

Measuring Linewidth / Lineshape

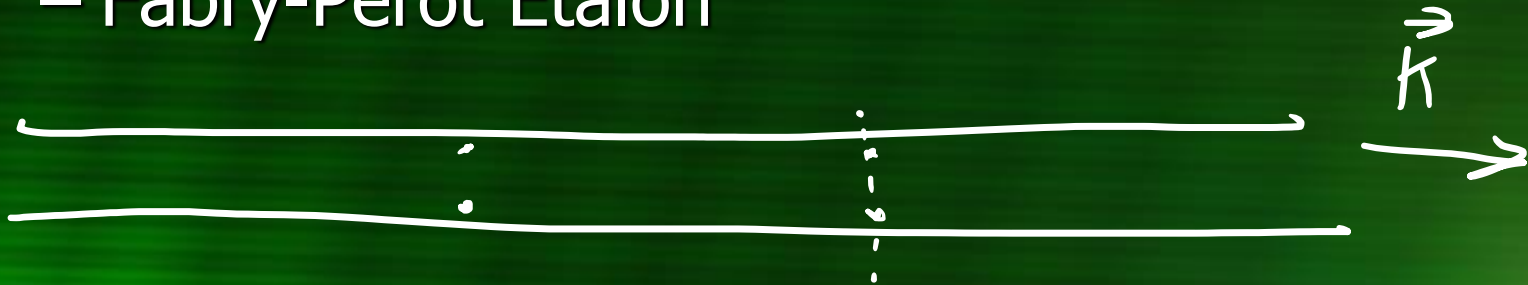
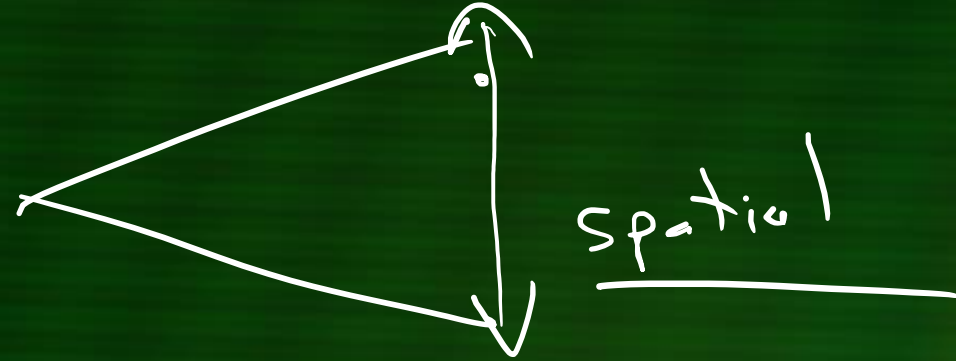
Dallin Durfee
June 29 2021

