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The Neutron Lifetime

FRED WIETFELDT, Tulane University

The neutron is a key component of ordinary stable matter. However when free from the confines of an atomic nucleus the neutron is unstable; it decays to a proton, electron, and antineutrino with a lifetime of about 15 minutes. Neutron decay is the prototype for nuclear beta decay and other semileptonic weak interactions. The neutron lifetime provides direct access to key parameters in the Standard Model of particle physics. It was important in the early universe and is needed for theoretical calculations of primordial element abundances. The neutron lifetime has been the subject of more than 20 major experiments over the past 60+ years. Two main methods, the neutron beam method and the cold neutron bottle method, have approached the 10^{-3} precision level in recent years, but unfortunately these two methods currently disagree by more than 8 seconds (almost 4 standard deviations). I will discuss the motivation and physics of the neutron lifetime, briefly review past and current experiments, and present details of a new project to measure the neutron lifetime to $<$0.3 s precision in a beam method experiment at the NIST Center for Neutron Research in Gaithersburg, MD. This work is supported by the National Science Foundation and the U.S. Dept. of Energy Office of Science.