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Nuclear Spin Dependent Parity Violation in Diatomic Molecules

SIDNEY CAHN, EMINE ALTUNTAS, DAVID DEMILLE, Yale University — Nuclear spin-dependent parity violation (NSD-PV) effects arise from exchange of the Z^0 boson between electrons and the nucleus, and from interaction of electrons with the nuclear anapole moment, a parity-odd magnetic moment. The latter scales with nucleon number of the nucleus A as $A^{2/3}$,whereas the Z^0 coupling is independent of A. Thus the former is the dominant source of NSD-PV for nuclei with $A \geq 20$. We study NSD-PV effects using diatomic molecules, where signals are dramatically amplified by bringing rotational levels of opposite parity close to degeneracy in a strong magnetic field. The NSD-PV interaction matrix element is measured using a Stark-interference technique. We present results that demonstrate statistical sensitivity to NSD-PV effects surpassing that of any previous atomic parity violation measurement, using the test system $^{138}Ba^{19}F$. We report our progress on measuring and cancelling systematic effects due to combination of non-reversing stray E-fields, E_{nr} with B-field inhomogeneities. Short-term prospects for measuring the nuclear anapole moment of $^{137}Ba^{19}F$ are discussed. In the long term, our technique is sufficiently general and sensitive to enable measurements across a broad range of nuclei.

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