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Neutron energy response of a hybrid scintillator/^{3}He calorimeter
ZHEHUI WANG, CHRISTOPHER L. MORRIS, KONSTANTIN N. BOROZDIN, KIWHAN CHUNG, J. ANDREW GREEN, STEVEN J. GREENE, GARY E. HOGAN, RANDY J. SPAULDING, FREDERICK J. WYSOCKI, Los Alamos National Laboratory, THE PROTON INTERROGATION TEAM — Fast neutron energy spectrum above 1 MeV provides a unique window for nuclear material detection and identification. We describe a neutron calorimeter consisting of an array of plastic scintillators and low-pressure (200 mbar) ^{3}He drift tubes. Fast neutrons transmit their kinetic energies to protons in the plastic through elastic collisions, generating one or multiple scintillator pulses. Thermalized neutrons are then detected through the capture reaction ^{3}He(n,p)^{3}H. The hybrid calorimeter implements a few coincidence schemes to measure fast neutron energy spectrum. By requiring a signal in the ^{3}He tube, only fast neutrons that deposit their full energies in the scintillators are counted. By requiring multiple scintillator responses within a certain time window and certain directions, only the proton recoil events due to fast neutron collisions are preferentially selected. The performances of the calorimeter are calibrated using neutrons of known energies. Practical issues such as γ-ray background reduction, nonlinear energy response of the scintillators, edge loss of protons, and configuration of the detector cells will be discussed. The measurements are compared with MCNPX simulations.

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