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On the Mechanical Control of Electrons at the Nanolevel

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Abstract– A generalization of the (Landau-Pekar) polaron concept permits to establish soliton-assisted transport in the form of electron surfing on a supersonically moving lattice soliton. Building upon such generalization, the concept of solectron was introduced [1-3]. The solectron is a dynamic bound state electron-anharmonic lattice deformation. For illustration, the case of a lattice with Morse interactions is used. Then an added, excess electron is considered in the "tight-binding" approximation. Eventually, there is electron trapping by the supersonically moving lattice soliton. Depending on values of the electron-phonon/soliton interaction, the electron transport is provided sub- or super-sonically. In an initial situation where there is an external electric field applied, the possibility exists of transport with no field over several orders of magnitude. On the other hand, the possibility also exists of charge transport with no need of electric field at all, from say a source to a drain along "natural channels" (crystallographic axes) [4, 5]. Hence the electron surfing process is a clear case of mechanical control of electrons at the nano-level. Finally, a solectron field effect transistor (SFET) has been designed, based on the electron surfing offering a ballistic-like flight of the solectron [6]. This opens up the possibility of extremely low energy consumption in computation.

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