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Measuring the electron's electric dipole moment using YbF: data acquisition and analysis

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It is well known that the existence of an electron electric dipole moment (eEDM) would violate time reversal symmetry. The Standard Model predicts an eEDM less than 10^{-40} e cm, however many popular extensions predict values in the range $10^{-29} - 10^{-27}$ e cm. Our experiment currently has the potential to measure eEDMs down to approximately 5×10^{-28} e cm, making it a precise probe for T-violation and physics beyond the Standard Model.

We measure the eEDM by performing a type of separated oscillating field interferometry on a pulsed beam of YbF. The molecules are prepared such that the molecular spin is oriented perpendicular to an applied strong (10 kV/cm) electric field. The spin is then allowed to precess about the electric field axis over a 0.5 ms interaction period. We measure this angle of rotation, which is directly proportional to the eEDM.

In order to measure the eEDM precisely and without systematic error we use a complex switching technique wherein certain parameters, including the applied electric and magnetic fields, are reversed between individual molecular pulses. We report our current technique in more detail as well as the tests we perform to check for systematic effects.

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