国立研究開発法人理化学研究所　仁科加速器科学研究センター
第286回 RIBF核物理セミナー
RIKEN Nishina Center for Accelerator Based Science
The 286th RIBF Nuclear Physics Seminar

Short-Range Correlations And The Quarks Within

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(MIT, Physics)

Since the discovery of quarks, nuclear physicists have been trying to understand the relation between the lower-resolution description of nuclei using protons and neutrons, and the underlying higher-resolution description in terms of quarks and gluons. At the intersection of these two paradigms are Short-Range Correlations (SRC): pairs of strongly interacting nucleons whose distance is comparable to their radii. Due to their overlapping quark distributions and strong interaction, SRC pairs serve as a bridge between low-energy nuclear structure, high- density nuclear matter, and high-energy quark distributions, with important consequences for strong-interaction physics, hadronic structure and astrophysics.

In this talk I will present new results from high-energy electron scattering experiments that probe SRC pairs via measurements of exclusive hard breakup reactions. Special emphasis will be given to the use of SRCs in probing the strong nuclear interactions at sub fermi distances and effect of SRCs on the behavior of protons in neutron-rich nuclear systems and its implications to dense nuclear systems such as neutron stars. Pursuing a more fundamental understanding of short-distance interactions, I will present new measurements of the internal quark-gluon sub-structure of nucleons and show how its modification in the nuclear medium relates to SRC pairs and short-ranged nuclear interactions. Last, I will discuss the development of new effective theories for describing short-ranged correlations, the way in which they relate to experimental observables, and the emerging universality of short-distance and high-momentum physics in nuclear systems.

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Main References:

“Probing the core of the strong nuclear interaction”, Schmidt et al. , (CLAS Collaboration), Nature, In-Print (2020). , “Modified Structure of Protons and Neutrons in Correlated Pairs”, Schmookler et al. (CLAS Collaboration), Nature 566, 354 (2019). , “Direct Observation of Proton-Neutron Short-Range Correlation Dominance in Heavy Nuclei”, Duer et al. (CLAS Collaboration), Phys. Rev. Lett. 122 172502 (2019). , “Scale and Scheme Independence and Position-Momentum Equivalence of Nuclear Short-Range Correlations”, Cruz-Torres et al., arXiv: 1907.03658(2019). , “Probing High Momentum Protons and Neutrons in Asymmetric Nuclei”, Duer et al. (CLAS Collaboration), Nature 560, 617 (2018). , “Nucleon-Nucleon Correlations Short-lived Excitations and the Quarks Within”, Hen, Miller, Piasetzky, and Weinstein, Rev. Mod. Phys. 89045002 (2017).

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＊ The talk will be given in English language.

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