TERAHERTZ SPECTROSCOPY OF EXCITED WATER

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The observation and characterization of water spectra have been intensely pursued in the astrophysical community. Its rotational transitions in the ground, (010) ($v_2 = 1$), (020), (100), and (001) states are primary targets of the ongoing Herschel mission. In this study, laboratory terahertz spectroscopy of water was carried out at JPL and Cologne, with the goals to measure all transitions HIFI might see and critically review and fit the lowest 5 vibrational states. DC discharge, radio frequency discharge and heating tapes were used to generate highly excited water. A total of 145 pure rotational transitions in the (000), (010), (020), (100), and (001) states of water were observed in the 293−1969 GHz region. Of these, 86 have been detected for the first time with MW accuracy. So far, the $1(1,0)-1(0,1)$ transition was observed for all five states; the $2(1,2)-1(0,1)$ transition was observed for (000), (100), and (001) but is missing for (010) (1753914 GHz) and (020) (1872972 GHz); the $1(1,1)-0(0,0)$ transition was observed for all states but (020) (1332967 GHz). The analysis is still in progress, and we will present the most recent fitting results to date. There are difficulties in fitting water spectra, such as the strong centrifugal distortion, which gives a non-convergent Watson Hamiltonian. In addition, the first triad states (100, 020, and 001) are strongly coupled. The latest attempt at a global fit of these 5 states using Euler series achieved a reduced RMS of 8.4 (Pickett et al. 2005, J. Mol. Spectrosc. 233, 174).