Dynamics of gapped momentum states in viscoelastic media

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Gapped momentum states occur in non-equilibrium dynamic systems caused by wave and dissipative processes, so the study of this fundamental phenomenon represents interest for variety of nonlinear systems at extremal conditions (shocked solids and liquids, dusty plasma). Study of Gapped Momentum States during the propagation of shear waves in liquids has attracted considerable attention, revealing an incomplete frequency-wavenumber spectrum [1,2]. This implies a critical transition, leading to a qualitative change in the momentum transfer mechanism and system's properties. The main emphasis of this work lies in the exploration of Gapped Momentum States associated with wave propagation in viscoelastic media. Analytical solutions for the dispersion relations, based on the viscoelastic models of Kelvin-Voigt, Maxwell, the standard linear solid, and Kelvin-Voigt with fractional derivative, were studied. Conditions and criteria for the gap formation in momentum space were formulated for mentioned models. The relationship between phase and group velocity and wavenumber was visualized by plotting graphs using numerical data. Wave profiles were constructed, and the dynamics of wave propagation at various scales were demonstrated for specified momentum transfer mechanisms.

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