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Study of Nucleon-Nucleon Short-Range Correlations, the EMC Effect, and their relation using Backwards-recoiling Protons

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The EMC effect is the observation that the structure of nucleons in nuclear medium is modified from that in free space. Over 1000 papers were written about the effect, but no explanation is commonly accepted. A linear correlation has recently been observed between the slopes of the EMC universal curve for $0.3 < x_B < 0.7$ in deep-inelastic (DIS) lepton scattering, $d[F_2(A)/F_2(d)]/dx_B$ and $a_2(A/d)$, the per-nucleon inclusive quasi-elastic electron scattering cross-section ratios from SRC in nucleus A to that from deuterium for $1.4 < x_B < 2$. This correlation is surprising because of the vastly different energy and distance scales of EMC and short-range nucleon-nucleon correlations (SRC).

A recent explanation of this correlation is that the modification of $F_2(A)$, the nucleon structure-function in the nuclear medium, depends on the virtuality of the nucleons, which is high for short-range correlated nucleons such that the EMC effect, to a large extent, is related to DIS from highly virtual, short-range correlated nucleon. We study this hypothesis by detecting EMC events "tagged"by high-momentum ($k_p > k_F$) protons recoiling backward to the momentum transfer, q, which have been shown to be spectators from scattering off their short-range correlated partners.

We shall present and discuss results of inclusive SRC, $a_2(A/d)$, and "normal"EMC $F_2(A)/F_2(d)$, as well as semi-exclusive SRC ("tagged"SRC), and semi-inclusive DIS ("tagged"EMC), $\{\sigma[A(e,e'p_{recoil})X]/A\}/\{\sigma[d(e,e'p_{recoil})X/2]\}$ for their respective X_B ranges.

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