Proton Coherent Delocalization in the Ground State of Nanoconfined Water

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X-ray and neutron Compton scattering measurements of the electron and proton momentum distribution in water confined in both single walled and double walled carbon nanotubes(SWNT and DWNT)[1], as a function of temperature and confinement size, demonstrate that water confined to distances of the order of $20\mathring{A}$ is in a unique quantum state, quite unlike the usual weakly interacting molecule picture. The protons delocalize coherently and collectively over distances of .2-.3 $\mathring{A}$ in effective double well potentials created by large scale reorganization of the valence electrons. We will discuss the phenomenology of this state, the transport of protons and water molecules in it, and some speculations as to how it arises.

1. G. F. Reiter, A. Deb, Y. Sakurai , M. Itou, and A. Kolesnikov, J. Phys. Chem. Letts. 7, 4433 (2016)