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The Viscoelastic Response of Topological Tight Binding Models
HASSAN SHAPOURIAN, TAYLOR L. HUGHES, SHINSEI RYU, Univ of Illinois - Urbana — The topological response to external perturbations is an effective probe to characterize different topological phases of matter. The Hall viscosity is an example of such a response which has been the subject of a great interest recently. So far, most of studies have focused on the continuum field theories. Here, we investigate this response for the tight binding (lattice) models. The presence of lattice breaks the continuous translational symmetry to a discrete symmetry and this causes two complications: it introduces a new length scale associated with lattice constant and makes the momentum a compact variable. We develop two different methods of how to implement a lattice deformation: (1) the lattice distortion is encoded in a U(1) phase acquired by a particle traversing a link between two sites; (2) a microscopic view is adopted and the lattice deformation appears in the gradient expansion of the hopping matrix elements. Consequently, we compute the Hall viscosity through the linear response (Kubo) formula. We examine these methods for three models: the Hofstadter model, the Chern insulator, and the surface of a 3D topological insulator. Our results in certain regimes of parameters, where the continuum limit is relevant, are in agreement with the field theory calculations.

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