Bound states of electrons with soliton-like excitations in one- and two-dimensional thermal systems

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We study the excitation of solitons in atomic systems with Morse interactions one-dimensional chains and planar samples in the region from low to intermediate temperatures and their influence on electrons moving in the lattice. The atoms are treated by classical Langevin equations for particles with Morse interactions. The dynamics of the free electrons is modelled in the framework of the tight binding model using Schrödinger and Pauli master equations. It is shown that electrons may form rather stable bound states with soliton-like excitations, an effect which was first detected by Davydov. We study the excitations of these quasiparticles, which move in general with supersonic velocity and are called here solectrons, in dependence on the temperature. Transport properties in particular diffusion are described by time-correlations and Kubo-type expressions. Several applications in particular to biopolymers are discussed.