Relativistic Faddeev Calculations

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Glöckle *et al.* started to study [1] relativity in the three-nucleon (3N) system under the Bakamjian-Thomas formalism [2], which belongs to the relativistic quantum mechanics and is dictated by the Poincaré algebra. Since a relativistic two-nucleon (2N) potential is not easily provided, we need some schemes which would allow us to transform a nonrelativistic potential into the corresponding relativistic one. Such schemes are required to fulfill the condition that the generated relativistic potential yields the same observables in the 2N system as the original nonrelativistic potential. There are two schemes which satisfy that condition. One was proposed by Coester *et al.* [3] and we call it the CPS scheme. It requires a solution of a nonlinear integral equation, which can be achieved numerically by an iteration method [4]. The other scheme is a momentum scaling method (MSM) [5], realized by an elaborate change of momentum variables. The above-mentioned schemes are examples of simple transformations, while we are actually interested in a comparison between the original nonrelativistic and the modified relativistic potential predictions in the 3N system. In the case of the triton binding energy we have already shown this comparison [6], demonstrating that the difference is smaller when the CPS scheme is employed.

On the other hand, the Kharkov model [7] provides directly the relativistic 2N potential so no transformation scheme is needed in this case.

At this workshop we present the relativistic results of the triton binding energies not only for the Kharkov potential [1] but also for the new N4LO chiral potential [8] and, additionally, for the older realistic CDBonn potential [9]. In Table 1 the triton binding energies for these potentials, are demonstrated.

Using the CDBonn potential and the Tucson-Melbourne 3N force we have investigated the Nd elastic scattering [10]. Relativistic calculations [10],[11],[12] show only small effects for elastic scattering cross sections and practically no effects for spin observables. Relativistic effects in the nucleon-induced deuteron

[1]Only the 5channel result of the Kharkov potential was already shown in [13].

Table 1: The theoretical predictions for the triton binding energy (in MeV), resulting from the solutions of the relativistic and nonrelativistic Faddeev equations with 42 3N-partial-wave states ($j_{max} = 5$). The numbers in brackets are obtained by the CPS scheme [3], used to transform the nonrelativistic potentials into the relativistic ones, and for the opposite transition in the case of the Kharkov potential.

Potential type	Nonrelativistic calc.	Relativistic calc.	Difference
CDBonn [9]	-8.249	(-8.150)	0.099
N4LO (R=0.9 fm)	-7.832	(-7.706)	0.126
N4LO (R=1.0 fm)	-7.867	(-7.748)	0.119
N4LO (R=1.1 fm)	-7.847	(-7.733)	0.115
Kharkov [7]	(-7.528)	-7.641	0.067

breakup have been investigated in [14]. The study of Nd scattering based on the Kharkov potential is also in progress.

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