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Evaluation of timing and pulse shape analysis method for the measurement of photoneutron energy distribution using commercially available digitizer

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Photonuclear reactions induced by high-energy photons play a pivotal role in nuclear physics and radiation transport simulation that is used for medical and industrial applications of high-energy photons. In the transport simulation, not only the photonuclear reaction cross section but also the energy distribution of secondary particles, especially neutrons, is essential because the behavior of neutrons strongly depends on their energies. Experimental studies on the measurement of neutron energy distribution have been carried out for photonuclear reactions for tens of MeV monoenergetic linearly polarized photons.

In this experiment, the emitted neutron energy distribution was obtained by using the electronics circuit and detector for the time-of-flight method and particle identification. The former requires nano-second timing measurement and the latter distinction of mili-Volt order signal difference. Because of the availability of a Ghz sampling digitizer, field programmable gate arrays (FPGA), and fast interface, the procedure can be done using commercially available single-board electronics.

This presentation addresses the above-mentioned data-taking using a 1 GHz sampling rate, 14-bit resolution, FPGA real-time signal processing, 1 MHz throughput digitizer (APV8104 by TechnoAP Co), as well as a comprehensive overview of the motivation, emphasizing the importance of energy spectrum. The data obtained by the digitizer are evaluated from the view of this application. In addition to this, we analyzed raw digitized data that can be obtained from the digitizer for further development to achieve better timing and signal difference analysis in comparison with the simple traditional scheme implemented in the FPGA of the module.

Minioral

Yes

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No

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