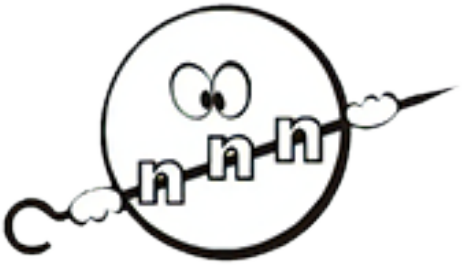

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Direct Neutron Fluence Measurement with a Novel Spherical Long Counter

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Efficient and practical neutron detectors are crucial in many areas, including national security, medicine, crystallography, and astronomy. As commonly used neutron detectors, 3He-gas-filled proportional counters still play an irreplaceable role in neutron fluence monitoring. 3He tubes are used directly to detect the thermal neutron, but the measurable neutron energy range is often extended by adding moderating materials, so-called long neutron counters. Long cylindrical counters have attracted much attention due to their easy range extension. Nevertheless, the large fluctuation of the energy response due to the neutron incidence direction has not been solved, which directly limits the application of long counters in neutron flux detection. Therefore, it is necessary to conduct innovative research on neutron detectors to measure neutron fluence more accurately and conveniently. We previously reported the physical design of a new spherical long counter for the first time. The spherical long counter has a stable neutron fluence energy response in the energy range from 0.01eV to 20MeV, and the angular response difference in 4π space is no more than 16.5%. Here we show the further development of the spherical long counter and the results of its verification using different types of neutron sources., including D-D, D-T quasi-monoenergetic accelerator neutron source, Am-Be, 252Cf isotopic neutron source, reactor thermal neutron source, and spallation neutron source. The angular and fluence responses of the spherical counter are examined, and the maximum angular response difference is 5.86%. The new detector we developed can adapt to the accurate measurement of multi-energy and multi-occasional neutron sources for direct neutron flux measurement.

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