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Phonon Modes and the Maintenance Condition of a Crystalline Beam

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Previously it has been shown that the maintenance condition for a crystalline beam requires that there not be a resonance between the crystal phonon frequencies and the frequency associated with a beam moving through a lattice of N periods. This resonance can be avoided provided the phonon frequencies are all below half of the lattice frequency. Here we make a detailed study of the phonon modes of a crystalline beam. Analytic results obtained in a "smooth approximation" using the ground-state crystalline beam structure is compared with numerical evaluation employing Fourier transform of Molecular Dynamic (MD) modes. The MD also determines when a crystalline beam is stable. The maintenance condition, when combined with either the simple analytic theory or the numerical evaluation of phonon modes, is shown to be in excellent agreement with the MD calculations of crystal stability.

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