Are Liquids Held Together by Springs? The Mesoscopic Foundations of Non-Equilibrium Thermodynamics and The Time's Arrow Revisited in the Dual Model of Liquids

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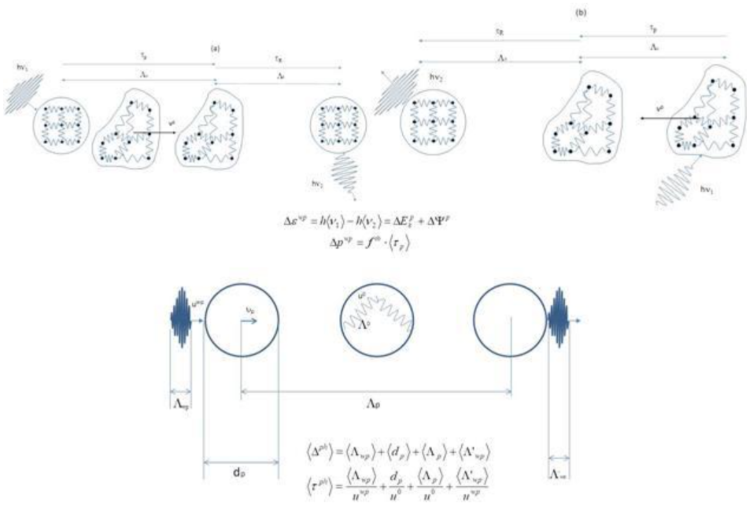
This talk has two goals. The first is to show that the elementary interaction in the Dual Model of Liquids (DML) between the solid-like molecule's aggregates and the lattice excitations is appropriate to represent the link between the behaviour at macroscopic scale of condensed systems, such as liquids, and the physical processes characterizing those systems at mesoscopic scale. On the one hand, at macroscopic scale liquids are described from the statistical point of view by the equations of the Non-Equilibrium Thermodynamics (NET). On the other hand, at mesoscopic scale energy and momentum are supposed in the DML be transported in liquids by means of quanta of elastic energy, the lattice particles, and exchanged with solid-like ephemeral aggregates of molecules, the liquid particles. This interaction is time reversal, as requested by the Onsager' principles and by the Newton' laws of dynamics, and gives rise to the transport of energy, momentum and mass through a liquid. In the DML framework, the physical processes responsible at macroscopic scale of such transport phenomena were modelled, and the expressions for the specific heat, the thermal conductivity, the diffusion and thermodiffusion coefficients, the Soret coefficient, the shear viscosity, were deduced and validated by comparison with the experimental data. The elementary interaction is further characterized by a (classical) tunnel effect, allowing the energy and momentum to be exchanged between the two reservoirs in one place and given back a step further and a time lapse later. The tunnel effect is a finger-print of the DML and a missing element in the classical approach; it allowed to correctly modelling, by means of the hyperbolic propagative equations, the time-dependent behaviour of systems following the application of a disturbance. The duality of liquids in the DML is due also to the supposed presence of wave packets, which are quanta of elastic/thermal energy.

The second goal consists in showing that just such a duality allows to identify a time's arrow on the mesoscopic scale in liquids. The interaction of quanta with the molecular clusters introduces a privileged direction, a mesoscopic asymmetry, that becomes relevant in time-dependent macroscopic processes, although the elementary interaction remains time reversible (Newtonian).



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