

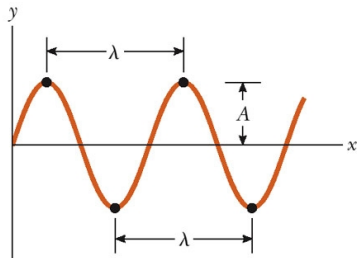
The SuperView 1B satellite is a commercial satellite designed to take surveillance photographs for sale and has been active since 2016. The cost for photos from the satellite archive is as low \$14. The aperture of the camera on the satellite is  $a = 0.42 \text{ m}$  and the satellite operates  $L = 530 \text{ km}$  above the Earth. What is the size of the smallest object visible to the camera? Visible light covers a range of wavelengths of  $\lambda \approx 400 - 700 \text{ nm}$ . What is the size of the smallest object visible to human eyes?





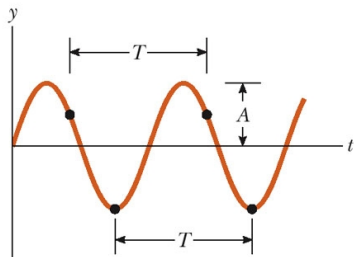
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(a)

$$y = A \sin(kx - \omega t + \phi_0)$$



(b)

Demo is [here](#).



- What happens when a static  $\vec{B}$  field is near a coil?

Lenz's Law demo is [here](#).

- What happens when a static  $\vec{B}$  field is near a coil? **Nothing**

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A changing  $\vec{B}$  field creates an  $\vec{E}$  field.

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- How do you create a  $\vec{B}$  field?

Lenz's Law demo is [here](#).

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Lenz's Law demo is [here](#).

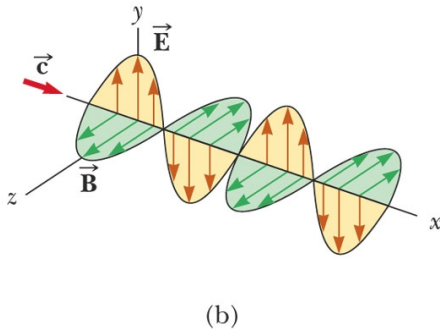
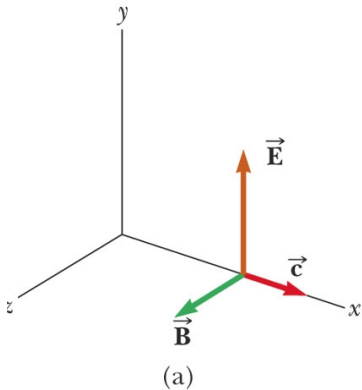
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A changing  $\vec{E}$  field can create a changing  $\vec{B}$  field.

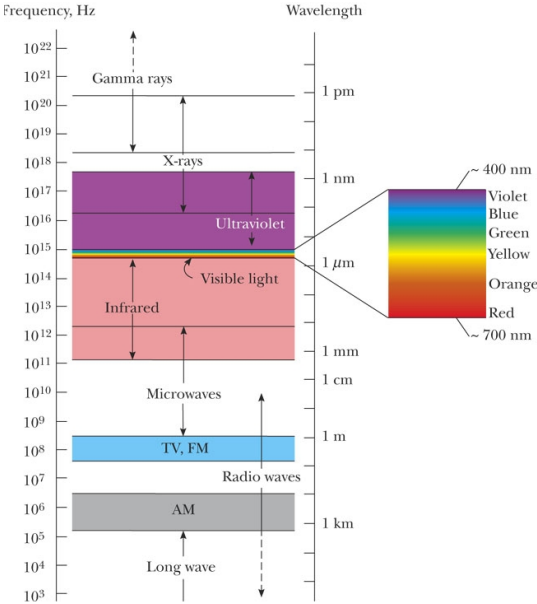
Lenz's Law demo is [here](#).



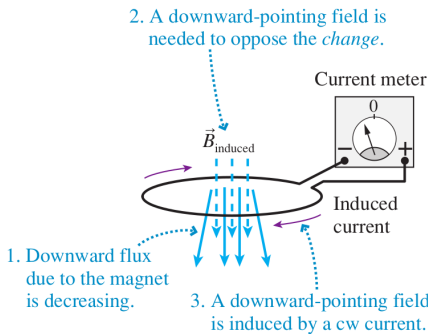
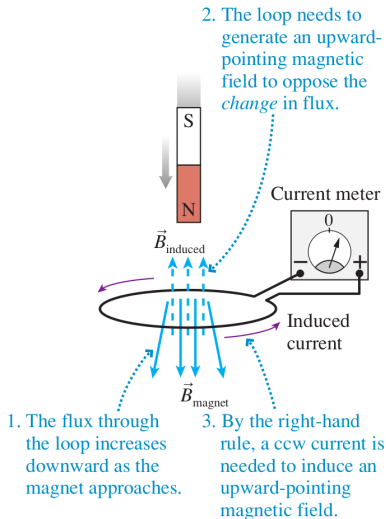
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# Electromagnetic Spectrum

