CRETE CENTER FOR QUANTUM COMPLEXITY AND NANOTECHNOLOGY

ΣΕΜΙΝΑΡΙΟ ΚΕΝΤΡΟΥ ΚΒΑΝΤΙΚΗΣ ΠΟΛΥΠΛΟΚΟΤΗΤΑΣ & ΝΑΝΟΤΕΧΝΟΛΟΓΙΑΣ/
CCQCN SEMINAR

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3rd Floor Seminar Room

Interchain Coupling Effects on Large Acoustic Polaron in three Parallel Molecular Chains

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Abstract

We study the properties of the single large adiabatic polaron in the substances composed of three parallel equally separated coplanar molecular chains. We particularly discuss polaron stability in dependence of the interchain coupling strength in order to elucidate the origin (conditions) of the large polaron existence and stability, which, contrary to predictions of continuum adiabatic theories may persist in realistic conditions. Besides this general framework, our study may be relevant for some particular substances - β-sheet proteins, for example. Our results can be interpreted in the sense of arguments in favour of the existence of the effectively two-dimensional stationary polarons that may appear in the structure built up of the three parallel coplanar molecular chains. These polarons have a large longitudinal radius (~ 1/μ) while the transverse one ranges from lt = 0, in the absence of interchain coupling, to approximately twice of the interchain separation when coupling strength tends towards the infinity. These two-dimensional polarons are both energetically and dynamically stable. This is quite the opposite of the expectations based on the traditional adiabatic large polaron theories which, in the case of short ranged electron-phonon interaction, predict that the stable large polaron may exist only in 1D systems. Stability of these 2D polarons increases with the increase of the intersite coupling strength so that they may be comparably more stable than the pure 1d polarons.
Similarly to the two-chain structure polaron motion, due to the quasi-relativistic dependence of adiabatic functional and energy on polaron velocity, increases the intrachain coupling constant - ~ g - and has tendency to confine polaron to single chain which may be achieved as its velocity increases towards the speed of sound – $u \rightarrow c_0$.