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 β-ray angular distributions from the purely spin aligned mirror pair ^{12}B($I^\pi = 1^+$, $T_{1/2} = 20.2$ ms) and ^{12}N($I^\pi = 1^+$, $T_{1/2} = 11.0$ 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 $2M_{fT}/f_A = -0.15 \pm 0.12 \pm 0.05$ (theor.), which is consistent with the theoretical prediction based on QCD in which $2M_{fT}/f_A$ 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 ± 4)% relative to the free nucleon mass.

Key words: β-Ray Angular Distribution; Alignment Correlation Term; G Parity; Axial Charge; In-Medium Nucleon Mass Renormalization.