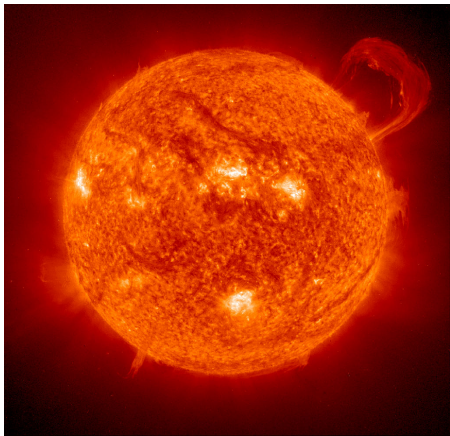
# 16



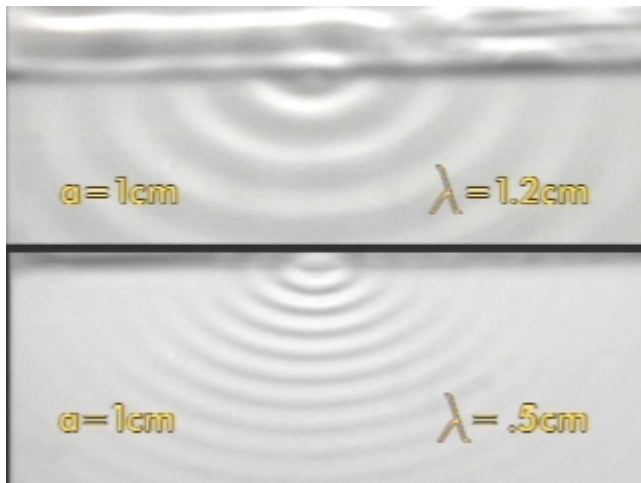




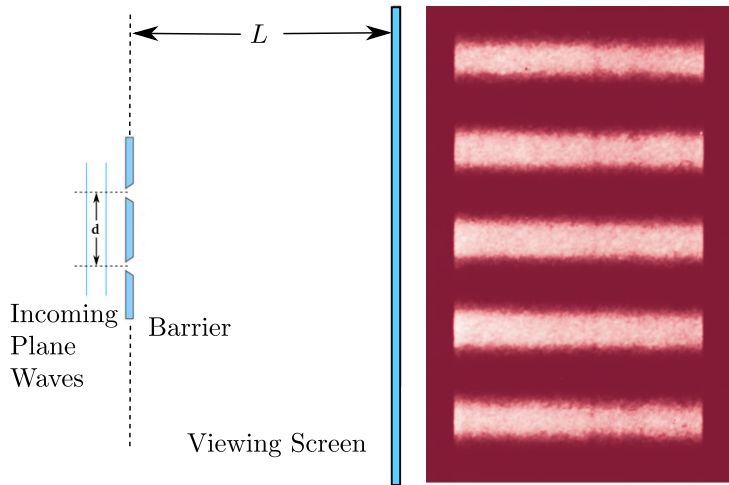
The intensity of sunlight reaching the Earth is called the solar constant (which is not really constant) and has a value of  $I_s = 1366 \text{ J/s} - \text{m}^2$ . What is the size of the electric field in sunlight? How does this compare with the typical fields we use in lab ( $|\vec{E}| \approx 10 \text{ N/C}$ )?



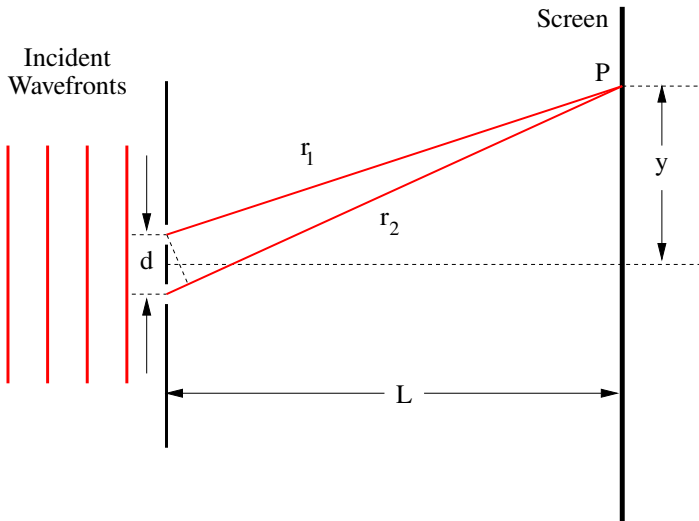
The videos are [here](#) and [here](#). The simulation is [here](#).