Business

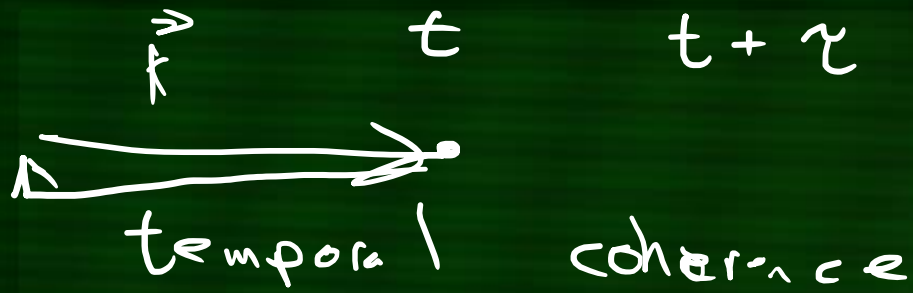
- I9 Form

Measuring Linewidth / Lineshape

- What is linewidth
- Methods
 - Interferometry
 - Fabry-Perot Etalon

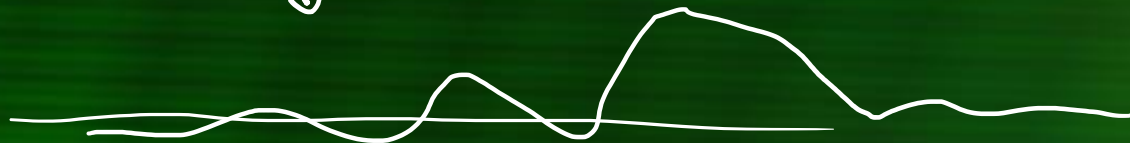
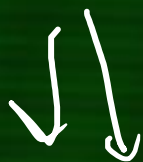
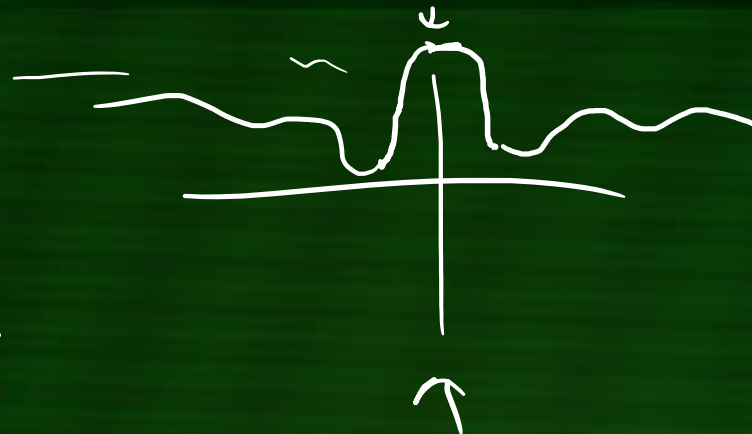
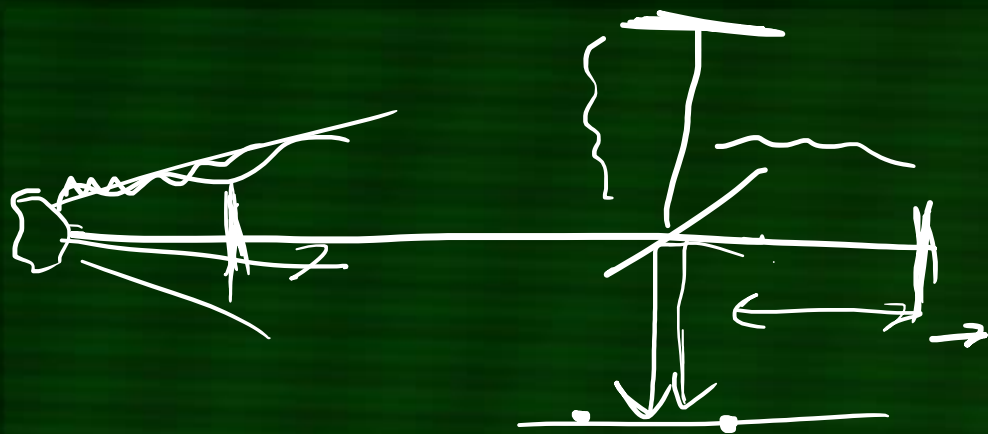


Virtual point source

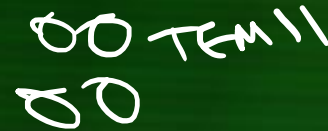
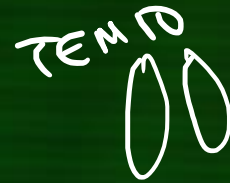
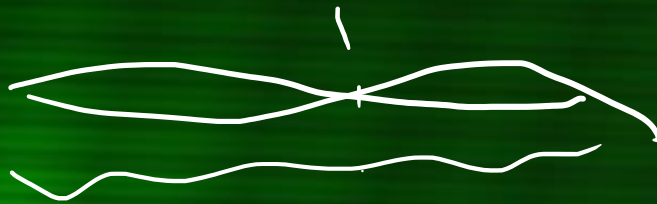
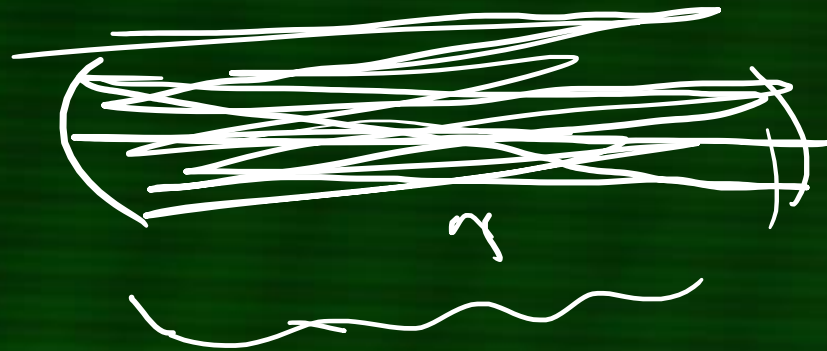


