Thermal conductivity

\[ \frac{\partial Q}{\partial t} = - k A \frac{dT}{dx} \]

describe phonon as particles.

From kinetic gas theory: \( K_p = \frac{1}{3} C_v \lambda_p v_p \)

\( v_p \): phonon speed (can take velocity of sound)

\( C_v \): specific heat (say, from the Debye model)

\( \lambda_p \): mean free path.

Scattering:

1. Imperfections (point defects, dislocations)
2. Sample boundaries

Low T: \( (1) \& (2) \) important \( \) crossover @ \( T = \frac{\Theta_p}{10} \)

High T: \( (3) \) dominates

**Note:** phonon-phonon scattering can only happen in the anharmonic case. As long as the anharmonic effects are not strong, we can use the phonon picture, but think of phonons propagating with a certain finite lifetime, after which they decay into other phonons.