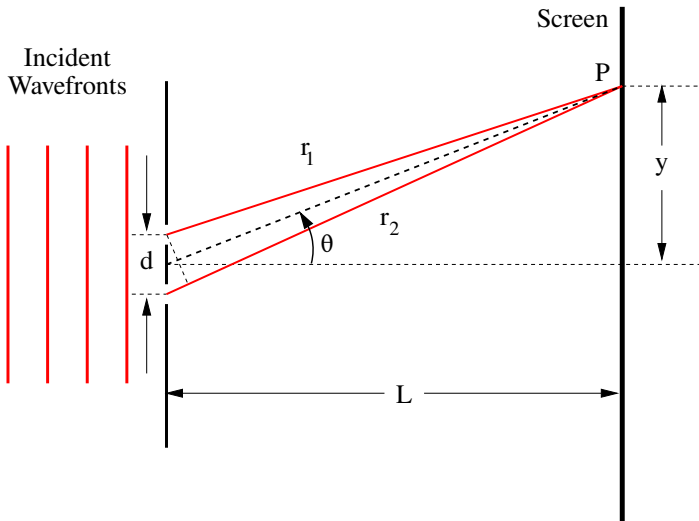
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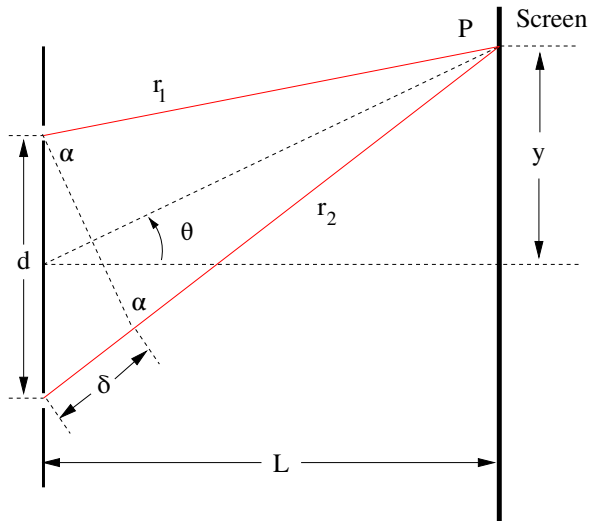
## Double Slit Interference



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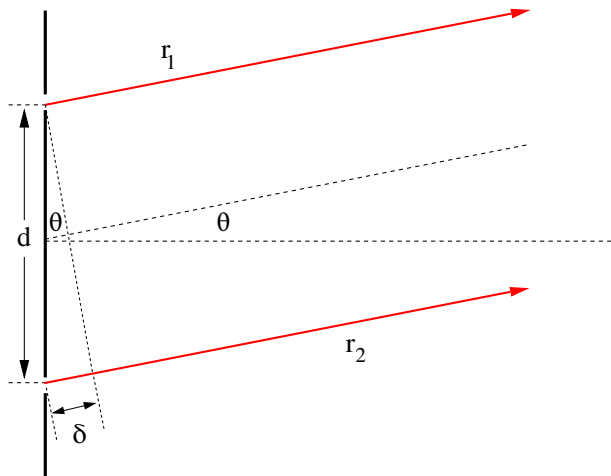


## Double Slit Interference

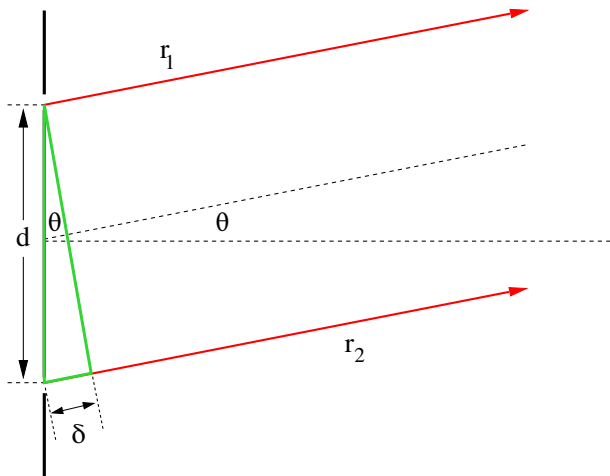




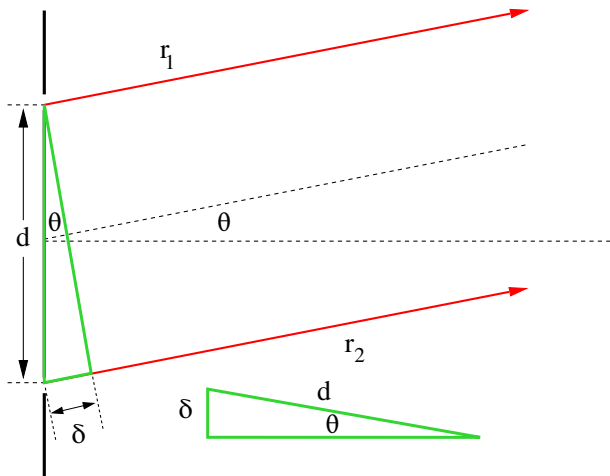
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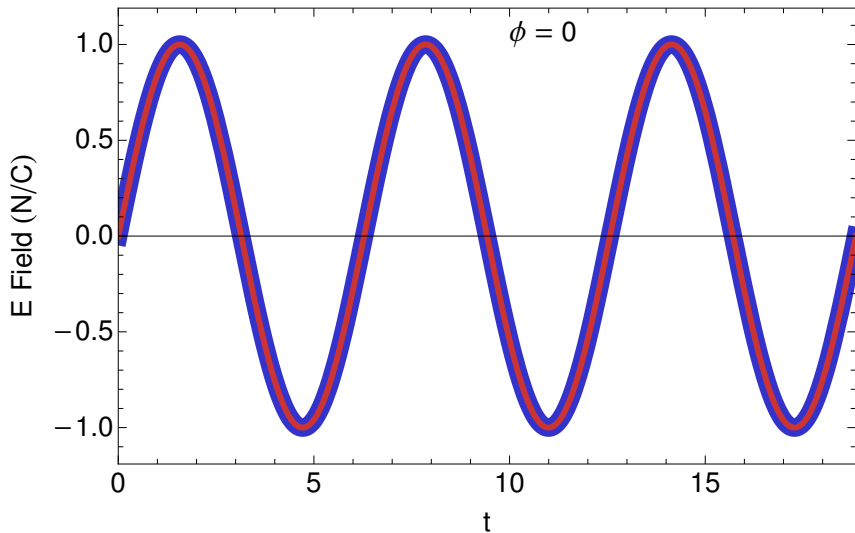
## Double Slit Interference



