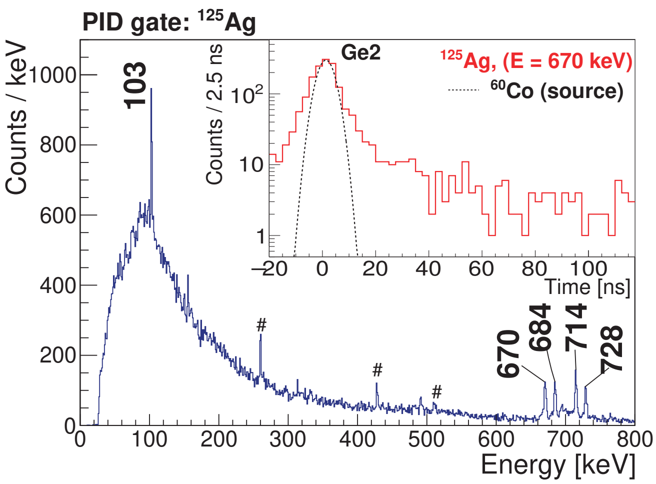

Fig. 1. Delayed HPGe energy spectrum for the ^{125}Ag ions. Background transitions are labelled with "#." The inset shows the time-resolution spectrum of one detector for a source and in-beam measurement.

References
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