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Nonlinear Waves in Layered Ionic Crystals

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Ionic crystal force fields are dominated at intermediate distances by Coulomb interaction. Typical layered structures like some silicates are composed of ions of the same sign, as for example, cations, surrounded by layers of ions with opposite sign, i.e., negative. Short range forces are also predominantly Coulomb repulsion between the nuclei screened by the ion electrons and Pauli repulsion. Therefore, the in-layer interaction is repulsive and the interaction between the cation layer and the sheets is a combination of electric attraction and short-range repulsion with a equilibrium distance. The out-of-plane layers provide an on-site potential which breaks the translational invariance in the plane with a periodic potential, which produces significant changes in the properties of propagation of nonlinear waves. The finite potential barriers between sites allow for the movement of ions at high energies. The different types of nonlinear waves that occur in the cation layers can be classified as extended nonlinear waves, nanopterons, intrinsic localized modes, solitons and kinks or shock waves. The latter have the property of transporting mass and charge, which allow for experimental measurements of currents. The physical implications of the existence of these different waves are analyzed.
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