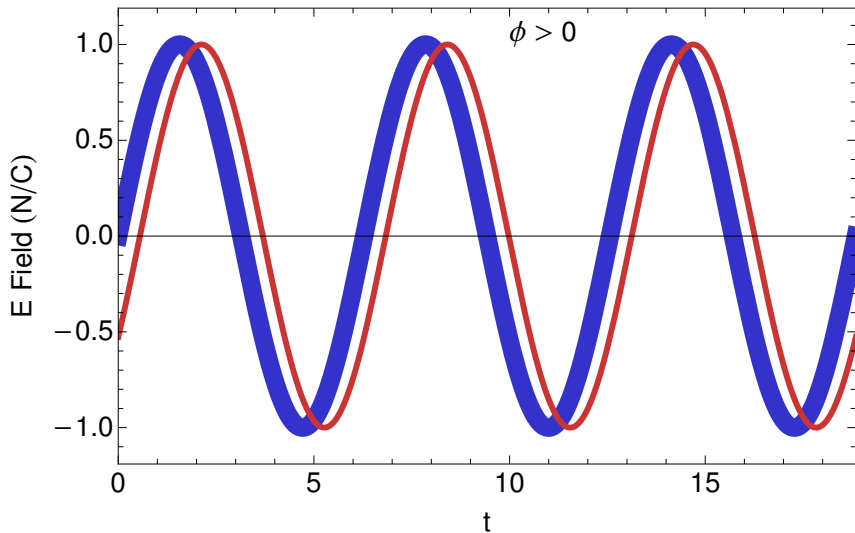
## Double Slit Interference



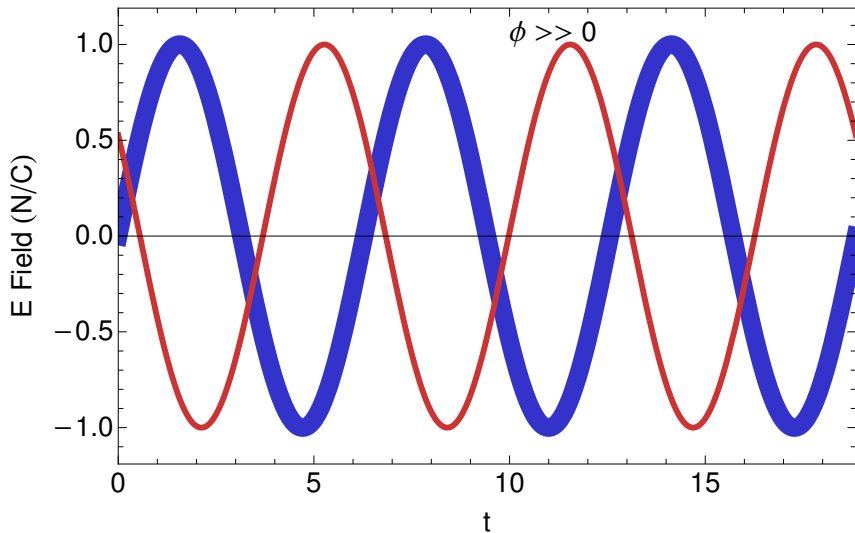
Blue – upper opening, Red – lower



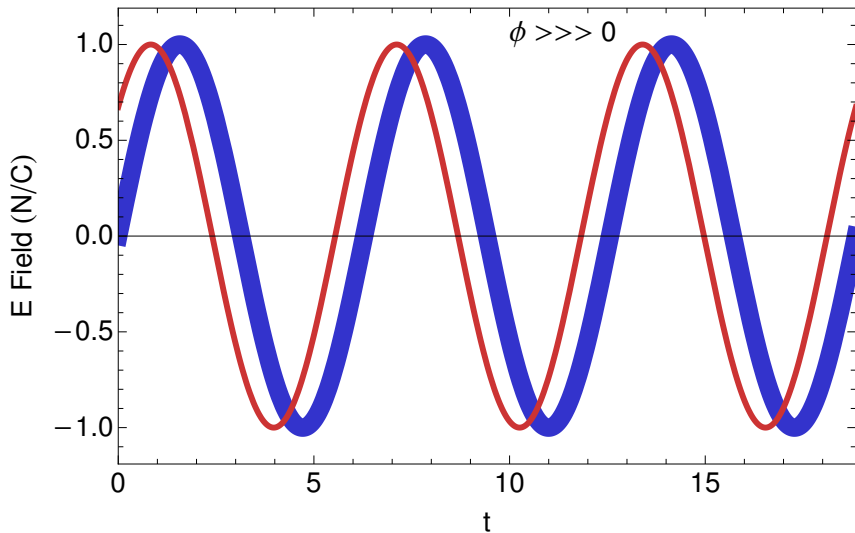
Blue – upper opening, Red – lower



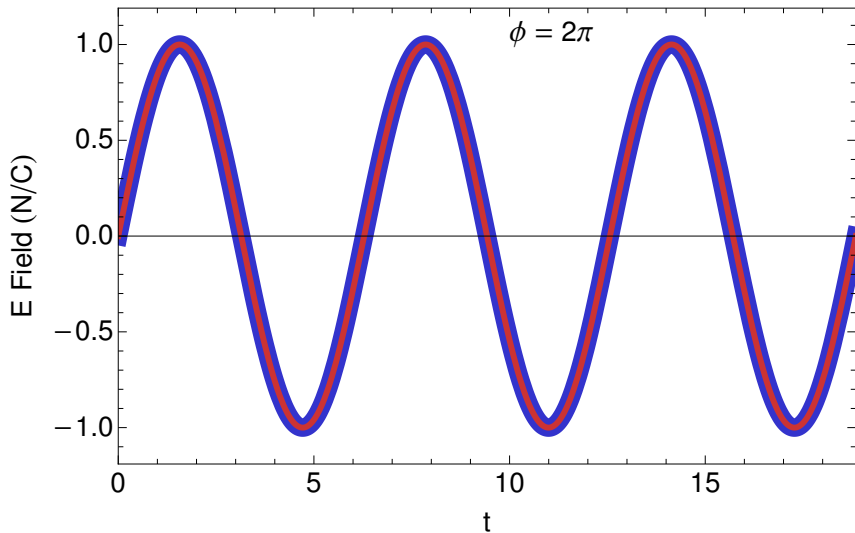
Blue – upper opening, Red – lower



Blue – upper opening, Red – lower

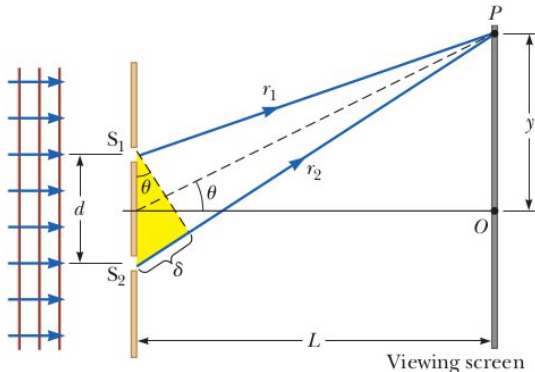


