FAR INFRARED AND MILLIMETER WAVE SPECTRA OF THE TORSIONALLY EXCITED STATES OF PERCHLORIC ACID, $HClO_4$.

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$HClO_4$ is a nearly spherical rotor with a moderately low 3–fold barrier to internal rotation, $(s \approx 5.15)$. Because the rotational energies are dominated by the K dependent solutions of the Mathieu equation the ground torsional state contains many perturbations which result from near resonances among the various K's. The excited torsional states, however, are all at or well above the top of the barrier to internal rotational where the K dependent Mathieu energies result in widely spaced, nearly free rotor levels. This paper describes the analysis of FIR spectra in the 200-400 cm^{-1} region and rotational spectra between 50 and 700 GHz which cover a wide range of excited internal rotation levels. FIR spectra were recorded at 0.00125 cm^{-1} resolution using a Bruker IFS 120 HR spectrometer with the synchrotron light source at the MAX-I electron storage ring in Lund. Examples of both the FIR and millimeter spectra will be shown. The molecular parameters used to fit the spectra will be presented. These will be compared with results obtained from previous work on the torsional ground state.