ROTATIONAL AND VIBRATIONAL DYNAMICS OF WATER IN SUPERFLUID HELIUM DROPLETS

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High resolution infrared spectroscopy is used to study the rotational and vibrational dynamics of H_2O and HDO monomers solvated in helium nanodroplets. Water is the simplest polyatomic molecule studied in helium to date and has a vibrational density of states that lies in between those of the diatomic and polyatomic molecules studied previously. We find that upon excitation, water relaxes vibrationally to its ground state on a timescale shorter than that of the experiment ($\sim$ 2 ms), despite having similar relaxation energies to the metastable vibrational states of CO and NO.[a] Additionally, transitions to rotational levels that are expected to be resonant with the bulk modes of helium are observed to be heavily broadened, indicating that these levels have short lifetimes. We present the excited state rotational and vibrational lifetimes extracted from the homogeneous line widths of the individual ro-vibrational transitions and compare them to other systems studied in helium.

[a] K. von Haeften and M. Havenith (private communication)