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The Hadronic Weak Interaction and Parity Violation in Cold Neutron-Nucleus Capture

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The study of the hadronic weak interaction has a long tradition, starting with the first observation of parity violation in the nucleon-nucleon (NN) interaction in cold neutron capture experiments, in the early 60's (Y. Abov *et al.,* 1964). Since then, there has been intense effort in gaining a better understanding of the weak NN interaction, both on the theoretical side, as well as on the experimental side. The existence of the NN weak interaction was first predicted in the generalization of Fermi's theory of nuclear beta decay (Feynman, Gell-Mann, Sudarshan, and Marshak) to include a universal charged weak current. In other words, a consistent theory for nuclear beta decay required the existence of the NN weak interaction. This basic framework has survived within the Standard Model (SM), with the crucial addition of the neutral weak hadronic currents. To this day, the latter remains a very poorly tested (and poorly understood) sector of the SM. The basic weak currents, as they occur in the SM, are modified by the strong interactions at low energy. At the same time, the large mass of the weak bosons requires close proximity of the quarks engaged in the interaction. The precision measurement of parity violating observables in few body NN systems can therefore provide important benchmarks for models that aim to describe low-energy, non-perturbative QCD, as well as effective models that seek to describe the NN weak interaction itself. Progress in measuring parity violating observables in cold neutron capture experiments has historically been hampered by a lack in high intensity neutron sources and other technological problems. Recently, significant technological advancements on all fronts and, especially, the completion of new, high intensity neutron sources have spurred renewed experimental activity in this area. I will present a brief overview of recent theoretical efforts and talk about current and proposed experimental work with cold neutrons.