Progress towards measurement of the electron electric dipole moment using the PbF molecule: Spectroscopic constants of the known electronic states of PbF

CHRISTOPHER MCRAVEN, POOPALASINGAM SIVAKUMAR, MILINDA RUPASINGHE, University of Oklahoma, GREG HALL, TREvor SEARS, Brookhaven National Laboratory, NEIL SHAFER-RAY, University of Oklahoma — The lead monofluoride molecule provides for a 1000- to 10,000-fold improvement in sensitivity to an electron electric dipole moment (e-EDM) over atomic-based measurements. The density of the relativistic electronic wave function near the lead nucleus leads to this exaggerated sensitivity. This density also leads to a mixing of the $^2\Pi$ ground state with $^2\Sigma$ excited states. For this reason, comparison of measurements of the electronic structure to calculation leads to a better understanding of the sensitivity of the molecule to an e-EDM. Here we present new spectroscopic constants for the $A$, $B$, $C$, $D$, $E$, and $F$ states. It was previously believed that the $A\ ^2\Sigma_{1/2}$ and the $X\ ^2\Pi_{1/2}$ state formed a simple mixed $^2\Pi - ^2\Sigma$ system. Our data suggest a more complicated system in which higher vibrational states of the $A\ ^2\Sigma_{1/2}$ electronic state mix with the $X\ ^2\Pi_{1/2}$ state whereas the lower vibrational states mix with the $D\ ^2\Pi_{1/2}$ electronic state.