$\tau_{\text{coherence}}$

$$\tau_{\text{coherence}} c = L_{\text{coherence}}$$



Laser Cavity

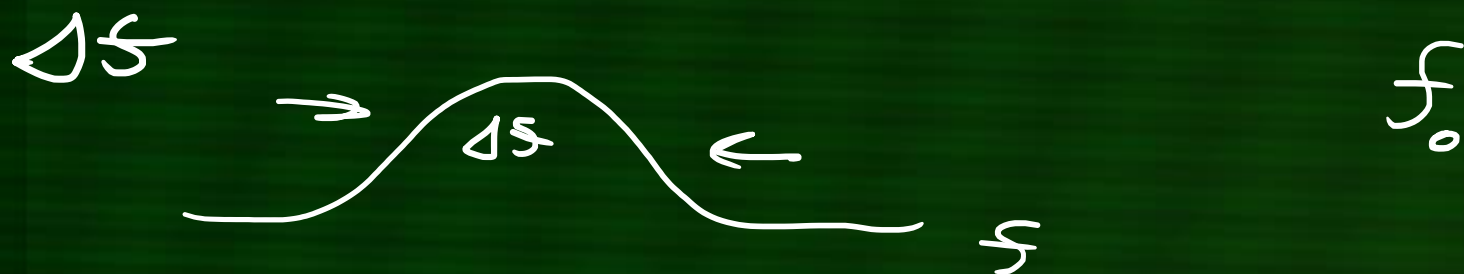


Side Free
SLM

TEM01

TEM02





$$\int A(\xi) \sin(2\pi \xi t + \phi(\xi)) d\xi$$

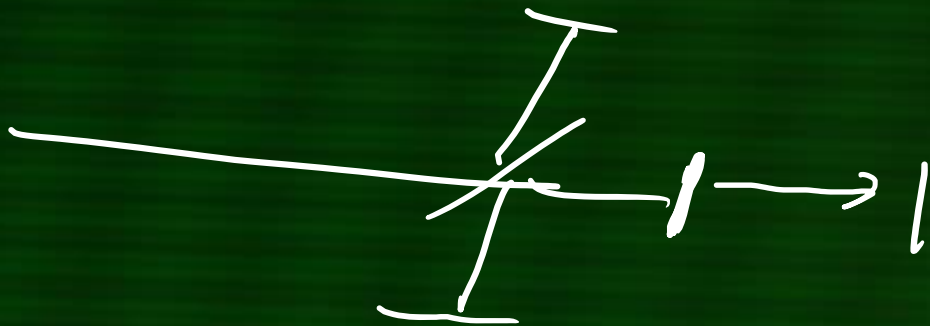
$$\sin\left(2\pi\left(\xi_0 - \frac{\Delta\xi}{2}\right)t\right) \quad \sin\left(2\pi\xi_0 t + \underbrace{\pi\Delta\xi t}_{\text{phase shift}}\right)$$

$$\sin\left(2\pi\left(\xi_0 + \frac{\Delta\xi}{2}\right)t\right) \quad \sin\left(2\pi\xi_0 t + \underbrace{\pi\Delta\xi t}_{\text{phase shift}}\right)$$

$$\frac{\pi}{2} = (\pi\Delta\xi - -\pi\Delta\xi)t \rightarrow t_c = \frac{\pi}{2} \frac{1}{2\pi\Delta\xi} = \frac{1}{4\Delta\xi}$$

$$\underline{L} = c \underline{t} \approx \frac{c}{4\Delta f}$$

$$\Delta f = \frac{c}{4L} = \frac{3 \times 10^8 \frac{\text{m}}{\text{s}}}{400 \text{ m}} = 10^6 \frac{1}{\text{s}}$$





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

$$\Delta f = \frac{c}{2L} = \frac{3 \times 10^8 \text{ m/s}}{2 \cdot 0.3 \text{ m}} = \underline{\underline{\frac{1}{2} \cdot 10^9 \text{ Hz}}}$$

$$\Delta\theta = \frac{C}{2L} = \frac{3 \times 10^8 \frac{m}{s}}{2 \underbrace{3 \times 10^3}_{\text{m}}} = \frac{1}{2} 10^{11} \text{ Hz}$$

$$\Delta\theta = \frac{C}{2L}$$

$$\lambda_{532 \text{ nm}} = \frac{c}{\nu} = \frac{3 \times 10^8 \frac{\text{m}}{\text{s}}}{532 \times 10^{-9} \text{ m}}$$

$$c = \frac{1}{T} \rightarrow \nu \approx \underbrace{1 \times 10^{15} \text{ Hz}}$$