Department of Civil Engineering and Engineering Mechanics

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Energy Exchange, Localization and Transfer in Nonlinear Oscillatory Chains and Nanostructures (Resonance Non-Stationary Dynamics)

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A new approach to non-stationary nonlinear dynamics, based on the concept of *Limiting Phase Trajectories* (LPTs), is presented. The systems under consideration are finite nonlinear oscillatory chains which can be identified, e.g., as the dynamical models of mechanical structures, polymer macromolecules or carbon nanotubes (CNTs). The LPT describes the most intensive energy exchange between weakly coupled parts of the system which can be considered as *effective particles* (EPs). They represent the excitations alternative to Nonlinear Normal Modes (NNMs) which are not involved into the processes with the energy exchange and demonstrate the wave-like behavior. It is possible to speak about distinctive wave-particle duality (WPD) in the framework of classical mechanics, and manifestation of particle-like or wave-like behavior depends on the initial conditions or on the type of attractor (it may be NNM as well as LPT).

Due introducing the EPs the physical nature of the WPD becomes apparent (when the particles themselves are strongly coupled, and the NNMs are resonant, that means their coherence, the EPs are weakly coupled). The transition from the most intensive energy exchange to the energy localization in the part of the system is also naturally described in terms of EPs and LPTs. The presented approach has significant applications connected with elaboration of the energy traps, synchronization of oscillators, providing the energy exchange and localization in CNTs etc., which will be described.

Leonid Manevitch is Head of the Laboratory of Physics and Mechanics of Polymers in the Semenov Institute of Chemical Physics at the Russian Academy of Sciences. His research interests include nonlinear normal modes and Limiting Phase Trajectories (LPTs); mechanisms of structural transitions in solid polymers, biological molecules, and nanostructures; and asymptotic methods in mechanics and physics. Prof. Manevitch is the author of 17 monographs and more than 400 papers.