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Wave propagation in mechanical metamaterials

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PROPOSITIONS
accompanying the thesis
WAVE PROPAGATION IN MECHANICAL METAMATERIALS

1. The topological boundary term in the Lagrangian of rotor chains creates asymmetrical behaviors between kinks and antikinks in the ϕ^4 model.
[Chapter 2 of this thesis]
2. The Maxwell-Calladine formula works for static frameworks. Extrapolating this formula to systems with finite mechanical energy may cause confusion, which can be solved by taking the perspective of dynamical systems.
[Chapter 3 of this thesis]
3. For twisted kagome lattices at the critical angle, the doubly degenerate band structure in the whole reciprocal space probably implies a symmetry of the dynamical matrix relating the eigenvectors in a special way.
[Chapter 4 of this thesis]
4. Transverse waves on a tension-free string have vanishing velocity up to linear order, and become shock waves when the string is under impact. These shocks can be understood from the perspective of linear waves riding on the tensioned region induced by the impact.
[Chapter 6 of this thesis]
5. During kink-impurity interactions in topological rotor chains, most of the kinetic energy lost is probably transferred to the kink shape mode and the impurity mode, in the same way as observed in the classical ϕ^4 theory.
[D. Campbell et al., doi:10.1016/0167-2789(83)90289-0]
[Z. Fei et al., doi:10.1103/PhysRevA.46.5214]



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6. As the mechanism in rotor chains has been found to connect the linear theory of topological bands to the nonlinear theory of topological solitons, rich structures of solitons in higher dimensions may also be realized as mechanisms in topological mechanical frameworks.

[V. Vitelli et al., arXiv:1407.2890]

7. As shown previously, Bloch's theorem still holds for generalized periodic frameworks where the conventional translational symmetry may not exist. The concepts and methods in topological mechanics may also be valid for such frameworks, as they are based upon the Bloch-wave description.

[O. Kit et al., doi:10.1103/PhysRevB.84.155431]

[B. G. Chen, bitbucket.org/bryangingchen/rigiditypackage]

8. A unique zero-energy vibrational mode can be associated with each bond removed from an isostatic lattice, the same way as the known fact that a state of self stress can be associated with an added bond. This unique zero mode is quasi-localized, and can be phenomenologically described by a theory inspired by the "blob" theory in polymer physics.

[D. Sussman et al., doi:10.1039/C6SM00094K]

[M. Rubinstein et al., *Polymer Physics*, Oxford University Press, 2003.]



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