Hierarchic Theory of Liquids and Solids & its Application to Biosystems

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Basically new quantitative Hierarchic theory of matter general for liquids and solids will be discussed (http://arxiv.org/abs/physics/0102086). This theory is proved to be more advanced than well known basic models of Einstein and Debye of condensed matter and can be reduced to them only after number of simplifications. In our approach the condensed matter is considered as a system of three-dimensional (3D) superposition of standing waves of following types:
a) the most probable de Broglie waves, related to molecules translation and librations in composition of condensed matter; b) the acoustic waves (thermal phonons); c) the electromagnetic waves (IR photons).

The existence of ambient (high-T) *mesoscopic* Bose condensation (mBC) in composition of liquids and solids in form of coherent molecular clusters with volume of 3D de Broglie waves of molecules, has been discovered as a result of computer simulations, using software, based on Hierarchic theory (copyright, 1997, USA, Kaivarainen).
Strongly interrelated collective excitations (quasiparticles), named the *effectons, convertons, transitons and deformons and their different combinations* are introduced in hierarchic model of condensed matter. They represent a mesoscopic scale of matter, intermediate between microscopic and macroscopic ones.

Our Hierarchic theory of condensed matter got a lot of convincing computerized verifications on examples of water and ice from comparison of calculated and experimental physical parameters, like heat capacity, thermal conductivity, surface tension, vapor pressure, viscosity and self-diffusion. The new quantitative theories of refraction index, Brillouin light scattering, Mössbauer effect and others, based on the same hierarchical model, are also in good correspondence with experiment. New optoacoustic device: "Comprehensive Analyzer of Water Properties (CAMP)", based on Hierarchic theory and corresponding computer program, has been proposed (http://arxiv.org/abs/physics/0207114).
It is shown, that the dimensions and dynamics of water clusters (mesoscopic Bose condensate) are crucial factors in evolution of biopolymer's spatial and dynamic structure.

Number of new phenomena where revealed:
- Solvent - mediated remote interaction between different kinds of proteins in the process of their large - scale dynamics (flexibility) change, induced, respectively, by ligand binding to the active sites, by temperature or by variation of solvent composition;
- Solvent-mediated distant interaction between protein and cells, accompanied by cells swelling or shrinking, correlated with change of protein flexibility and water activity, enhancing or triggering the passive osmosis via membranes of cells.

A new kind of interaction of water clusters, containing 30 - 70 molecules, with the open inter-domain and inter-subunit cavities of macromolecules/proteins, named *clusterphilic interaction,* was introduced (http://arxiv.org/abs/physics/0105067). Such interaction can be considered, as the intermediate one between the hydrophobic and hydrophilic ones. It follows from our dynamic model

of protein behavior in water, that intramolecular *clusterphilic interaction* stands for remote signal transmission, allosteric properties in multi-domain and oligomeric proteins.

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