TERAHERTZ SPECTROSCOPY AND GLOBAL ANALYSIS OF H_3O^+

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Eight ground state inversion transitions of H_3O^+ in the 0.9-1.6 THz region have been measured using the frequency multiplier submillimeter spectrometer (FMSS) at JPL. The accuracy of these measurements is estimated to be 300 kHz. The ions were generated in a DC discharge through a gas mixture of a few mTorr of H_2 and 30 mTorr of H_2O. A multistate analysis was carried out for H_3O^+, which includes the lines observed in this work, previous submillimeter and terahertz inversion transitions in the ground state, and previous infrared data on all the four vibrational fundamental bands. Accurate molecular parameters were obtained with taking into account the strong Coriolis interaction between the symmetric OH stretching mode ν_1 and the doubly degenerate asymmetric OH stretching mode ν_3. Frequency predictions, particularly for high-J transitions in the ground state and in the ν_1 and ν_3 fundamental bands, have been greatly improved by including in our analysis 200 more high-J transitions, which were excluded in previous analyses. The more precise measurements and new predictions reported here will support the analysis of astronomical observations by the future high resolution spectroscopy telescopes such as Herschel, SOFIA, and ALMA.