

STARK AND ZEEMAN EFFECT IN THE $[18.5]^2\Delta_{3/2} - X^2\Delta_{3/2}$ TRANSITION OF THORIUM MONOFLUORIDE^a

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Studies of the bonding and electronic structure of simple actinide compounds^{bcd} are attractive because they provide insight into the chemistry of more complex molecules associated with radioactive waste. These molecules are the most effective venues for developing a synergism between theory and experiment. The primary goal of the present study is to understand and identify different levels of covalency in a series of gas phase actinides and lanthanides containing molecules via the determination of the permanent electric dipole moment, μ , and magnetic g-factors. The electronic spectrum of ThF has been investigated using: a) medium resolution two dimensional (2D)^f; ultrahigh field free, Stark, and Zeeman spectroscopy of a supersonically cooled molecular beam sample. A strong band system near 540 nm was detected and the Stark shifts and splitting were analyzed to produce μ values of 1.426(18)D and 0.586(30)D, for the $X^2\Delta_{3/2}$ and $[18.5] \Omega=3/2$ states, respectively. Zeeman splittings were analyzed to show that both the ground and excited $[18.5] \Omega=3/2$ states are predominately $^2\Delta_{3/2}$ spin-orbit components. A molecular orbital correlation diagram will be used to rationalize the observed very small μ values, the electronic state distribution, and garner insight into the bonding mechanism.

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