Abstract for GR-TR Conference on Statistical Mechanics and Dynamical Systems

Talk Invited Invited Talk

Breather induced anomalous charge diffusion in a DNA model

G. Kalosakas*

Materials Science Department, University of Patras, Rio GR-26504, Greece
* Electronic Address: georgek@upatras.gr

We present results on the diffusive motion of a charge propagating along a double stranded DNA, when the charge carrier interacts with the nonlinear stretching dynamics of base-pairs [1]. The coupled charge-lattice system is studied in the framework of the semiclassical dynamical equations [2].

Signatures of anomalous diffusive properties are found at relatively high temperatures. A sublinear diffusion and a plateau appear before the standard long-time diffusion, during the evolution of charge's mean squared displacement, and also a significant degree of heterogeneity is exhibited among individual trajectories [3]. The higher the temperature, the more evident is the anomalous charge's relaxation.

These properties are connected with the existence of vibrational hot-spots (breather or multibreather excitations) in the lattice component of the system, which result in an enhanced confinement of the charge, at the microscopic level [4].

Macroscopic charge transport parameters are strongly affected in this case, as it can be exemplified by the significant suppression of the diffusion coefficient D [3, 5]. The variation of D with temperature follows a stretched exponential law. These results are contrasted with the corresponding ones in the case of a linearized lattice, in the absence of breathers.

Such an anomalous diffusion of a charge coupled to a thermalized lattice may be also relevant in other low-dimensional soft materials with strong anharmonicities, like for example in conducting polymers.

---

[1] S. Komineas, G. Kalosakas, and A.R. Bishop, *Phys. Rev. E* **65**, 061905 (2002).

[2] G. Kalosakas, S. Aubry, and G.P. Tsironis, *Phys. Rev. B* **58**, 3094 (1998).

[3] G. Kalosakas, K.L. Ngai, and S. Flach, *Phys. Rev. E* **71**, 061901 (2005).

[4] G. Kalosakas, K.Ø. Rasmussen, and A.R. Bishop, *J. Chem. Phys.* **118**, 3731 (2003); *Synth. Met.* **141**, 93 (2004).

[5] G. Kalosakas, work in progress.