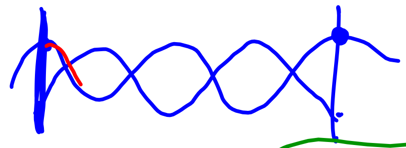
Resonators: Resonance means that you have a wave that bounces back and forth in some way where the subsequent reflections constructively interfere.

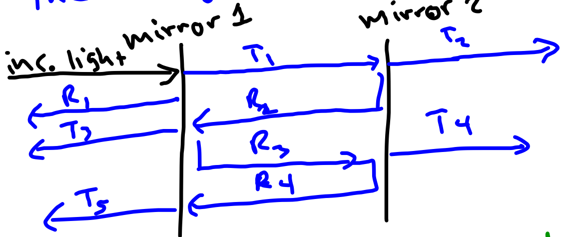
Physics 1, w/ waves on a string, what was the resonance condition for both ends fixed.

$$L_{string} = \frac{n\lambda}{2} \quad n = 1, 2, 3 \ldots$$



Resonators w/ Light. Lasers, optical modulators (switch), interferometry.

We will talk about the simplest resonator, the Fabry-Perot Resonator (slab geometry).



Amplitude of the incident light is E_0.

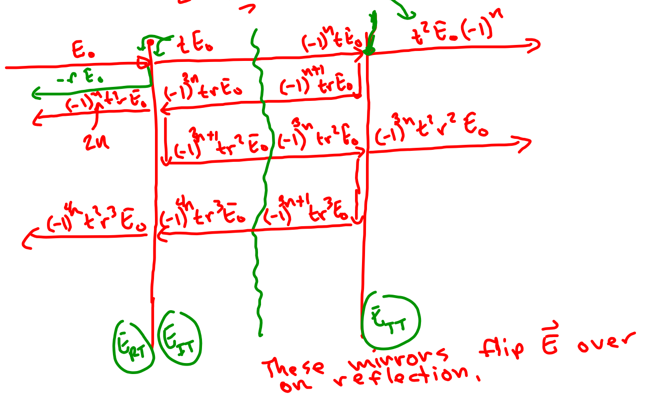
Let's say there's no loss in the mirrors

$\Rightarrow R + T = 1$ $\qquad R = \frac{I_R}{I_0} = \frac{E_R^2}{E_0^2} \Rightarrow r = \sqrt{R} = \frac{E_R}{E_0}$

$$t = \sqrt{T} = \frac{E_T}{E_0}$$

Let's start w/ on resonance.

$L = \frac{n\lambda}{2}$



$\Rightarrow$ Solve for series solns for $r_{tot}, t_{tot}, E_{inside,tot}$.

If $n=$ int $\Rightarrow 1$.

$$E_{RT} = -rE_o + (-1)^{2n} t^2 rE_o + (-1)^{4n} t^2 r^3 E_o + \cdots$$

$$= -rE_o + t^2 rE_o \sum_{i=0}^{\infty} r^{2n}$$

$$\left\{ \sum_{n=0}^{\infty} x^n = \frac{1}{1-x} \right\}$$

$$= -rE_o + t^2 r E_o \frac{1}{1-r^2}$$

$t^2 = 1 - r^2$

$$= -rE_o + rE_o = \emptyset \quad \Rightarrow \boxed{E_{RT} = \emptyset \text{ on resonance}}$$

$\Rightarrow R_T = \emptyset$

$= -1$ for $n =$ odd, $+1 = n =$ even

$$E_{TT} = E_o \sum_{k=0}^{\infty} (-1)^{n(2k+1)} t^2 r^{2k} = \pm E_o t^2 \sum_{k=0}^{\infty} (r^2)^k$$

$$= \pm \frac{t^2}{1-r^2} = 1$$

$$\Rightarrow \boxed{E_{TT} = E_o \text{ on resonance}}$$

$\Rightarrow T_T = 1.$

$$E_{IT} = E_o t \sum_{i=0}^{\infty} r^i$$

{assuming $n =$ odd}. me picking where all terms add giving an anti-node.

$$= \frac{E_o t}{1-r}$$

$$= \frac{E_o \sqrt{1-R}}{1-\sqrt{R}}$$

We've talked about on resonance, and off resonance a little.

So what about all those places in between.

Lets start with the answer.