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Hadronic weak interaction: The NPDGamma experiment

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The measurement of very small parity-violating (PV) observables in few-nucleon systems, where nuclear wave functions are calculable, is a via for understanding the hadronic weak interaction (HWI), which remains enigmatic due to the dominance of the strong interaction in hadronic systems and the non-perturbative nature of Quantum Chromodynamics at low energies. Additionally, the study of the strangeness-conserving HWI could help to understand phenomena that have been observed in the strangeness-changing sector and that cannot be explained in the framework of existing theories, like the dominance of the $\Delta I = 1/2$ channel in the decay of kaons or the relative weak amplitudes in the non-leptonic decay of hyperons. The strangeness-conserving HWI also offers the possibility to study neutral currents at low energies, since charged currents are suppressed for the $\Delta I = 1$ nucleon-nucleon interactions. The $\Delta I = 1$ channel, accessible through the exchange of pions, dominates the strong interactions between nucleons at low energies. The availability of very intense neutron sources has allowed the development of experiments to measure PV effects in nuclear interactions between polarized slow neutrons and light nuclei with sensitivity in the 10−8 level. A pioneer among these is the NPDGamma experiment, which last year completed data acquisition at the Spallation Neutron Source at the Oak Ridge Natiobal Laboratory to determine the PV asymmetry in the spatial distribution of the gamma rays emitted in the capture of polarized cold neutrons by protons, A_γ. This asymmetry is dominated by the $\Delta I = 1$ $^3S_1 - {}^3P_1$ parity-odd transition in the n − p system, therefore it is related to the weak coupling that characterizes the exchange of one pion in the HWI, $h^1\pi$. A statistical uncertainty of ~ 1.3×10^{-8} was achieved in the determination of A_γ. I will describe the experiment and discuss preliminary results, as well as their comparison with theoretical calculations and previous experimental results.

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