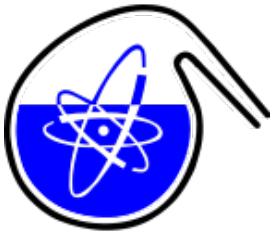

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A Comparison Study of Simulation for Neutron Induced Prompt Gamma Using MCNPX and PHITS

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PGAA (Prompt Gamma Activation Analysis) is an established nuclear analytical technique for the non-destructive determination of elemental and isotopic compositions. The neutron activation analysis research group in KAERI (Korea Atomic Energy Research Institute) has been developing a fake gold bar detection method using a PGAA. However, a real experiment to verify the detection method was not performed because of the seismic retrofit for HANARO. As an alternative method, a computer simulation based on the Monte Carlo method was used to confirm the detection method. Prompt gamma-rays are the most important element for a PGAA. MCNPX and PHITS, Monte-Carlo radiation transport simulation codes, have succeeded in simulating a prompt gamma-ray spectrum. However, the prompt gamma-ray spectrum generally simulated by MCNPX did not show accurate gamma energy peaks in our previous study. Thus, the simulation was conducted in two separate files to describe the accurate prompt gamma energy peaks. The neutron transport and prompt gamma ray production rate in the sample were first calculated. Photon transport for the detection of prompt gamma rays emitted from the sample was then simulated. The other code, PHITS (Particle and Heavy Ion Transport code System), is a general purpose Monte Carlo particle transport simulation code developed under collaboration between JAEA, RIST, KEK, and several other institutes. According to Ogawa et al., a new theoretical model to simulate gamma de-excitation nuclei was developed based on the Evaluated Nuclear Structure Data File (ENSDF) in FHITS. The model is applicable for neutron capture products and spallation products of 1071 nuclear species from Li to bk. In this study, the neutron induced prompt gamma-ray spectra are calculated after a neutron beam is irradiated onto the target sample using PHITS. The simple geometry of the neutron irradiation system in the PHITS simulation is modeled after the fake gold detection system. The track of neutrons irradiated onto the sample is simulated using a T-track tally, and the prompt gamma-rays emitted from the sample are calculated using a T-cross tally. Finally, a comparison of PHITS and MCNPX code in PGAA is described, and an optimal method for simulation of neutron induced prompt gamma is discussed.

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