CALCULATION OF ELASTIC PROTON-DEUTERON SCATTERING WITH INTEGRAL EQUATIONS

E.O.Alt[1], A.M.Mukhamedzhanov[2], A.I.Sattarov[3]

[1] *Institut fur Physik, Universitet Mainz, D-55099 Mainz, Germany*
[2] *Cyclotron Institute, Texas A&M University, College Station, TX 77843, USA*
[3] *Physics Department, Texas A&M University, College Station, TX 77843, USA*

During the past decade, calculations of neutron-deuteron (nd) scattering observables have become feasible using the most up-to-date models of the nucleon-nucleon (NN) interaction including 3N forces. The goal is to get a better understanding of interesting physical phenomena such as 3N forces and off-shell behavior of the NN interaction; but also signatures of the quark substructure may be obtainable. Furthermore, extraction of NN on-shell information which is difficult to deduce from NN scattering experiments could be possible. Such expectations are, however, to be confronted with the experimental situation which for neutrons as projectiles is rather unsatisfactory: despite great efforts the available data are sparse and of an accuracy which as yet does not allow to meaningfully differentiate between all the various theoretical assumptions entering the calculations.

For the proton-induced (pd) reaction, on the other hand, a rich body of accurate data is available and is still being continuously expanded. There, however, the theoretical situation has been unsatisfactory up to now. Either when being of similar sophistication as in the nd case, reliable calculations had to be confined to energies below the deuteron break-up threshold or, when performed at positive energies, had to resort to simple unseats for the nuclear interaction. But experimental comparison of nd with pd observables clearly show that the Coulomb force in the latter case in general leads to appreciable modifications. Hence, the standard procedure of comparing `realistic' nd calculations with pd data must be considered unsatisfactory in that the expected (smaller) effects of the physically interesting topics might be more or less veiled by the neglected Coulomb effects.

Recently, we have published the first results for pd differential cross section and polarization observables obtained in the screening and renormalisation approach, for a realistic (the Paris) potential, at an energy above the break-up threshold (at 10 MeV) [1]. In fact, we used a separable representation of the Paris potential which is known to provide an excellent approximation to the original local potential. The NN interaction was taken into account in the states 3S1 - 3D1, 1S0 and in all P waves. The only partial agreement indicates that some aspects of the nuclear force are not yet fully accounted for in our calculation although the general trends suggested by the data, in particular concerning the relation between neutron and proton data, are well reproduced. Possibilities for further improvement consist in considering more modern potentials, and in taking into account still higher NN partial wave contributions and three-body forces. New results for other proton bombarding energies will be presented.

1. E.O.Alt, A.M.Mukhamedzhanov, A.I.Sattarov, Phys. Rev. Lett. 81, 4820 (1998).