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The Parity-Violating Directional Asymmetry in the Capture of Polarized Neutrons on Protons

DAVID BOWMAN, Oak Ridge National Laboratory

The NPDGamma experiment completed 2 years of data taking as of December 2014. The experiment was done at the Fundamental Physics Cold Neutron Beam at Spallation Neutron Source. The apparatus consisted of a supermirror polarizer, a resonant spin rotator, a 17-liter liquid para hydrogen target, an array of 48 CsI gamma detectors, and a current-mode data acquisition system. The experiment has measured the parity-violating asymmetry between the polarization direction of neutrons and the direction of the gamma ray in the reaction $\vec{n} + p \rightarrow^2 d + \gamma$. This asymmetry determines the part of the hadronic weak interaction carried by the pion. We will present a value for the asymmetry and the weak pion-nucleon coupling. We describe auxiliary experiments to determine the neutron polarization, geometrical factors that describe the sensitivity of each detector to the asymmetry, and other quantities. We describe the analysis procedures and algorithms. We discuss statistical and systematic uncertainties. The statistical uncertainty is consistent with the counting statistics limit. The combined systematic uncertainty from all sources is small compared to the statistical uncertainty.