Measurement of the parity-violating gamma asymmetry of radiative neutron-proton capture

Yasuhiro Masuda representing the npdγ collaboration

We will report on the status of an experiment we are building to measure the neutron-proton-capture γ asymmetry in the reaction $n+p \rightarrow d+\gamma$. The asymmetry is related to the weak πNN coupling, H_π^1. The value of H_π^1 will be obtained with an uncertainty of 1.0×10^{-7}, 10% of its expected value, 1.1×10^{-6}.

The weak meson-exchange potential is applied for theoretical understanding of the nucleon-nucleon (*NN*) weak interaction. For the study of the hadronic weak interaction, parity-violating effects are used to isolate the weak *NN* interaction from the much larger effects of strong and electromagnetic interactions. Many parity violation experiments have been carried out in many nuclei. However, the determination of the weak meson-exchange coupling is very difficult from the nuclear experiments. The observables depend on nuclear wave functions relevant to parity violating observables. The nuclear wave functions can not be exactly calculated, except in few-nucleon systems.

For two-nucleon systems, the nuclear uncertainty is negligible. The longitudinal asymmetry of *pp* scattering has been measured for the determination of ρ and ω meson couplings, H_ρ and H_ω. γ asymmetry and circular polarization of a neutron-proton radiative capture reaction were measured for the determination of H_π^1 and H_ρ, respectively. However, no finite values were obtained because of statistical limitation. The upper limit of H_π^1 was obtained from the measurement of the γ-ray circular polarization from ^{18}F. The nuclear uncertainty relevant to the parity-mixing matrix element was removed by using an analogue nuclear beta decay transition. Recently, ^{133}Cs nuclear anapole moment was observed by an atomic parity-violation experiment. The value of H_π^1 was estimated by the nuclear anapole moment, which was significantly larger than the limit by the ^{18}F experiment, near the upper limit of the reasonable range .

The H_π^1 is obtained by the present experiment without the nuclear uncertainty. The current controversy will be resolved.