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Circular polarization measurement of γ-rays emitted from ^{32}S(n,γ)^{33}S reactions with polarized neutrons

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The total angular momentum of resonance is one of the significant parameters in nuclear data, but the identification is difficult. The parameter has been determined by several methods: the measurement of the spin-dependent transmission ratio by polarized neutrons and a polarized target [1], the measurement of intensity ratio of cascade γ-rays emitted from neutron resonance captures [2], and the measurement of γ-cascade multiplicity [3]. In spite of these efforts, available data were limited, and estimated values of the parameter have often been recorded in the evaluated nuclear data libraries, such as JENDL-5 [4].
As an alternative, we are inventing a new method which determines the total angular momentum of resonances from the measurements of circular polarization of γ-rays emitted from capture reaction of polarized neutrons on a target [5]. This method relies on the fact that the circular polarization of γ-rays from polarized neutron capture depends on the total angular momentum. We aim to apply the experiments at the thermal region performed in the 1950s to 1970s [6-8] to the resonance region. In order to measure the circular polarization of γ-rays, a Compton polarimeter was developed. For its operation confirmation, ^{32}S was selected as a target because its polarized thermal neutron capture is known to emit 5.4 MeV γ-rays whose circular polarization is 50%. The circular polarization of γ-rays was measured with Ge detectors at J-PARC·MLF·ANNRI, and the analyzing power at the γ-ray energy of 5.4 MeV was determined as about 2%. In this presentation, we will report on the details of the sulfur experiment and future prospects for circular polarization measurements at ANNRI.
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