

# Scattering of phonons by quantum-dislocation segments in an elastic continuum

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© 2019 American Physical Society. A canonical quantization procedure is applied to elastic waves interacting with pinned dislocation segments ("strings") of length  $L$  via the Peach-Koehler force. The interaction Hamiltonian, derived from an action principle that classically generates the Peach-Koehler force, is a power series of creation and annihilation operators. The leading term is quadratic, and keeping only this term the observable quantities of scattering processes are computed to all orders in perturbation theory. The resulting theory is characterized by the magnitude of  $kL$ , with  $k$  the wave number of an incident phonon. The theory is solved for arbitrary  $kL$ , and different limits are explored. A significant result at this level is the scattering cross section for phonons by dislocation segments. As a function of frequency, this cross section has a much richer structure than the linear-in-frequency behavior that is inferred from scattering by an infinite, static, dislocation. The ra