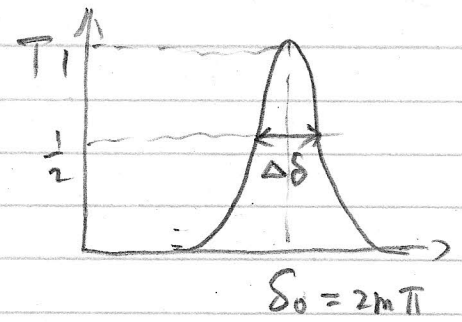
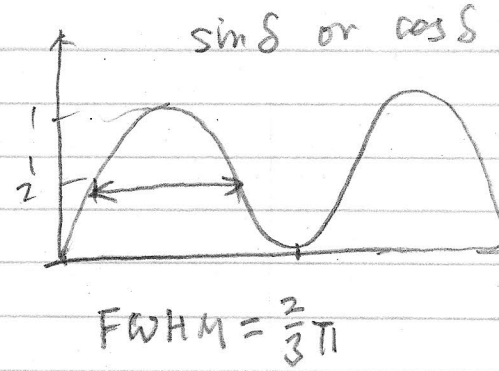
Lect. 17, April 1, 2010

Find $\Delta\delta$ of FWHM (full width at half maximum)





At $\delta = \delta_0 = 2m\pi$, $T = 1$

At $\delta = \delta_0 + \frac{\Delta\delta}{2}$, $T = \frac{1}{2}$

Since $T = \frac{1}{1 + F\sin^2\frac{\delta}{2}}$

$$\frac{1}{2} = \frac{1}{1 + F\sin^2\left[(2m\pi + \frac{\Delta\delta}{2})/2\right]}$$

$$F\sin^2\frac{\Delta\delta}{4} = 1$$

Since $\Delta\delta \ll 1 \Rightarrow \left(\frac{\Delta\delta}{4}\right)^2 \approx \frac{1}{F}$

$$\Rightarrow \Delta\delta = \frac{4}{\sqrt{F}} = \frac{2(1-R)}{\sqrt{R}} \quad \cdots\cdots (8)$$

$R \uparrow$, $F \uparrow$, $\Delta\delta$ or FWHM decreases

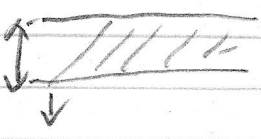
From one maximum to next maximum $\Delta\delta = 2\pi$

From the maximum to half of maximum $\Delta\delta = \frac{4}{\sqrt{F}}$

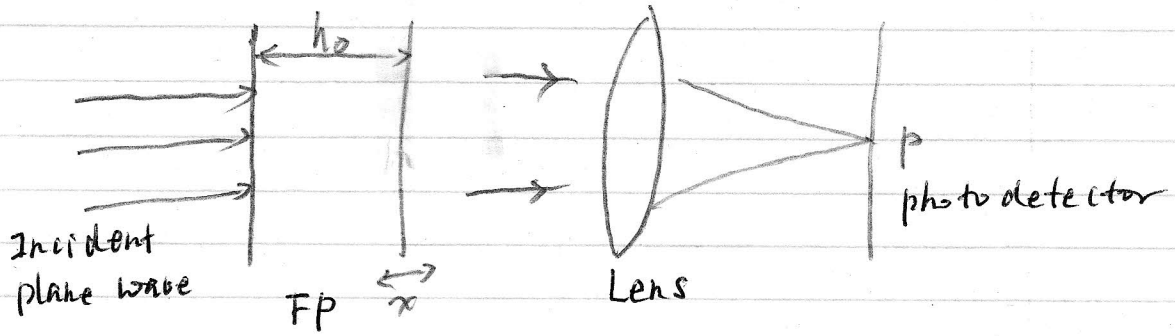
$F = 400$, $\Delta\delta = 0.2$

* Fabry – Perot Etalon : film h is fixed

* Fabry – Perot Interferometer : film h is adjustable.



Fabry - Perot Interferometer (16.4)



$$h = h_0 + x,$$

For normal incidence $\cos\theta_2 = 0$. air $n_2 = 1$

$$\delta = \frac{4\pi h}{\lambda_0} = \frac{4\pi\nu_0(h_0 + x)}{c}$$

Exp: $h_0 = 10\,cm$, $\lambda_0 = 5000\,\text{Å}$, or $\nu_0 = 6\times10^{14}\,Hz$

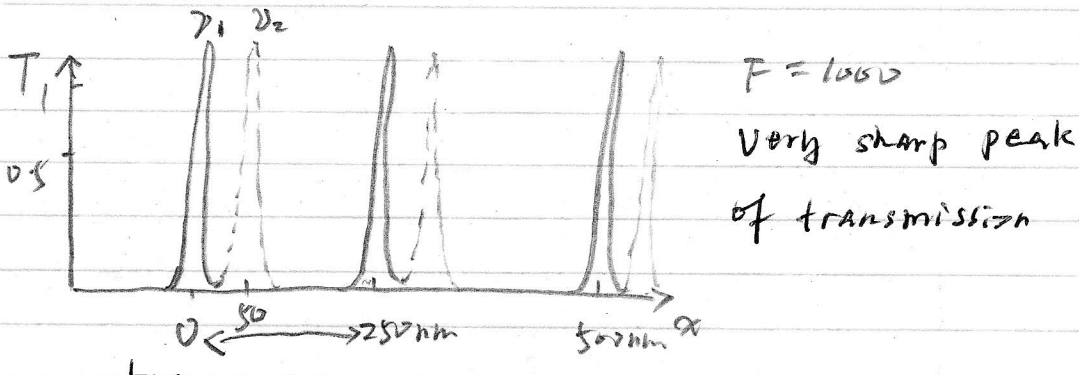
$$\delta = 800000\,\pi\left[1 + \frac{x}{h_0}\right]$$

The transmission resonances will occur for $\delta = 2m\pi$

$\delta = 800000\,\pi$, $800002\,\pi$, $800004\,\pi$

$m = 400000$ 400001 400002

$x = 0$ $x = 250\,nm$ $x = 500\,nm$



transmission resonance

$F = 1000$

Very sharp peak of transmission

Two frequencies $\nu_1 = 6\times10^{14}\,Hz$ $\lambda_0 = 5000\,\text{Å}$

$\nu_2 = 6\times10^{14}\,Hz - 300\,MHz$; $\lambda_0 = 5000\,\text{Å} + 0.05\,\text{Å}$

Same order $m = 400,000$, $\delta = 800,000\,\pi$

For ν_1, $x = 0$; For ν_2, $x = h_0\frac{\Delta\nu}{\nu_0} = 5\times10^{-8}\,m = 50\,nm$

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