

Summary (so far)

- Nonmechanical cantilevers, beams, membranes, wires can be good transducers of force, pressure, & mass into displacement or motion.
- Reaction to force:  $k \propto \frac{w^3}{l^3}$  (For cantilever)
- Motion of cantilevers is characterized by normal modes of oscillation. We can approximate the fundamental normal mode ( $\omega_1$ ) as a simple harmonic oscillator with angular freq.  $\omega_0 = \omega_1$ .

For a given driving force spectral density,  $S_F(\omega)$ , the displacement spectral density will be:

$$S_x(\omega) = \frac{1}{(\omega_0^2 - \omega^2)^2 + \frac{\omega_0^2 \omega^2}{Q^2}} \frac{S_F(\omega)}{m^2}$$

cantilever is a filter
transfer function squared

good approx for lever with  $n=1$  &  $\frac{1}{4}$  of total

• Brownian motion — Thermal motion

$$\bar{E}_1 = \frac{1}{2} k_B T$$

$$\frac{1}{2} k_B T = \frac{1}{2} m \langle \dot{x}^2 \rangle = \frac{1}{2} k \langle x^2 \rangle$$