

February 25, 2005

- Today's Office Hour: *Cancelled* ☹
- See/email me to make an appointment

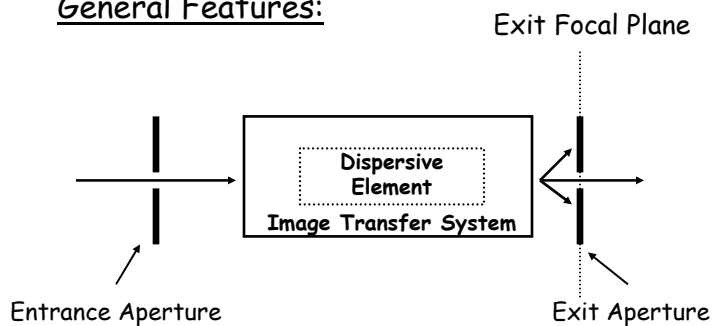
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Wavelength Selectors

■ Dispersive Devices

-separates EMR into individual λ -components

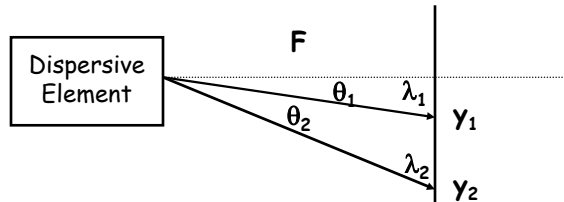
General Features:



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Dispersion (Terminology)

- How do we quantify the spatial separation of wavelengths on the exit focal plane?



Angular Dispersion: $D_a = d\theta/d\lambda$ (property of dispersive element)

Linear Dispersion: $D = dy/d\lambda$ (property of dispersive device)

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More Dispersive Terminology

- If $d\theta$ is small, it can be shown that:

$$D = F \times D_a$$

- More commonly, we will use:

Reciprocal Linear Dispersion (D^{-1}) = $1/D$

-example: typically around $0.1 - 20 \text{ \AA/mm}$ in UV/Vis

Effective Bandwidth:

$$\Delta\lambda_{\text{eff}} = D^{-1} \times w$$

$$D^{-1} = 16 \text{ \AA/mm}$$

$$w = 100 \text{ \mu m}$$

$$\Delta\lambda_{\text{eff}} = 1.6 \text{ \AA}$$

slitwidth

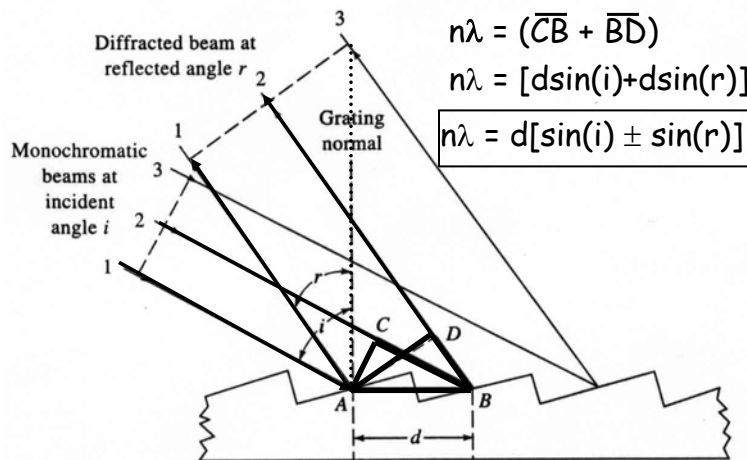
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Diffraction Gratings

- Typically, a series of closely spaced *facets* ruled onto a *reflecting surface*
 - Spacing of facets must be comparable to λ of EMR
 - Parallel EMR rays striking adjacent facets will travel different distances
 - *Constructive interference* occurs if the difference in the distance travelled by the two rays is an integer multiple of λ s
 - *Constructive interference* will be a function of the *angles* (incident and reflection) and the *wavelength*

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Let's see how it works!



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Spectral Order

$$n\lambda = d[\sin(i) \pm \sin(r)]$$

spectral order

For *fixed* values of *i* and *r*, $n\lambda$ is constant.

Example: $n\lambda = 6000 \text{ \AA}$

<u>n:</u>	1	2	3	4
<u>λ:</u>	6000	3000	2000	1500

Special Case:

$n\lambda=0$ (*zeroth order*)

ALL λ s reflected!

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Dispersion for a Grating

- For a fixed angle of *incidence* (*i*):

$$n d\lambda = d \cos(r) d(r)$$

So:

$$\frac{d(r)}{d\lambda} = \frac{n}{d \cos(r)}$$

D_a

If the angle *r* is kept small ($<5^\circ$):

$$\frac{d(r)}{d\lambda} \approx \frac{n}{d}$$

wavelength independent

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Spectral Resolution/Resolving Power

- We define *Resolution* (or *Resolving Power*):

$$R = \lambda_{\text{avg}} / \Delta\lambda$$

R is the resolving power needed to *just resolve* two spectral features:
Rayleigh Criterion

