

Progress Towards Measurement of the Nuclear Anapole Moment of Ba-137 Using BaF Molecules

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Nuclear spin dependent parity violation (NSD-PV) effects in atoms and molecules arise from Z^0 boson exchange between electrons and the nucleus, and from the magnetic interaction between electrons and the parity-violating nuclear anapole moment. It has been proposed to study NSD- PV effects using an enhancement of the observable effect in diatomic molecules. Here, we demonstrate measurements of this type with sensitivity to NSD-PV effects surpassing that of any previous atomic PV measurement, using the test system $^{138}\text{Ba}^{19}\text{F}$. With ~ 168 hours of data, we measure the matrix element, W , of the NSD-PV interaction with combined statistical and systematic uncertainty $\delta W < 0.7$ Hz. The sensitivity we demonstrate would be sufficient to measure NSD-PV effects of the size anticipated across a wide range of nuclei. We describe the details of our method and future improvements, including an extensive study of systematic errors associated with our technique, and show that these can be controlled at least at the level of the present statistical sensitivity.

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