Referee report on the project

"Probing the Deuteron short-range Spin Structure in the (d,p) reactions using polarized deuteron beam at Nuclotron-M"

The spin observables of the deuteron induced hadronic reactions at Nuclotron energies are critically sensitive to the manifestation of the relativistic effects in the composite systems, for which it is necessary to build the realistic theory of nucleon-nucleon interaction. Also they are sensitive to the structure of light nuclei at short distances between the nucleons, in particular, to possible manifestation of the non-nucleon degrees of freedom and three-nucleon correaltions. Such studies at high energies can be sensitive to the transition from the ordinary nuclear matter consisting of the nucleons and mesons to the state where the QCD fundamental degrees of freedom (quarks and gluons) play a dominant role. The uniqueness of the DSS project is the systematic measurements of the polarization effects in deuteron-proton elastic scattering and deuteron-proton exclusive breakup with polarized deuteron and, in perspective, with polarized proton beam at Nuclotron, because this can allow to study the contribution of different mechanisms, in particular, excitation of Δ-isobar and other resonances, as a function of the energy.

During last years the authors performed the systematic measurements of the differential cross section and deuteron analyzing powers deuteron-proton elastic scattering. The collaboration performed the unique beam energy scan of the deuteron analyzing powers Ay, Ayy and Axx in dp-elastic scattering at the angular range 60^{o}-140^{o} in cms. New data are sensitive to the short-range spin structure of the deuteron where the manifestation of the strong relativistic effects and non-nucleonic degrees of freedom are expected. At the same time new relativistic approach taking into account the Δ-isobar excitation in the intermediate state has been developed to describe the obtained experimental data.

Authors made also significant progress in the development of the efficient tensor-vector deuteron polarimetry, they performed first measurements of the proton beam polarization at internal target station. Proposed experimental program on the manipulation of the deuteron and proton spins at Nuclotron is an important step to organize the spin transparency mode at NICA. This activity is very important for future spin studies at Nuclotron and NICA.

Authors plan to continue the measurements of the analyzing powers in deuteron-proton elastic scattering at intermediate energies where the contributions of the three-nucleon forces and relativistic effects are significant. If the proton beam of high intensity will be available, the first measurements of the nucleon analyzing power in proton-deuteron elastic scattering will be performed. These measurements will be performed with upgraded setup, which can be used as an efficient proton polarimeter at the same time. This is very important for the realization not only DSS project, but also for SPD at NICA, since the authors prepared a proposal on the continuation of such measurements at SPD at higher energies. Systematic measurements of the analyzing powers in deuteron-proton mesonless breakup in coplanar geometry at 400 MeV are planned. The realization of these measurements will allow to obtain new experimental data which will shed a light on the short-range spin structure of the deuteron.

The estimation of the project realization cost and requested beam time are reasonable. The active participation of young physicists in this project is visible. Therefore, I propose to approve the project for 2025-2029 years with the first priority.

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11.12.23г