Laser Absorption Spectroscopy of LaF^+ : Accurate Term Energies for the $H^2\Pi$, $D^2\Phi$, and $X^2\Delta$ States

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The laser absorption spectrum of the LaF^+ molecular ion has been observed for the first time. Gas phase LaF was obtained by heating a mixture of a 0.2 g of La metal and 0.3 g of LaF_3 powder to 1900 K. LaF^+ ions were produced by passing a 25 kHz discharge (80-100W, 0.5A peak current) through the vapor. Under these conditions the Tantalum heating tube used to vaporize the sample also acted as a hollow cathode. 138 lines of the $^2\Phi_{2.5}$-$^2\Delta_{1.5}$ (0,0) band were recorded. This band system was observed previously [a] in the emission spectrum of LaF^+. Accurate term energies are (in cm^{-1}):

$$T_0(H^2\Pi_{1.5}) = 30398.78(5),\ T_0(D^2\Phi_{3.5}) = 17099.24(5),\ \ T_0(X^2\Delta_{2.5}) = 274.62(5),$$
$$T_0(H^2\Pi_{0.5}) = 30237.85(5),\ T_0(D^2\Phi_{2.5}) = 16534.738(5),\ T_0(X^2\Delta_{1.5}) = 0.0$$

Ligand field theory models were used to provide the configurational assignment for the LaF^+ electronic states. The symmetry for the ground state of the LaF^+ molecular ion has been reassigned as $X^2\Delta$.

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[a] E. A. Shenyavskaya and L. V. Gurvich, J. Mol. Spectrosc. 81, 152-163 (1980).