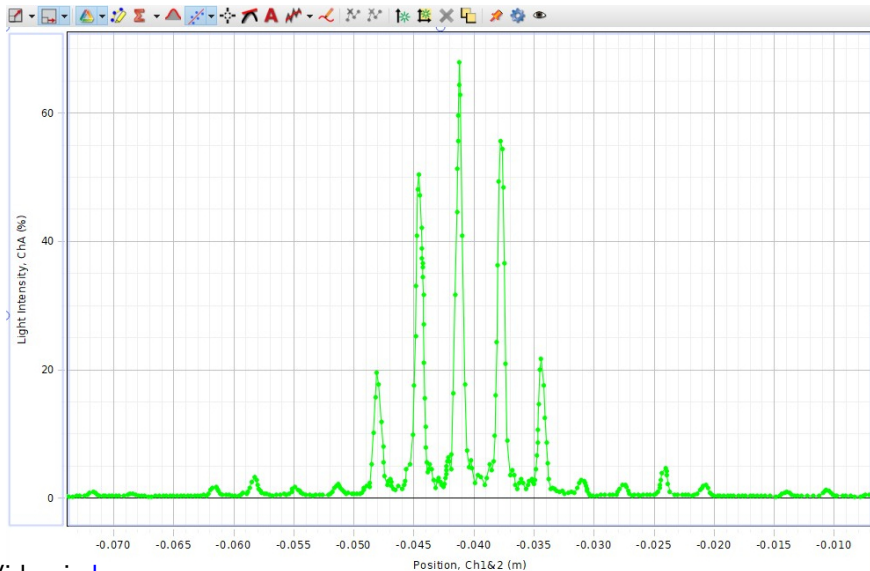
Blue – upper opening, Red – lower





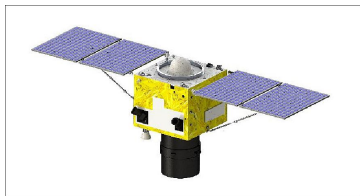
A double-slit experiment is performed with  $\lambda = 589 \text{ nm}$  light and a distance  $L = 2.0 \text{ m}$  between the slits and the screen. The fifth interference maximum is observed at a distance  $y = 4.0 \text{ mm}$  from the central maximum. What is the spacing  $d$  of the slits?

