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Exploring Short-Range Correlations (SRC) in Nuclei through Hadronic Probes at JINR

Short-Range Correlations (SRC) emerge when a proton and neutron within a nucleus come into close proximity - at distances comparable to the nucleon radius - forming a high-momentum, strongly interacting pair. This phenomenon offers a unique window into the transition region between two descriptions of nuclear matter: the low-resolution picture of nuclei as systems of protons and neutrons, and the high-resolution view governed by quark and gluon degrees of freedom.

Over the past decade, electron scattering experiments have established SRCs as a key feature of nuclear structure, influencing nucleon-nucleon interactions, nuclear binding, and many-body dynamics. Building on these insights, the Joint Institute for Nuclear Research (JINR, Russia) has initiated a dedicated program to study SRCs via hadron-hadron interactions, providing complementary information to that obtained from electron scattering.

This program employs GeV/nucleon-energy ion beams impinging on a cryogenic liquid hydrogen target, optimized for probing SRCs through hard quasi-elastic knockout reactions in inverse kinematics. These reactions selectively probe single nucleons or correlated nucleon pairs with high internal momenta and allow reconstruction of nuclear fragments and their momentum distributions. Following two successful experimental runs with a carbon-12 beam, the next phase, reported here, will utilize a tensor-polarized deuteron beam, aiming to unravel spin-dependent aspects of SRC dynamics and deepen our understanding of the underlying nuclear forces.

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