Study of Deuteron-Proton and Deuteron-Deuteron Collisions at Intermediate Energies

Nadezhda Ladygina
Laboratory of High Energy Physics
Joint Institute for Nuclear Researches
141980 Dubna, RUSSIA

During a few decades hadronic reactions with a participation of the light nuclei were extensively investigated at the energies of few hundred MeV. These processes are the simplest examples of the hadron nucleus collision that is why the interest to this reaction is justified. A number of experiments is aimed at getting some information about the deuteron or helium wave functions as well as nucleon-nucleon amplitudes from the scattering observables.

In this paper I consider two reactions. The first of them is the dp-elastic scattering in the deuteron energy range between 500 MeV and 2 GeV. The second reaction is the $dd \to {}^3He\, n$ at the energies from 200 MeV up to 520 MeV. At these energies the methods based on the solution of the Faddeev equations are unusable. I start from the AGS-equations [1], [2] and iterate their over nucleon-nucleon t-matrix. The plane-wave-impulse-approximations (PWIA), single scattering (SS) and double scattering (DS) contributions are taken into consideration for the $dp \to dp$ process. For the $dd \to {}^3He\, n$ reaction I consider the one-nucleon-exchange (ONE) and single scattering terms. The applied approach was presented in details in refs. [3], [4].

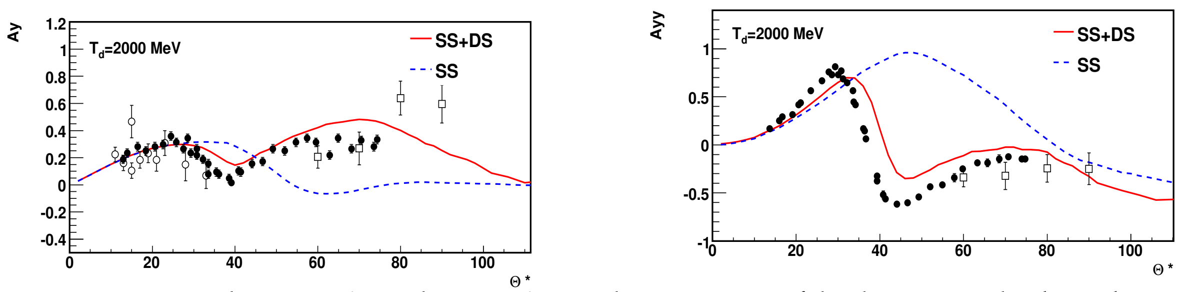

Figure 1: The vector, A_y, and tensor, A_{yy}, analyzing powers of the deuteron in the $dp \to dp$. The data are taken from: • [5]; ○ LHE JINR, hydrogen bubble chamber experiment, and □ LHE JINR Nuclotron, talk by P.Kurilkin given at this conference.

The results of the calculations for the dp- elastic scattering are given in Fig.1. The angular dependencies of the vector and tensor analyzing powers are presented at the deuteron energy of 2 GeV. Here, the solid curves correspond to the results of calculations including both the single scattering and double scattering terms. The dashed curves are the results

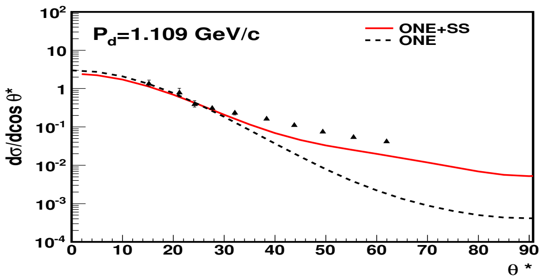

Figure 2: The differential cross section of the $dd \rightarrow {}^3He\, n$. The data are taken from [6].

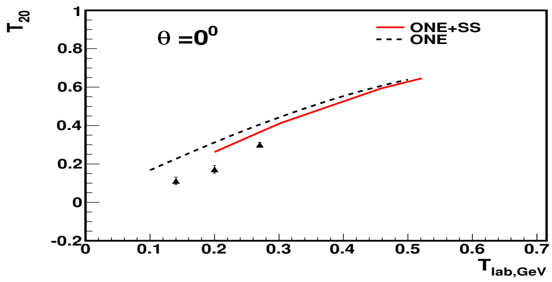

Figure 3: The tensor analyzing power in the $dd \rightarrow {}^3He\, n$. The data are taken from [7].

taking of account only SS-contribution. One can see the inclusion of the DS-term significantly improves the agreement between the theoretical predictions and experimental data, especially, for the tensor analyzing power.

The differential cross section of the $dd \rightarrow {}^3He\, n$ reaction is presented in Fig.2 at laboratory momentum of 1.109 GeV/c [6]. Also the energy dependence of the T_{20} has been obtained at zero scattering angle in the energy range between 200 MeV and 520 MeV (Fig.3). The results demonstrate the significant improvement an agreement of the data and theory predictions, especially, for non forward angles, when the single scattering term is included. It allows us to regard this approach as a next step towards a solution of the four-nucleon problem.

Acknowledgments

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