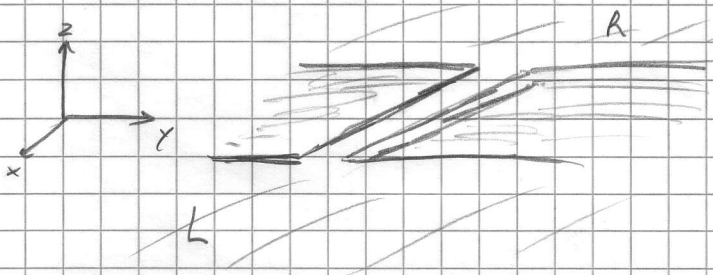


The Quantum Limit of Thermal Conductance



nanoscale suspended rod

$$\vec{u}_{qm} = \vec{A}_{qm} e^{iqx} \phi_{qm}(y, z)$$

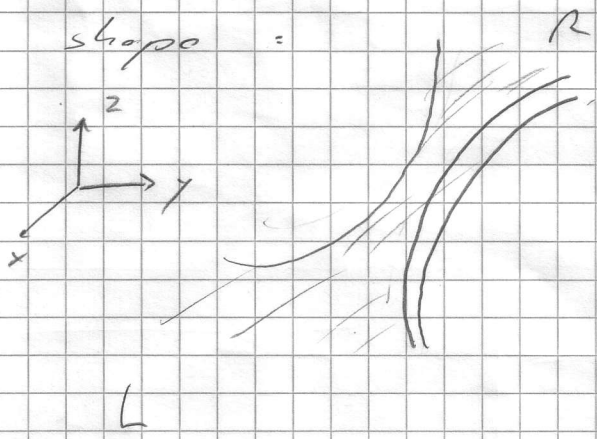
Phonons continuous along x, quantized in y & z.

Each mode has a transmittance: $T_m(\omega)$

This $T_m(\omega)$ can be a complicated function of ω for a square rod. The transmittance through the beam between the thermal reservoirs

(L & R) is $T_m(\omega) \approx 1$ For a catenoidal

shape:



Energy of modes: $\epsilon_m(q) = \hbar \omega_m(q)$

Occupation of modes (Bose-Einstein distribution):

$$n^0(\epsilon) = \frac{1}{e^{\frac{\epsilon_m(q)}{k_B T}} - 1}$$

Energy flux:

$$\dot{Q} = \sum_m \int_0^\infty \frac{dq}{2\pi} [n_L^0(q) - n_R^0(q)] T_m(q) \hbar \omega_m(q) v_m(q)$$

1D integral

phonon velocity

$$v_m(q) = \frac{\partial \omega_m}{\partial q}$$