

Physics opportunities for the fixed-target experiment at the Nuclotron with the SRC detector setup

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In this report we discuss some possible experimental studies at a fixed target setup at the NICA collider complex at Joint Institute for Nuclear Research (Dubna, Russia). NICA can provide a unique variety of beams of light to heavy nuclei with energies of a few GeV/nucleon. Additionally, there is a possibility to have polarized beams of protons and deuterons.

One of the existing projects is aimed at Short-Range Correlations (SRC) studies. SRC are formed when the wave functions of two nucleons partly overlap. In this very short-lived configuration, the momenta of the pairing nucleons are opposite in space and higher than the Fermi Sea level. The JINR SRC physics program complements the world-wide efforts of the SRC studies. The first two SRC measurements at JINR took place 2018 and 2022 and used hard quasi-elastic scattering reactions $^{12}\text{C}(p, 2p)^{11}\text{B}/^{10}\text{B}/^{10}\text{Be}$ registered using a modified BM@N spectrometer. The key feature of the setup is a dedicated two-arm spectrometer aimed at measurements of trajectories and momenta of the two final state protons. The next SRC experiment at the new experimental area will measure a hard quasi-elastic $d(p, 2p)$ scattering reaction using tensor-polarized deuteron beams, a liquid hydrogen target, and a similar two-arm spectrometer consisting of trigger, coordinate, and time-of-flight detectors. Considering the SRC setup as a starting point, we discuss other physics topics of potential interest like strange particle production near the threshold, search for the nuclear modification in small systems, test of isospin symmetry in nucleus-nucleus collisions. Estimates of reaction kinematics are done for some of the listed reactions with the discussion of necessary detector upgrades.

We demonstrate that the physics program of the NICA complex can be enriched by studies of particle production close to the boundary kinematics and experiments accessing moderate-to-high values of the parton momentum fraction x , which can be particularly sensitive to the effects of cold QCD.