# About the two phase structure of liquid water

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The physical origin of coherence inside condensed matter at ambient conditions of temperature and pressure is still widely debated among physicists because in the past decades the existence of macroscopic quantum states has been only related to cryogenic systems such as superconductors and superfluids. The main objection is still related to the KT paradox, i.e. the existence of long lasting coherent states or of lifelong excitations at room temperature is not compatible with the energy exchanges due to the thermal random motion.

The existence of coherent macroscopic states at physiological temperature allows us to re-consider many “impossible” phenomena. Energy transfer in biological systems, as example, implies the extreme energetic efficiency of living organisms. Photosynthetic complexes capture of solar radiation occur with a near-perfect quantum efficiency. High efficient energy transfer is just a characteristic of coherent systems and the existence of giant dipoles in biologic systems can be explained in terms of mesoscopic portions of matter sharing the same wave function

Coherent macroscopic states find their rationale in a general theory of coherence in condensed matter: in particular, liquid water turns out to be a superposition of two populations of molecules having different degree of mutual correlation and belonging to different quantum states.

Several experimental findings (Optical Kerr Effect, IR spectroscopy, THz reflection spectroscopy) have confirmed this two levels picture of liquid water even at room temperature. Liquid water can be considered as a double level system, i.e. a system where molecules can oscillate between two energetic states.

Such a picture can also be applied to explain EZ formation. EZ also exists in de-ionized water, thus, even though the observed squared root of time dependence of the formation of the EZ points toward a diffusive process, the ultimate nature of the diffusing particles has still to be clarified.

The formation of a film of water on the surface of a solid body can be described by the general theory of the Van der Waals forces and its thickness depends on the electrostatic dielectric constant of both the film $\varepsilon_{water}$ and the solid surface $\varepsilon_{solid}$. However, considering the fact that water has two different phases whose dielectric constant can be very different, an interesting and unpredictable picture emerges.