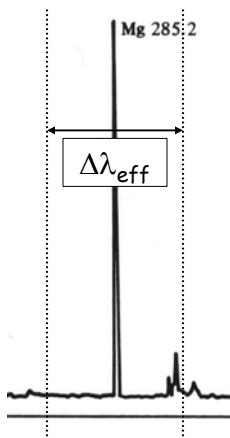


March 2, 2005

➤ Reminder: Exam #2, 2 weeks from today 😊

1

## Resolution versus Light Throughput



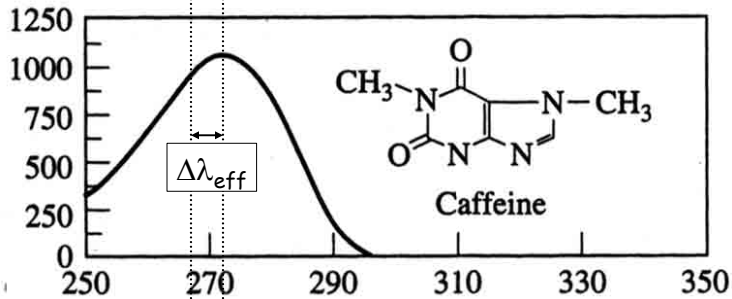
### Case I:

$$\Delta\lambda_{\text{eff}} \gg \text{actual linewidth}$$

- slitwidth limited resolution
- common with *atomic* spectra
- decreasing*  $\Delta\lambda_{\text{eff}}$  will *increase* L/B (!)

2

## Resolution versus Light Throughput: II

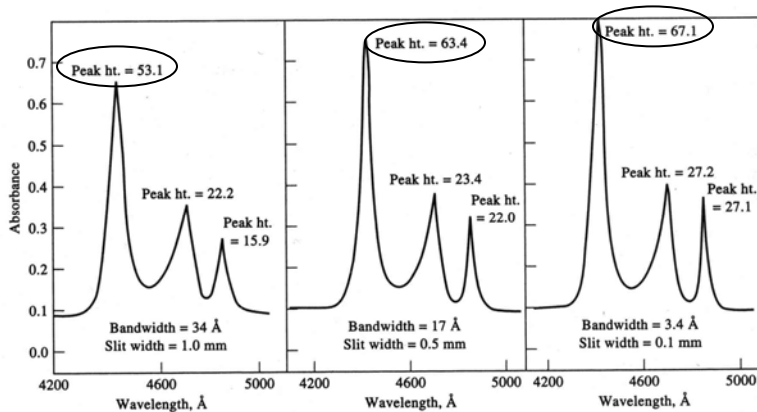


**Case II:**  $\Delta\lambda_{eff} < \text{actual bandwidth}$

- common with *molecular spectra*
- decreasing slitwidth, improves resolution, but *decreases* light throughput

3

## Effect of Slitwidth on Absorbance

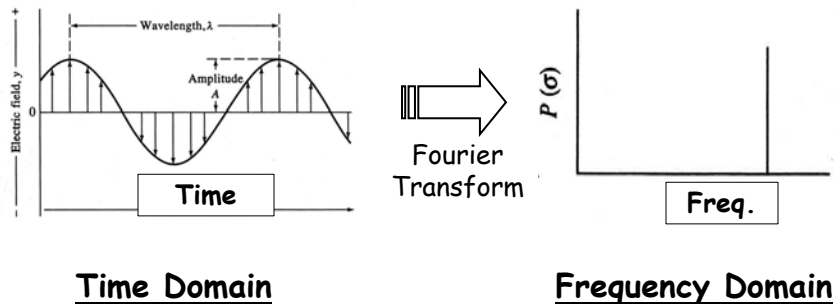


4

# Non-Dispersive Methods

## ■ Fourier-Transform Interferometry

What if we could measure the *oscillating wavefunction* of EMR *directly*?



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## Direct Measurement: Feasible?

