

Report on the project

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

The study of the spin effects in hadronic reactions at intermediate and high energies with participation of the deuteron has great scientific importance. The spin observables 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. It is very important also the study of the such phenomena at intermediate energies where three-nucleon forces or reaction mechanisms involving more than two nucleons into the interaction are playing a role. At high energies such studies 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 goal of the DSS project is the study of the spin effects in the deuteron induced reactions at intermediate and high energies at Nuclotron. These data will allow to obtain new information important for the mentioned above problems.

The experimental program of the DSS project includes the measurements of the deuteron analyzing powers in deuteron-proton elastic scattering and deuteron-proton exclusive breakup at the internal beam. The collaboration performed the unique measurements of the energy dependence of the deuteron analyzing powers A_y , A_{yy} and A_{xx} in dp-elastic scattering at the angular range 60° - 140° 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. In parallel the collaboration developed efficient deuteron beam polarimeter and performed first measurement of the proton beam polarization at Nuclotron.

Collaboration plans to perform the measurements of the deuteron and proton analyzing powers in dp- and pd- elastic scattering at the intermediate energies where the polarization observables are sensitive to the spin structure of the three-nucleon forces. The additional advantage of the experimental program is the possibility to study the dp- non-mesonic breakup in different kinematical configurations sensitive to the relativistic effects. Authors prepared also a proposal on the continuation of such measurements at SPD at higher energies.

The collaboration has very good experience in the performing of the polarization experiments at intermediate and high energies. The significant part of necessary for the experiment equipment already exists, the upgrade of the setup to enlarge its acceptance is on the track. The required resources for the setup upgrade are adequate to the planned results and allow to create the base for the further investigations in spin physics at NICA. The participation of the physicists from countries-participant and Japan is very important.

I propose to approve the project for 2022-2024 years with the first priority.

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11.04.2021