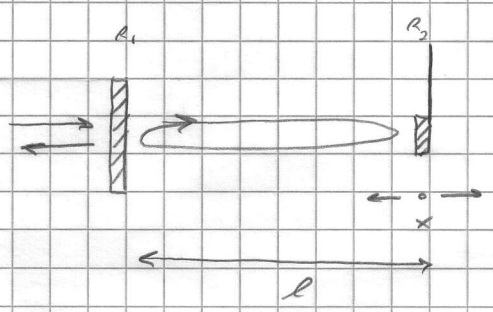
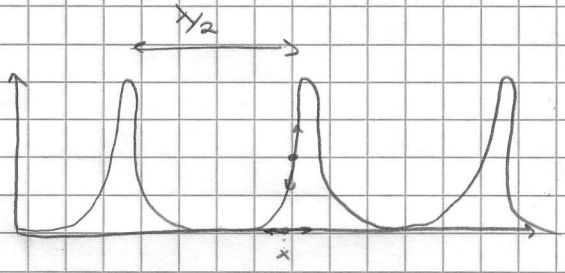
27. 10. 2009 # 7

Opto-mechanical Cooling – Cavity Cooling

Recall our Fabry-Perot interferometer:



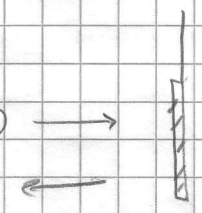


$$P_c = P_I \frac{(1-R_1)}{(1-\sqrt{R_1R_2})^2} \frac{1}{1+F\sin^2\left(\frac{2\pi l}{\lambda}\right)}$$

Power in cavity / Power incident on cantilever reflector

$$F = \frac{4\sqrt{R_1R_2}}{(1-\sqrt{R_1R_2})^2}$$

Semi-classical Picture



$n \rightarrow$ photons arriving per unit time $\left[\frac{\#}{s}\right]$

$$\Delta p = 2\frac{h\nu}{c} \qquad \therefore \frac{2n\Delta t\, h\nu}{c} = \Delta p$$

$$\frac{\Delta p}{\Delta t} = \frac{2n h\nu}{c}$$

$$\therefore \mathcal{F} = \frac{2P}{c}$$ ← power (intensity)

The cavity Finesse (F) introduces $\lambda/2$ in the reaction force.

∴ We can say that the real force, F_{opt}, logs $\mathcal{F}$ a little.

$$\dot{F}_{opt}(t) = \frac{\mathcal{F}(n) - F_{opt}(t)}{\tau}$$