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The 192th HENPIC seminar by Dr. Shujie Li

Title: Nucleon-nucleon interactions at short distances

Abstract: Among the four known fundamental forces or interactions, gravitation and electromagnetism are close to daily life, while the strong and weak forces only reveal themselves at sub-atomic or smaller scales. The strong force, which is mediated by gluon exchange between quarks confines quarks into protons and neutrons (nucleons). The residual component of this strong force that induces the strong nuclear interactions between nucleons at the fermi scale (10^-15m). This so-called "nuclear force" is attractive at a longer distance (e.g. for nucleon separation greater than the proton radius) and binds nucleons together into nuclei), while the force is strongly repulsive at a much shorter distance which prevents the nucleus from collapsing.

Nucleon interactions at short distances are not well-described in either QCD or the field theory. Experimentally, a series of electron-nucleon scattering measurements at Jefferson Lab (JLab) have determined about 20% of nucleons in heavy nuclei are moving fast (above the Fermi momentum) due to hard, short-distance interactions with another nucleons, forming so-called short-range correlated (SRC) pairs. Understanding those SRC pairs is necessary in providing a complete description of nuclear structure. It also offers us a unique chance to probe the tensor and repulsive force at intermediate to short distances. In this talk, I will present recent results from the JLab Hall A tritium program which studied the momentum distribution, and spin/isospin structure of SRC pairs in the mirror nuclei tritium and helium-3. I will then discuss how those measurements help us better understand the short-distance part of strong nucleon-nucleon interactions, and how the current and future measurements can push further by looking at the quark structure of small configurations.

Summary