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VENDETA: VErsatile Neutron DETector Array, a new high-resolution neutron time-of-flight measurement array

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Prompt neutrons are emitted by fission fragments during the nuclear fission process. These neutrons play a crucial role for applications as they drive the chain reaction in nuclear fuel by inducing new fissions. The measurement of Prompt Fission Neutron Spectra (PFNS), which are the energy distributions of these neutrons, need to be done with high precision. Neutron multiplicity and average energy can be derived from the PFNS. These data are critical for applications, necessitating measurements with uncertainties well below 1%.

The importance of this data motivated the development of the VErsatile Neutron DETector Array (VENDETA), which is a high-resolution time-of-flight array for neutron detection. VENDETA's liquid scintillator detectors offer a high intrinsic efficiency, exceeding 20% over a range of 100 keV to 20 MeV, with a peak efficiency of 65% for 650 keV neutrons. For low energies, neutron-gamma discrimination capabilities are preserved down to 30 keVee. Additionally, its excellent time resolution (< 500 ps) enables fine energy resolution for fast neutrons. This work will present the VENDETA set-up as it was operated at the Los Alamos Neutron Science CEnter (LANSCE) and its characterization with a 252Cf(sf) source. A measurement was run in 2024 for 240Pu(sf), an actinide of interest invariably present in small quantities in nuclear fuel. High statistics results on the PFNS and neutron multiplicity with high accuracy will be shown and demonstrate VENDETA's capabilities.

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