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A preliminary study of prompt gamma-ray activation analysis using pulsed neutron at J-PARC / ANNRI

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The Accurate Neutron-Nucleus Reaction Measurement Instrument (ANNRI) has been constructed at the beamline No. 04 at the Material and Life Science Experimental Facility (MLF) of the Japan Proton Accelerator Research Complex (J-PARC). ANNRI has been used for the measurement of nuclear cross-section data, nuclear astrophysics and prompt gamma-ray analysis (PGA). MLF is a very intensive pulsed neutron facility, and expected to reach 1 MW proton beam power in the near future. The germanium detector-array, which consists of two cluster-Ge detectors, eight coaxial-Ge detectors and BGO Compton suppression detectors, was installed at the flight length of 21.5m in ANNRI. It is designed to provide high gamma ray energy resolution and high detection efficiency. The time resolution of Ge detector is poor but this is not a disadvantage because of the proton beam pulse width of 0.1 micro sec. We have developed a time-of-flight prompt gamma-ray analysis combined with gamma-ray coincidence technique. Preliminary experiments of BCR CRM 680 and 681 (polyethylene reference material) etc. were made in ANNRI. The power of the proton beam was approximately 200 kW and the repetition of the neutron beam was 25 Hz. In this study, the background spectra, the data acquisition dead time and the effect of the self-shield of neutron flux, which depend on the neutron energy, have been measured and evaluated. These are compared with the results of the experiments of multiple prompt gamma-ray analysis at Japan Research Reactor-3, and the similarity and difference are discussed.
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