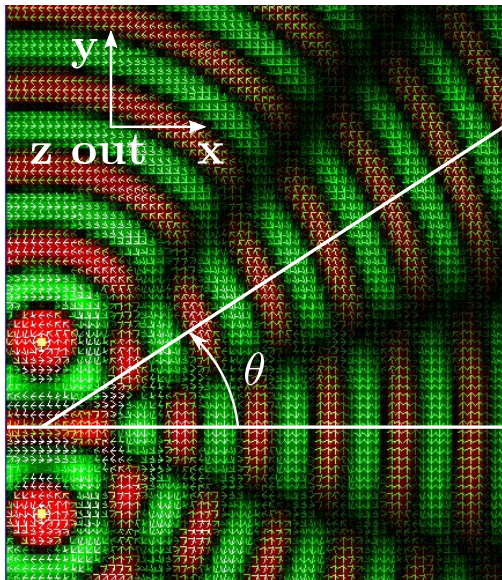


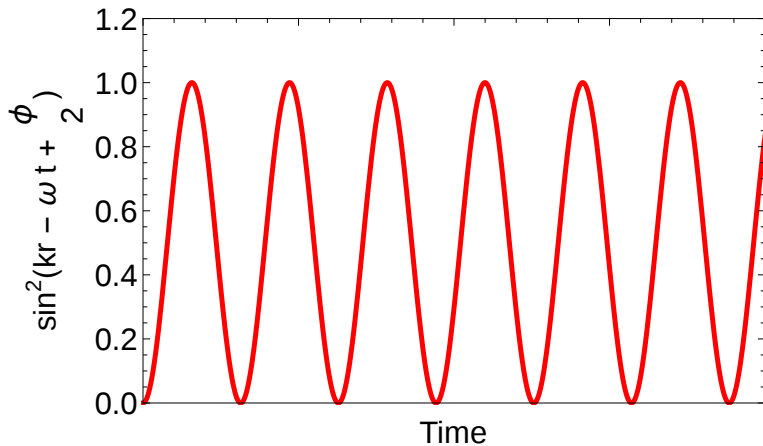


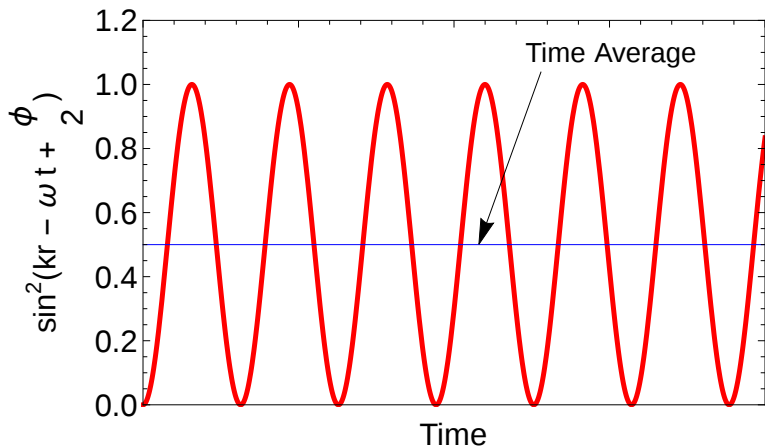
Video is [here](#)

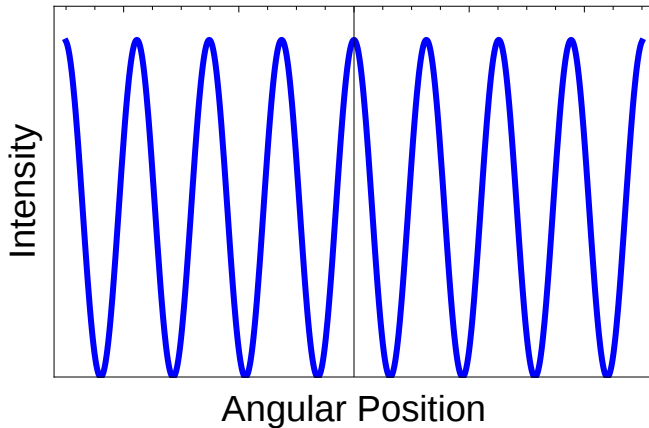
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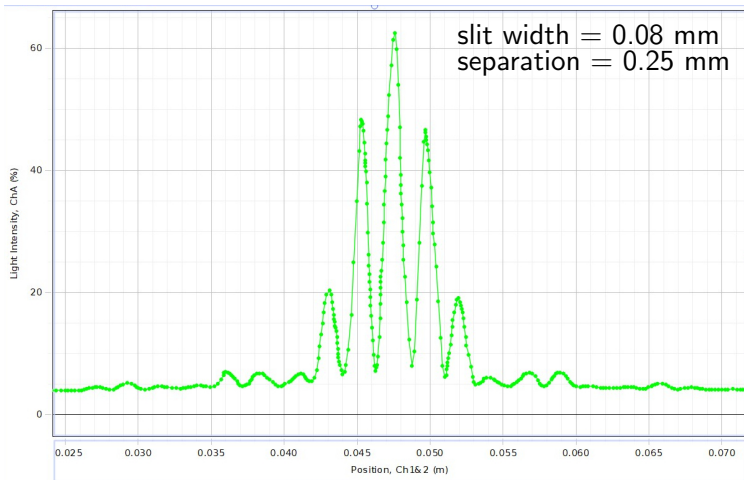




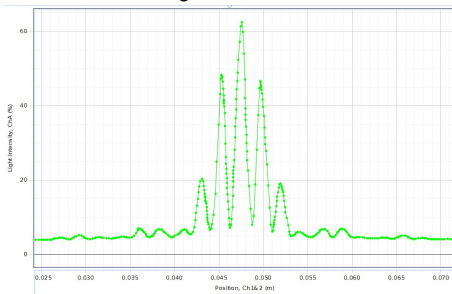
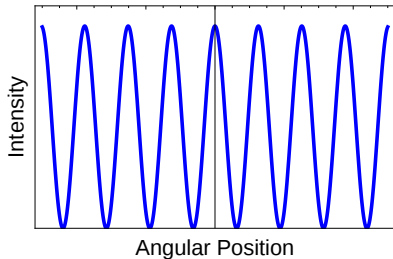




