UCNA Experiment: Analysis of 2011/2012 and 2012/2013 Data Sets

DISSERTATION

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ABSTRACT OF DISSERTATION

UCNA Experiment: Analysis of 2011/2012 and 2012/2013 Data Sets

The UCNA Experiment at the Los Alamos Neutron Science Center (LANSCE) is the first measurement of the β-decay asymmetry parameter A_0 using polarized ultracold neutrons (UCN). A_0, which represents the parity-violating angular correlation between the direction of the initial neutron spin and the emitted decay electron's momentum, determines $\lambda = g_A/g_V$, the ratio of the weak axial-vector and vector coupling constants. A high-precision determination of λ is important for weak interaction physics, and when combined with the neutron lifetime it permits an extraction of the CKM matrix element V_{ud} solely from neutron decay. At LANSCE, UCN are produced in a pulsed, spallation driven solid deuterium source and then polarized via transport through a 7 T magnetic field. Their spins can then be flipped via transport through an Adiabatic Fast Passage spin flipper located in a low-field-gradient 1 T field region prior to transport to a decay storage volume situated within a 1 T solenoidal spectrometer. Electron detector packages located at each end provide for the measurement of decay electrons. Previous UCNA results (based on data collected in 2010 and earlier) were limited by systematic uncertainties, in particular those from the UCN polarization, calibration of the electron energy, and electron backscattering. This dissertation will present a background of Neutron Decay, an overview of the UCNA Experiment, followed by a detailed report on the entire analysis process for the 2011/2012 and 2012/2013 data sets.

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Papers in Refereed Conference Proceedings

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