Gamma-ray detector array for isomer tagging at SHARAQ

Y. Kiyokawa,[*1] S. Michimasa,[*1] M. Kobayashi,[*1] R. Yokoyama,[*1] D. Nishimura,[*2] S. Ota,[*1] A. Mizukami,[*2] H. Oikawa,[*2] K. Kobayashi,[*3] H. Baba,[*4] G.P.A. Berg,[*5] M. Dozono,[*1] N. Fukuda,[*4] T. Furuno,[*6] E. Ideguchi,[*7] N. Inabe,[*4] T. Kawabata,[*6] S. Kawase,[*1] K. Kisamori,[*1,*4] T. Kubo,[*4] Y. Kubota,[*1,*4] C.S. Lee,[*1] M. Matsushita,[*1] H. Miya,[*1] H. Nagakura,[*3] H. Sakai,[*4] S. Shimoura,[*1] A. Stolz,[*8] H. Suzuki,[*4] M. Takaki,[*1] H. Takeda,[*4] S. Takeuchi,[*4] H. Tokieda,[*1] T. Uesaka,[*4] K. Yako,[*1] Y. Yamaguchi,[*3] Y. Yanagisawa,[*4] and K. Yoshida[*4]

Mass measurement of neutron-rich short-lived nuclei was performed by employing the TOF-Bρ technique at the RIKEN RI Beam Factory(RIBF). A beam of ^{70}Zn at 345MeV/nucleon bombarded a ^{9}Be target to produce neutron-rich nuclei with atomic numbers (Z) ranging from 10 (Ne) to 23 (V) and A/Q from 2.5 to 2.9. Nuclei of interest were separated and particle identified on an event-by-event basis by using the BigRIPS separator coupled with the SHARAQ spectrometer. Details of this experiment can be found in Ref.[1].

Herein, we report on an isomer tagging gamma-ray detector array to assist in particle identification.Furthermore the array was used to search for new isomeric states. Figure 1 shows a schematic view of the γ-ray detector array, installed in the air downstream of the final focal plane (S2) of the SHARAQ spectrometer. The array consisted of 2 clover-type HPGe detectors, each surrounded with 8 NaI(Tl) scintillators. A 20-mm-thick plastic scintillator was placed as an active beam stopper for Sc isotopes at the center of the detector array. An 12-mm-thick aluminum degrader was installed upstream to adjust the stopping range of the nuclei of interest. A veto scintillator was installed downstream of the γ-ray detector array to reject the events where the nuclei penetrated the stopper. The dynamic range of HPGe and NaI(Tl) detectors covers γ-rays up to 3 MeV. The energy resolution of the HPGe [NaI(Tl)] detectors was about 3.8 keV [60 keV] at 1333 keV [662 keV] in FWHM and full-energy peak efficiencies were 0.6% [9.7%] for 1.2-MeV γ rays. The decay time window for gamma-ray spectra was set to 100 ns – 15 μs after the particles arrived at S2. The data acquisition (DAQ) system for the γ-ray detector array was separate from the one for the mass measurement and ran with single triggers from HPGe or NaI(Tl) detectors. For making an event correlation between the two DAQs used for isomer tagging and for particle identification, a common time stamp was recorded in both DAQ systems.

Figure 2 shows the delayed γ-ray spectra measured by HPGe in (a) ^{50}K and (b) ^{43}S used for the particle identification. The energies of the observed gamma rays were consistent with those of previous works, Refs.[2),3)].

Further analysis for the identification of new isomeric states and isomeric ratios is in progress.

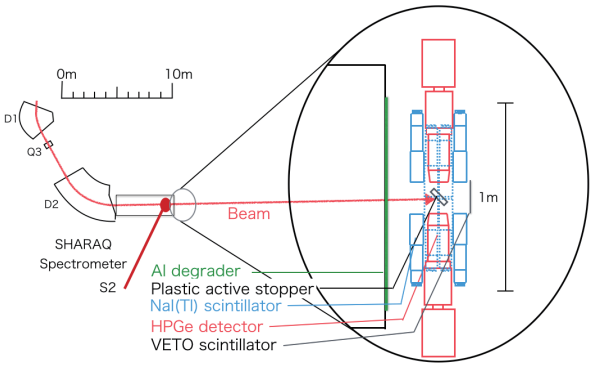

Fig. 1. Schematic view of the isomer tagging system downstream of the final focal plane of SHARAQ(S2).

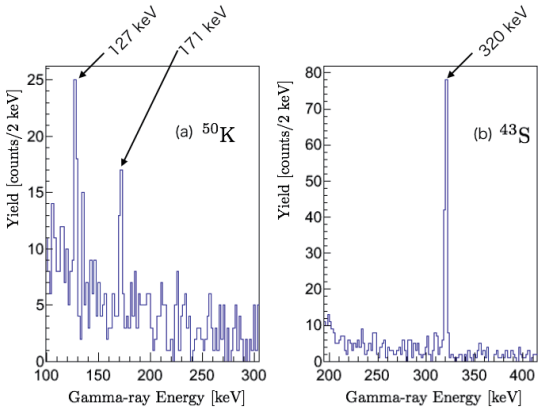

Fig. 2. Delayed γ-ray spectra measured by HPGe in (a) ^{50}K and (b) ^{43}S used for the particle identification.

*1 Center for Nuclear Study, University of Tokyo
*2 Tokyo University of Science
*3 Rikkyo University
*4 RIKEN Nishina Center
*5 University of Notre Dame
*6 Department of Physics, Kyoto University
*7 RCNP, Osaka University
*8 NSCL, Michigan State University

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