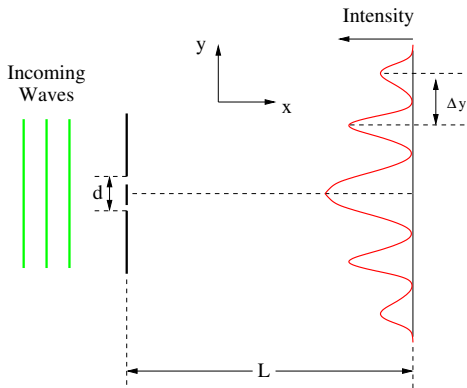


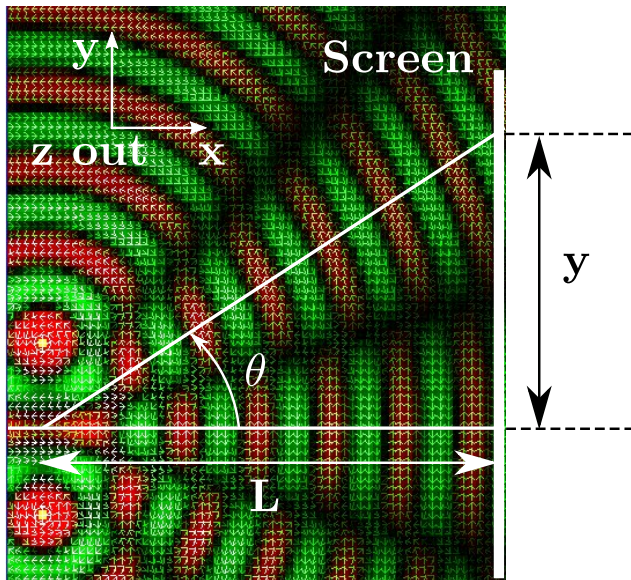




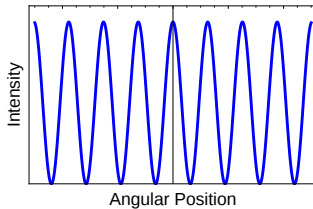


A laser beam is passed through two narrow slits and an interference pattern is thrown on a screen a distance  $L = 1.7 \text{ m}$  away from the slits. The bright spots are  $\Delta y = 0.1 \text{ m}$  apart. What is the separation  $d$  of the slits? The light has a wavelength  $\lambda = 6.5 \times 10^{-7} \text{ m}$ .

