NANOSCALE MOLECULAR SUPERFLUIDITY OF HYDROGEN AND ITS SPECTROSCOPIC IMPLICATIONS

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We present microscopic quantum theoretical analysis of the nanoscale superfluid properties of solvating clusters of para-H_2 around the linear OCS molecule, prompted by recent experiments showing anomalous spectroscopic features for these systems at low temperatures. Using path integral methods that incorporate the Bose permutation symmetry of para-H_2, we analyze the extent of a superfluid response of the molecular hydrogen density to molecular rotation around different axes. We find that a highly anisotropic hydrogenic superfluid response does appear at low temperatures, and we analyze the temperature dependence and anisotropy of this in terms of the local structure of quantum exchange within the first solvation shell of hydrogen molecules. A rationalization for the anomalous spectroscopic features observed experimentally is given.