# Review of recent and planned experiments in few-body systems with hadronic probes

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The ultimate goal in nuclear physics is to understand the properties of nuclei based on the nucleon-nucleon (*NN*) interaction. With the advent of new techniques, such as Green's Function Monte-Carlo method and very fast computers, it has become possible in the past few years to describe the excitation energy spectrum of light nuclei starting from the free *NN* interaction. However, the need to include three-body forces in the calculations is evident; without them there is a large underbinding of the ground and excited states of nuclei. It is, therefore, imperative to investigate the two- and three-body systems thoroughly with the aim of understanding the two and three-nucleon forces.

Modern nucleon-nucleon potentials have been obtained in the last decade by several groups using different approaches [1-3] all yielding a very small $\chi^2$/datum when fitted to experimental results. The need to do yet more experiments in the two-body sector, as far as the elastic channel is concerned, is not, then, very pressing. However, to provide a better picture in the two-body sector, one could measure the simplest inelasticity in a *NN* collision, namely the bremsstrahlung process. This process probes the dynamics of the *NN* interaction at very different kinematics than is the case for elastic scattering. The simplicity of this reaction resides in the fact that the electromagnetic vertex should be well understood and under control. The next step is to move to a three-body system and measure effects which are beyond two-body effects whereby information can be obtained on the properties of three-body forces. Theoretically, there have been advances in understanding the three-body forces [4]. The inclusion of these forces in the Faddeev framework to calculate experimental observables [5] is now-a-days possible. More recently, attempts are being made to treat the two- and the three-body forces on the same footing within the effective-field theory approach [6].

This talk will concentrate on the experimental efforts which have been made in the last few years on few-body systems with special attention given to hadronic probes and intermediate energies. The bremsstrahlung measurements have been performed in the proton-proton and proton-deuteron systems [7-9]. The second system has been used in order to extract the proton-neutron bremsstrahlung cross sections and analyzing powers as well as information on the other exit channels. The models presently on the market are not able to describe these simple systems yet. The three-body studies normally employ the proton-deuteron system for obvious experimental reasons [10-13]. The comparison with calculations yield mixed results. In some kinematics and for some observables, the Faddeev calculations do a very good job while the calculations fail to a surprisingly large degree in some other kinematics. The results of the recent and the planned measurements should provide a good data base for the theorists to see where the problems are residing. Once a good understanding of these simple systems exists, one can perform ab initio calculations to investigate heavier systems with high precision.

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