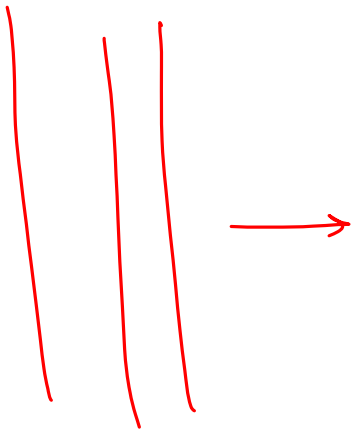
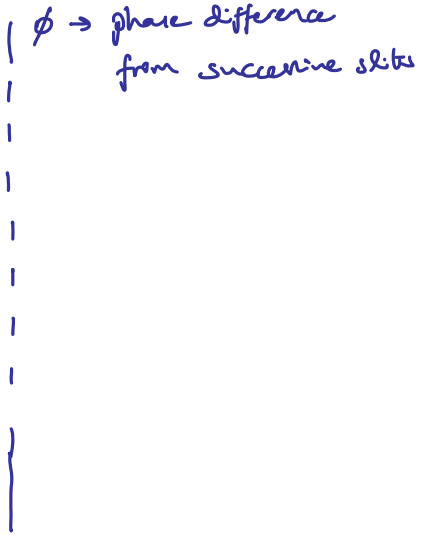
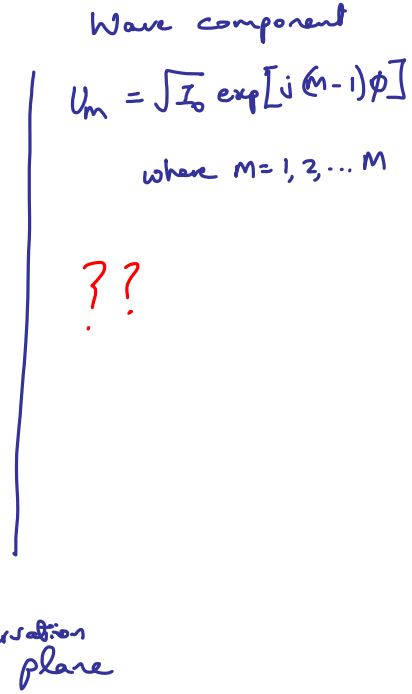
Note Title 8/6/2018

Learning Outcome: Interference of light and Coherence property of light



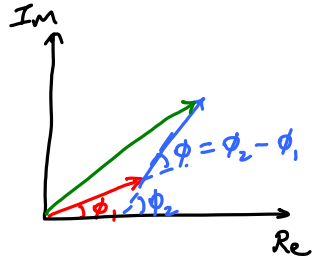


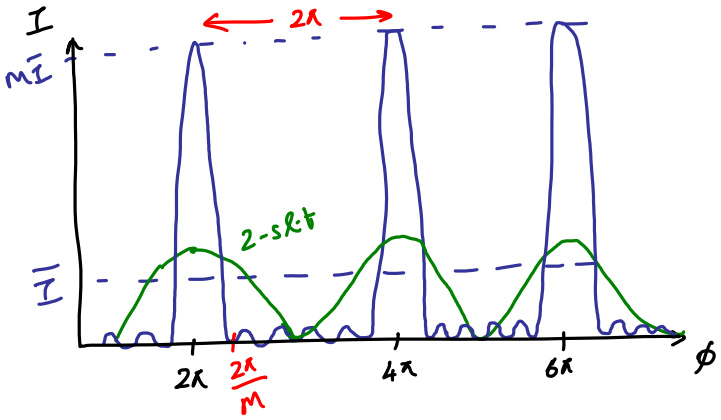
Total Wave amplitude $U = \sqrt{I_0}\left(1 + h + h^2 + \cdots + h^{M-1}\right)$ where $h = e^{j\phi}$

$$= \sqrt{I_0} \cdot \frac{1 - h^M}{1 - h} = \sqrt{I_0} \; \frac{1 - e^{jM\phi}}{1 - e^{j\phi}}$$

Total Intensity $I = |U|^2 = I_0 \cdot \left| \frac{1 - e^{jM\phi}}{1 - e^{j\phi}} \right|^2 = I_0 \left| \frac{e^{-jM\phi/2} - e^{jM\phi/2}}{e^{-j\phi/2} - e^{j\phi/2}} \right|^2$




$$I = I_0 \; \frac{\sin^2(M\phi/2)}{\sin^2(\phi/2)}$$

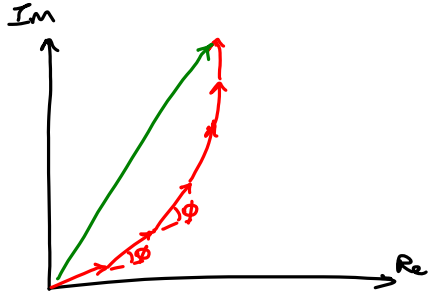



$\frac{M\phi_{min}}{2} = \pi$

$\phi_{min} = \frac{2\pi}{M}$

More # of interfering sources

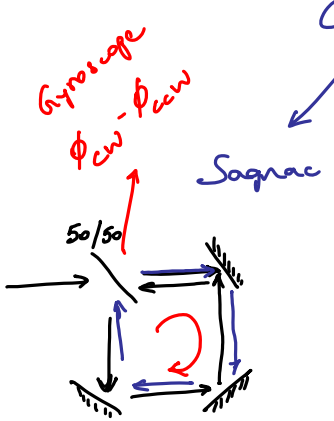
$\Rightarrow$ Narrower spectral selectivity



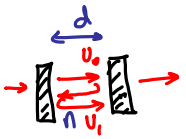
# Interferometers

## Common Path

### Sagnac




### Fabry-Perot




$$\Delta\phi = \frac{2\pi}{\lambda} n \cdot 2d$$

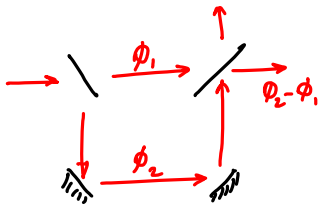
$$= 2\pi m$$

$n=1$,

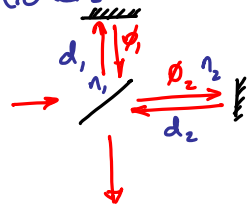
$$\boxed{d = m \cdot \frac{\lambda}{2}}$$

## Differential Path

### Mach-Zehnder




### Michelson




$$\phi_2 - \phi_1 = \frac{2\pi}{\lambda} 2 n_2 d_2 - \frac{2\pi}{\lambda} 2 n_1 d_1$$

$$= \frac{2\pi}{\lambda} 2 (n_2 d_2 - n_1 d_1)$$

→ Optical path length difference

Constructive Interference, $\phi_2 - \phi_1 = 2\pi m$

If $n_1 = n_2 = 1$,

$$\boxed{d_1 - d_2 = \frac{m\lambda}{2}}$$