E12-10-008: Detailed Studies of the Nuclear Dependence of F_2 in Light Nuclei

The quark sub-structure of nuclei differs somewhat from the simple sum of the quark distributions of the constituent protons and neutrons. This was first observed by the EMC collaboration in the 1980s, and the complete explanation of this so-called "EMC effect" - the suppression of high-momentum quarks in heavy nuclei - is still elusive. Later measurements found that the effect was similar in all medium and heavy nuclei, with the size of the suppression increasing with the density of the nucleus.

New measurements at Jefferson Lab focusing on light nuclei found that the effect is not driven by the average density of the nucleus, but is related instead to the local environment of the nucleon involved in the scattering. High-density configurations within nuclei (clusters of two or more nucleons in close proximity) appear to be connected with the origin of the EMC effect. These high-density clusters in light nuclei were also studied in a related measurement designed to map out the strength of "short-range correlations", pairs of high-momentum nucleons generated by the strong short-distance interaction between nucleons when they come very close together in the nucleus. The contribution of these short-range correlations in light nuclei scaled with the size of the observed EMC effect, further supporting the idea that the modification to the quark distribution was related to small, dense configurations within nuclei.

At 12 GeV, we will measure both the quark distributions and contribution of high-momentum nucleons in a series of light nuclei. This will further elucidate the connection between the nuclear quark distributions and the high-density configurations in nuclei. Initial measurements will be performed on 9Be, 10B, 11B, and 12C. This will expand our set of measurements on light nuclei, where cluster structure can be important. It will also allow us to look at the impact of the addition of a single nucleon, providing sensitivity to the contributions from a single nucleon in the nucleus.