Tabletop Tests of Supersymmetry: An Electron EDM Search with Tungsten Carbide Molecules

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The Standard Model of particle physics is incomplete. As such, various extensions to the Standard Model, most notably Supersymmetry (SUSY), contain predictions of "new physics" that can be observed by experiments ranging in size from the Large Hadron Collider (LHC) at CERN to laboratory-based, tabletop precision measurements. This talk will focus on the latter.

Specifically, this talk will describe an electron electric dipole moment (EDM) search using the valence electrons in the $^3\Delta_1$ ground state of tungsten carbide (WC) molecules. An electron EDM violates both parity (P) and time-reversal (T) symmetries and is revealed as an energy splitting between spin-up and spin-down states that is proportional to the electric field experienced by the electron. This energy splitting, perhaps at the $\sim h \times \mathcal{O}(\mathrm{mHz})$ level or below, must be resolved on top of residual Zeeman shifts that are typically several orders of magnitude larger. It will be shown that the internal level structure of tungsten carbide molecules can enhance a potential electron EDM signal while mitigating deleterious Zeeman effects. Our projected sensitivity to detecting an electron EDM reaches across most of the allowed range predicted by Supersymmetric theories.