Abstract for the 2017 Canadian-American-Mexican Graduate Student Physics Conference (CAM 2017)

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Oral Presentation

Neutron Structure and the BONuS Experiment at Jefferson Lab

Abstract

Experiments with free neutron targets are impractical due to the instability of free neutrons. To extract neutron data, nuclear targets are used but these data contain large uncertainties because of nuclear binding effects, for example. As a result, the neutron is not as well understood as the proton. The BONuS experiment with Jefferson Lab's CLAS detector has been designed to study the nearly free neutron structure by using the spectator tagging technique, which helps to reduce nuclear uncertainties significantly. The backscattered spectator protons in $d(e, ep)X$ inelastic scattering with momenta <100 MeV/c are detected by using a Radial Time Projection Chamber (RTPC). This selects electron-scattering events from nearly free neutrons in BONuS. The BONuS6 experiment took data with CLAS at electron beam energies of up to 5.3 GeV in 2005, which provided a first good result in the resonance and deep-inelastic region for Bjorken x <0.65. The recent upgrade at Jefferson Lab to 11 GeV beam energy will allow us obtain data to higher Bjorken x of 0.85. Now we are preparing the new BONuS12 experiment using the new CLAS12 detector. We are working on redesigning the RTPC including a new drift gas, upgrading the data acquisition system, and upgrading the simulation and particle tracking software. This presentation includes an overview of the BONuS experiment with the kinematics of the spectator tagging technique to study the neutron structure, along with updates to BONuS12.