Название публикации:
Nonlinear waves in a model for silicate layers

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Аннотация:
Some layered silicates are composed of positive ions, surrounded by layers of ions with opposite sign. Mica muscovite is a particularly interesting material, because there exist fossil and experimental evidence for nonlinear excitations transporting localized energy and charge along the cation rows within the potassium layers. This evidence suggests that there are different kinds of excitations with different energies and properties. Some of the authors proposed recently a one-dimensional model based on physical principles and the silicate structure. The main characteristic of the model is that it has a hard substrate potential and two different repulsion terms, between ions and nuclei. In a previous work with this model, it was found the propagation of crowdions, i.e., lattice kinks in a lattice with substrate potential that transportmass and charge. They have a single specific velocity and energy coherent with the experimental data. In the present work, we perform a much more thorough search for nonlinear excitations in the same model using the pseudospectral method to obtain exact nanopteron solutions, which are single kinks with tails, crowdions, and bi-crowdions. We analyze their velocities, energies, and stability or instability and the possible reasons for the latter. We relate the different excitations with their possible origin from recoils from different beta decays and with the fossil tracks. We explore the consequences of some variation of the physical parameters because their values are not perfectly known. Through a different method, we also have found stationary and moving breathers, that is, localized nonlinear excitations with an internal vibration. Moving breathers have small amplitude and energy, which is also coherent with the fossil evidence. Published by AIP Publishing.

Ключевые слова:
Anharmonic lattices; numerical-calculation; discrete breathers; charged-particles; localized modes; solitary waves; solitons; tracks; excitations; existence