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YbF, BOB and the eEDM: probing zero with diatomic molecules

ZACHARY GLASSMAN, RICHARD MAWHORTER, Pomona College, JENS-UWE GRABOW, Leibniz Universitat Hannover, TIMOTHY STEIMLE, ANH LE, Arizona State University — The shape of the electron is a fascinating mystery which could prove to unlock a path to physics beyond the standard model. The key to finding this shape, or charge distribution, is a measurement of the electron Electric Dipole Moment, or eEDM. The standard model predicts an eEDM of less than $10^{-40}e\cdot$cm, but other models, such as string theory, predict values that are orders of magnitude higher. The current experimental upper limit is $\approx 10^{-28}e\cdot$cm, measured with YbF, a diatomic chosen due to huge internal fields in the Yb nucleus. These large fields are essential to resolving the energy level splittings resulting from the eEDM. We have performed both Fourier transform microwave spectroscopy and pump-probe optical microwave double resonance spectroscopy on YbF in pursuit of further constraining the Yb nuclear wavefunction, a necessary parameter for the eEDM experiments. We present a robust method for fitting multi-isopologue data sets which allows quantitative determination of effects such as the breakdown of approximating the nucleus as a point charge and the breakdown of treating electronic and nuclear wavefunctions as separable.

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