On the quantum nature of the two fluids in liquid water

Antonella De Ninno

ENEA- FSN-TECFIS-DIM, Frascati Research Centre, via E. Fermi 45, Frascati 00044 (Roma) Italy

Abstract

The molecular dynamics of liquid water has been studied by a variety of spectroscopic techniques. In spite of a large number of papers published in the last twenty years in the literature, the basic model of liquid water is still controversial, however, the picture emerging from different experimental techniques points towards the coexistence of two fluids in liquid water. In this talk we compare the results from FTIR, NIR and THz spectroscopy on pure water and aqueous solutions of electrolytes. We will show that liquid water is a mixture of two different species of H_2O molecules: one made of non-bonded or single H-bonded molecules and the other made of highly correlated cluster of molecules and that the permittivity of water and aqueous solutions can be easily explained in terms of these populations each one obeying to the single-parameter Debye model.

The vibrational spectroscopy results show the emergence of a self-similar behaviour in the restructuring of liquid water perturbed by the addition of a solute or by the temperature change. The data show an auto-organized system, beyond the first-hydration layer, that obey to the same mathematical set of equation describing quantum coherent systems.