The excited $E$ internal rotor state of He-CH$_3$F is studied using microwave spectroscopy and $ab\ initio$ calculations. Bound state calculations on a high-level $ab\ initio$ intermolecular potential surface predict a T-shaped ground state and two low-lying excited states with the He localized either at the C end ("linear") or the F end ("anti-linear") of the C-F bond, similar to that found for the $A$ internal rotor state presented previously. There are several distinct differences between the $A$ and $E$ states. Whereas the ground state rotational transitions of the $A$ state could be fit with a standard asymmetric rotor Hamiltonian, the $E$ state exhibits a much more complex energy level structure due to the internal rotation of the CH$_3$F. In addition, the $E$ state is calculated to be bound by 11.709 \text{ cm}^{-1}, 0.249 \text{ cm}^{-1}$ greater than the $A$ state relative to their respective dissociation products, $K = 1$ or $K = 0$ CH$_3$F, and the ground state to linear state energy gap is predicted to be 4.148 \text{ cm}^{-1}, 0.156 \text{ cm}^{-1}$ greater than in the $A$ state. At present six rotational transitions between five different energy levels have been observed and assigned with the aid of double resonance experiments and the $ab\ initio$ calculations.

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$^a$54th International Symposium on Molecular Spectroscopy (1999)

$^b$55th International Symposium on Molecular Spectroscopy (2000)