A PbF PROBE FOR THE ELECTRON ELECTRIC DIPOLE MOMENT

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A molecule in a state of total angular momentum F has a familiar $2F+1$ degeneracy. In the presence of a pure magnetic field, this $2F+1$ degeneracy is completely lifted with each magnetic sub-level M_F acquiring its own energy. In the presence of an electric field, quantum states with non-zero magnetic quantum numbers $|M_F|$ remain doubly degenerate. This fact is well established by Stark spectroscopy and is a consequence of time-reversal symmetry. In 1950, Purcell and Ramsey pointed out that time-reversal symmetry could be broken by the existence of an electric dipole moment of the electron. Over the last 60 years, the interest in such a symmetry breaking dipole moment has increased, in part because it may explain the matter-antimatter asymmetry of the Universe, and in part because it could help to differentiate between competing fundamental models of Physics. If large enough, such a dipole moment could lead to an observable lifting of the degeneracy between $+M_F$ and $-M_F$ states of a molecule in a pure electric field. We report on progress toward searching for an electric dipole moment by an optical quantum beat experiment utilizing the $X_1\ ^2\Pi_{1/2}$ state of PbF molecule.