開発のための核ギマケー測定システム

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A PAC (perturbed angular correlation) measurement system has been installed in combination with the RF ion guide system at the ISOL facility in April, 2004. RF ion guide system provides us more neutron rich nuclei produced by proton induced fission reaction with Uranium targets. At the region of neutron rich nuclei around mass ~100, the nuclear g-factor of ground and low-lying states has hardly ever been measured because of the small production cross section and the short half-lives\(^1\). Therefore, the development of the new system for nuclear g-factor measurement is one of the present main subjects for nuclear structure studies of neutron-rich unstable nuclei.

A new PAC system has been designed with a goniometer (1.6m dia.) and 6 sets of clover HPGe detectors and permanent magnet with magnetic flux density of 1.1 T. The mass separated unstable nuclei by RF-IGISOL, are transferred to the magnet position by the tape transport system\(^2\).

The experiment using new PAC system has been done for the g-factor measurement of the 5/2+ isomer state of \(^{113}\)Cd with TIPAC (Time Integral Perturbed Angular Correlation) method. The parent nuclei of \(^{113}\)Cd and other A=113 isobars have been produced by 50 MeV proton induced Uranium fission reactions and mass separated by RF-IGISOL, then they are implanted onto collection tape of Aluminised Myler. The repeated time sequence for the collection and measurement is as follows; the first 180 sec. for collection with proton beam-on period, the second 1 sec. for tape moving away from the collection position to the detector position, the last 180 sec. for the measurement with
proton beam-off period. In this experiment, the mass-separated yield of $^{113}$Ag with low-lying high-spin states was about 150 [atoms/sec] at the detector position.

At the test experiment for the $\text{A}=113$ mass-separated source, we have measured the gamma single spectra, beta gated gamma spectra and gamma-gamma coincidence spectra using the 3-clover Ge detectors and 3 single Ge detectors. Figure 1 shows the detector arrangement with Goniometer, which can set the angular position with 0.1 degree precision. The obtained typical spectrum of beta-gamma coincidence for $\text{A}=113$ is shown in Fig. 2. The whole system of the RF-IGISOL, tape transport system and detectors have been well functioned at this test trial. The nuclear g-factor, however, can not be extracted from the the perturbed angular correlation of the gamma-gamma coincidence spectra, since the statistics of the spectra are not sufficient because of the beam time restriction and relatively low yield from the RF-IGISOL. Presently, the upgrade development of RF-IGISOL system has been progressed on.

References


Figure 1. The detector system for the perturbed angular correlation measurement by gamma-gamma coincidence. This Goniometer platform is located on the 2.5 m stage from the ground level which is 1.25 m higher level from the beam line. Presently, 3 clover Ge detectors and 3 single Ge detectors are used. The permanent magnet with 0.98 T of Nd magnet is installed at the source position for the PAC measurement (the center of Goniometer). The mass separated source is transferred from the beam line (1.25 m level) to the center of Goniometer (2.5 m level) by the tape transport system.
Figure 2. The low energy part of the beta coincident gamma-ray spectrum at the mass number $A=113$. 