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A zero magnetic moment molecular probe of the electron's electric dipole moment.

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The stationary states of a molecule in a pure electric field are degenerate in the sign of the projection of total angular momentum on the field axis. A lifting of this $\pm M_F$ degeneracy would be an indication of CP (time reversal) symmetry violation. For heavy paramagnetic molecules, this CP violation would be attributed to an electron electric dipole moment (e-EDM) and could at once separate Supersymmetric models from the Standard Model and explain why we are made of matter instead of antimatter. A major obstacle to observing CP violation in this way is that the background magnetic-field induced splitting of the $\pm M_F$ degeneracy normally dwarfs any possible electric-field induced splitting. Here we report how the physics of $^2\Pi_{1/2}$ PbF can be exploited to gain extraordinary sensitivity to the e-EDM while reducing the magnetic g factor to less than 10^{-7}. The construction of a radical beam source of PbF, sensitive resonance enhanced multi-photon ionization (REMPI) detection of PbF, and progress toward measurement of the e-EDM are reported.