TESTS OF PARITY AND TIME-REVERSAL VIOLATION USING DIATOMIC MOLECULES

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Our group is pursuing several experiments to study violations of discrete symmetries such as parity (P-) and time-reversal (T-). These effects arise due to particle physics phenomona at very high energy scales, yet can give rise to observable effects in precision spectroscopic measurements. Our experiments all use the structure of diatomic molecules to dramatically amplify the signals due to P- and T-violation, relative to previous experiments using atoms for similar purposes. This talk will focus on two of our experiments. The ACME project[b] seeks to measure the permanent electric dipole moment of the electron, a P- and T-violating effect predicted in many extensions to the Standard Model of particle physics (e.g. Supersymmetric theories). ACME uses ThO molecules, delivered from a newly-developed type of cryogenic molecular beam source,[c] to simultaneously provide high statistical sensitivity and unprcedented rejection of systematic errors. The ZOMBEY experiment[d] seeks to measure P-violating effects in free radicals, with the goal to determine properties of the electroweak force that are inaccessible to accelerator-based measurements. This talk will describe the concepts and methods of these experiments, highlighting the crucial role of molecular spectroscopy in optimizing their performance.

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[b] A. C. Vutha *et al*., J. Phys. B **43**, 074007 (2010).

[c] N. R. Hutzler *et al*., arXiv:1101.4217; J. F. Barry *et al*., arXiv:1101.4229.

[d] D. DeMille *et al*., Phys. Rev. Lett. **100**, 023003 (2008).