

Developments on the Theory of the Deuteron

M. Schwamb^{a,b} and H. Arenhövel^b

^aDipartimento di Fisica Nucleare e Teorica dell'Università degli Studi di Pavia,
I-27100 Pavia, Italy

^bInstitut für Kernphysik, Johannes-Gutenberg Universität, D-55099 Mainz, Germany

A still very interesting topic in medium-energy physics is concerned with the role of effective degrees of freedom (d.o.f.) in hadronic systems in terms of nucleons, mesons and isobars. In particular, the connection of such effective d.o.f. to the underlying quark-gluon dynamics of QCD has still to be clarified. For the study of these basic questions, the two-nucleon system provides an important test laboratory. First of all, it is the simplest nuclear system for the study of the NN -interaction. Moreover, due to the lack of free neutron targets, the deuteron is the simplest nucleus which can be used to extract neutron properties.

In the present contribution, we discuss state-of-the-art models of hadronic and electromagnetic reactions on the two-nucleon system above pion threshold. Four major topics are considered: (i) retardation effects in the meson exchange contributions to the NN -interaction and meson exchange currents in the electromagnetic breakup of the deuteron in the Δ -region [1, 2, 3], (ii) off-shell effects in the one-body current treated in a simple pion cloud model in deuteron photodisintegration [4], (iii) final state interaction effects in π -photoproduction on the deuteron [5] and (iv) the GDH-sum rule on the deuteron [6, 7], where the validity of the spectator picture and the possibility of obtaining information on the neutron spin asymmetry is discussed. Another interesting topic is the existence of large destructive interferences between pion production and the np -breakup in the spin asymmetry. This allows a stringent test of our present theoretical understanding of the two-nucleon system above π -threshold by comparison with future experimental results.

References

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