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Improved Determination of the Neutron Lifetime

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The most precise determination of the neutron lifetime using the beam method reported a result of $\tau_n = (886.3 \pm 3.4)$ s. The dominant uncertainties were attributed to the absolute determination of the fluence of the neutron beam (2.7 s). The fluence was determined with a monitor that counted the neutron-induced charged particles from absorption in a thin, well-characterized ^{6}Li deposit. The detection efficiency of the monitor was calculated from the areal density of the deposit, the detector solid angle, and the ENDF/B-VI ^{6}Li(n,t)^{4}He thermal neutron cross section. We have used a second, totally-absorbing neutron detector to directly measure the detection efficiency of the monitor on a monochromatic neutron beam of precisely known wavelength. This method does not rely on the ^{6}Li(n,t)^{4}He cross section or any other nuclear data. The monitor detection efficiency was measured to an uncertainty of 0.06 %, which represents a five-fold improvement in uncertainty. We have verified the temporal stability of the monitor with ancillary measurements, and the measured neutron monitor efficiency has been used to improve the fluence determination in the past lifetime experiment. An updated neutron lifetime based on the improved fluence determination will be presented.

Work done in collaboration with M. Dewey, D. Gilliam, J. Nico, National Institute of Standards and Technology; G. Greene, University of Tennessee / Oak Ridge National Laboratory; A. Laptev, Los Alamos National Laboratory; W. Snow, Indiana University; and F. Wietfeldt, Tulane University.