Spin Manipulation by Use of Nuclear Quadrupole Interactions
– Quarks and Medium Effects in the Nucleus

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The alignment correlation terms in the $\beta$-ray angular distributions from the purely spin aligned mirror pair $^{12}\text{B}(I_{1/2}^\pi = 1^+, T_{1/2} = 20.2 \text{ ms})$ and $^{12}\text{N}(I_{1/2}^\pi = 1^+, T_{1/2} = 11.0 \text{ ms})$ were precisely measured to place a new limit on the $G$-parity conservation law. For the creation of the alignment, the spin manipulation technique was applied, which utilized the nuclear quadrupole interactions. The $G$-parity violating induced tensor coefficient was determined to be $2M f_T/f_A = -0.15 \pm 0.12 \pm 0.05$ (theor.), which is consistent with the theoretical prediction based on QCD in which $2M f_T/f_A$ is proportional to the mass difference between up and down quarks which constitute the nucleon. Also determined the axial charge to be $y = 4.90 \pm 0.10$ (90\% CL). From the result, we have found that the nucleon mass inside the nucleus is reduced (16 $\pm$ 4)\% relative to the free nucleon mass.

\textit{Key words: $\beta$-Ray Angular Distribution; Alignment Correlation Term; $G$ Parity; Axial Charge; In-Medium Nucleon Mass Renormalization.}