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From Deuterium to Free Neutrons - Recent Experimental Results

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Lepton scattering has long been used to gather data on the internal structure of both protons and neutrons. Assuming isospin symmetry, these data can be used to pin down the contributions of both u and d quarks to the spatial and momentum-spin structure of the nucleon and its excitations. In this context, information on the neutron is crucial and is typically obtained from experiments on few-body nuclear targets (predominantly ^{3}He and deuterium). However, the need to account for binding effects complicates the interpretation of these experiments. On the other hand, detailed studies of the reaction mechanism can yield important new information on the structure of few-body nuclei and the interplay of nuclear and quark degrees of freedom. Recent theoretical and experimental advances have allowed us to make significant progress on both fronts – a cleaner extraction of neutron properties from nuclear data and a better understanding of nuclear modifications of the bound neutron structure. I will concentrate on recent results on the deuteron. I will present a new extraction of neutron spin structure functions in the resonance and large-x region (from the EG1 experiment with CLAS at Jefferson Lab). The same data can also be used for a detailed comparison with modern calculations of quasi-elastic spin-dependent scattering on the deuteron. A second experimental program with CLAS uses the technique of "spectator tagging" to extract the unpolarized structure functions of the neutron with minimal uncertainties from nuclear effects. By mapping out the dependence of the cross section on the "spectator" momentum, we can learn about final state interactions between the struck nucleon and the spectator, as well as modifications of the neutron structure due to nuclear binding. I will present preliminary results from the "BoNuS" experiment which pushed the detection limit of the spectator proton down to momenta of 70 MeV/c, where nuclear corrections should become small.