- Suppose we had EMR with  $\lambda = 10 \mu\text{m}$

$$\text{Freq} = \nu = c/\lambda = \frac{3.00 \times 10^8 \text{ m/s}}{10 \times 10^{-6} \text{ m}}$$

$$\nu = 3 \times 10^{13} \text{ Hz}$$

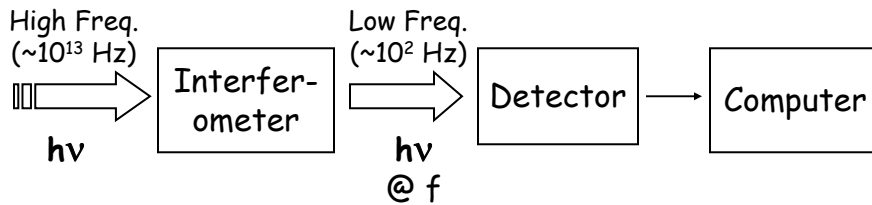
That's 1 cycle every  $33 \times 10^{-15}$  secs  
(33 femtoseconds!)

Upshot: we *can't* measure the oscillating EMR field *directly* for *optical* radiation

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# Enter Interferometry

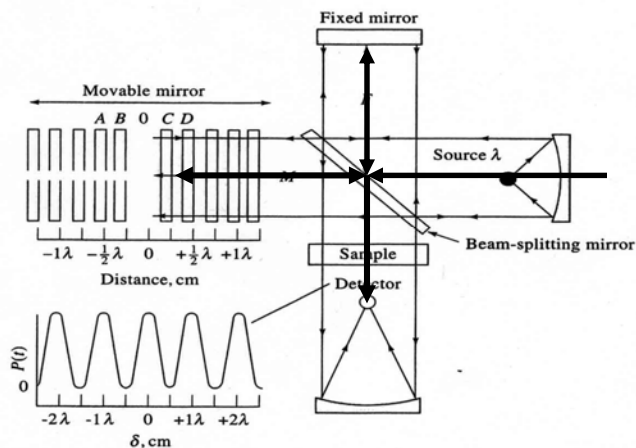
- We need a signal that is *much* slower, so that it can be measured . . . How?



7

# Michelson Interferometer

- EMR enters and hits *beamsplitter*
- Part goes to *fixed mirror*
- Part goes to *moveable mirror*
- Reflected beams recombine at *beamsplitter*

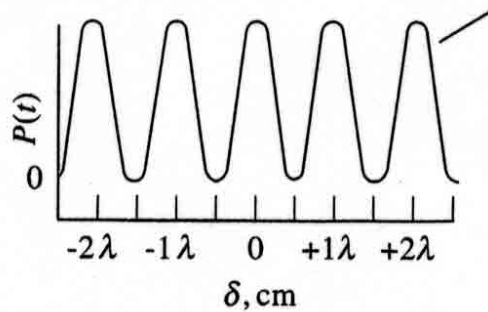


## Resulting Interferogram

$\delta = \text{pathlength difference}$   
(retardation)

$$\delta = 2(M-F)$$

$$\delta = 2x \text{ (mirror displacement)}$$



So, we get *maxima* when  $\delta = n\lambda$  and *minima* when  $\delta = \frac{1}{2}n\lambda$  (recall that the actual mirror movement is  $\frac{1}{2}\delta$ )

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## Modulation Frequency

- *Moving Mirror* moves continuously at a fixed velocity ( $V_M$ ), so the signal at the detector will oscillate at a related frequency ( $f$ ).

$$f = 2V_M/\lambda$$

Or:

$$f = (2V_M/c)v$$

If  $V_M = 0.1 \text{ cm/sec}$ ,  $\lambda = 10 \text{ }\mu\text{m}$  EMR will be modulated at:  $f = 2(1.0 \times 10^{-3} \text{ m/sec})/(10 \times 10^{-6} \text{ m}) = \underline{200 \text{ Hz}}$

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