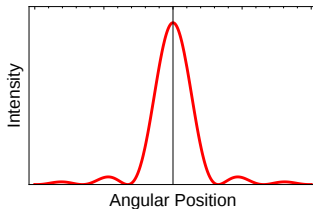


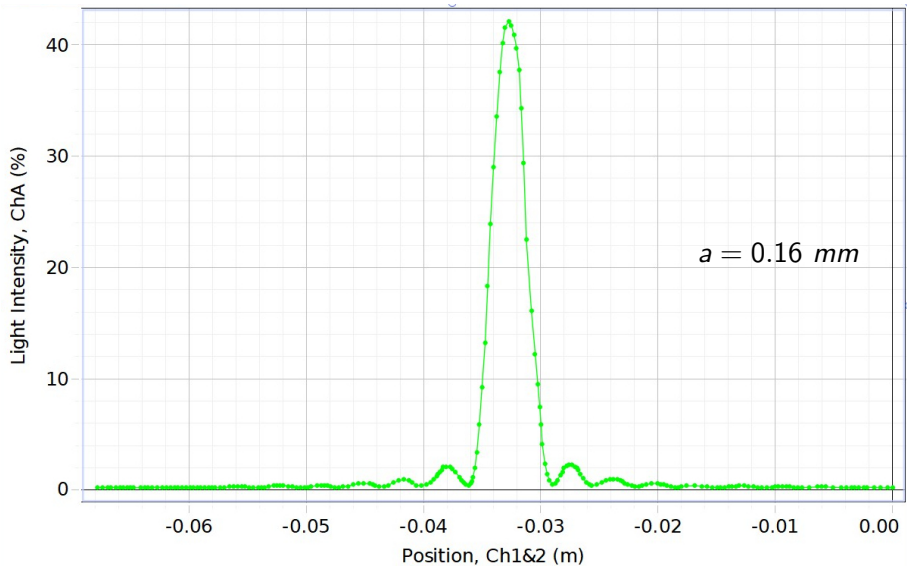


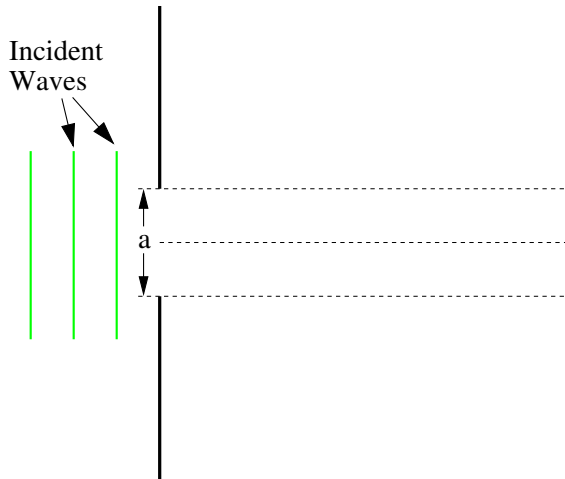
## Interference

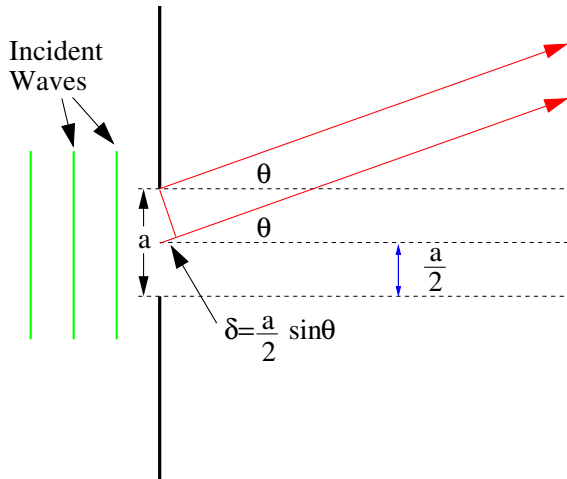


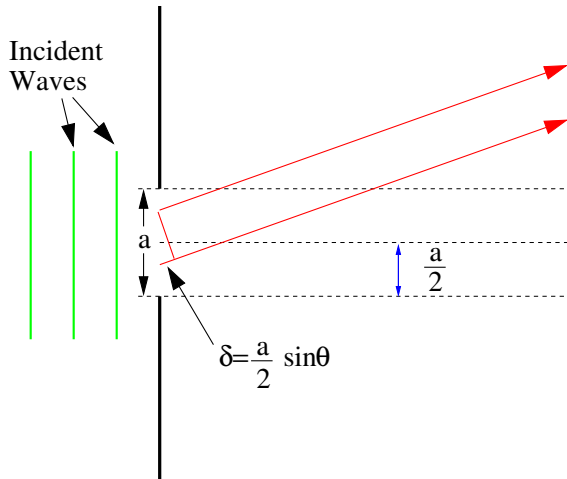
## Diffraction



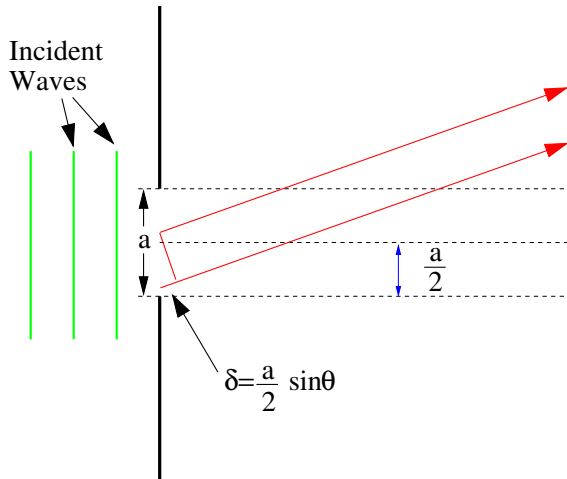


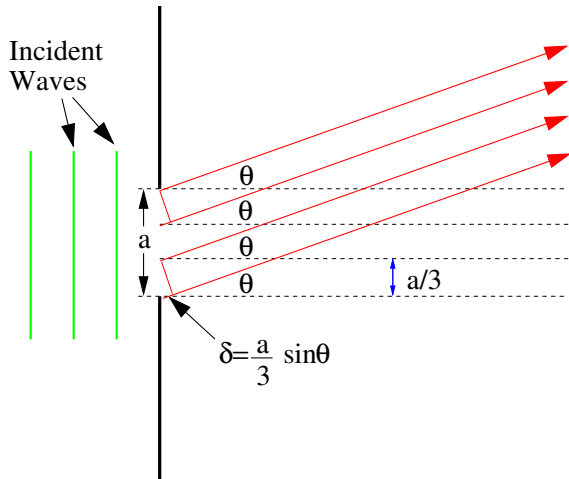


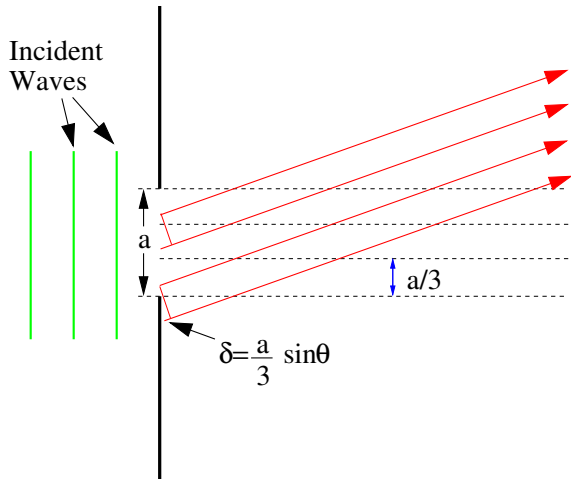


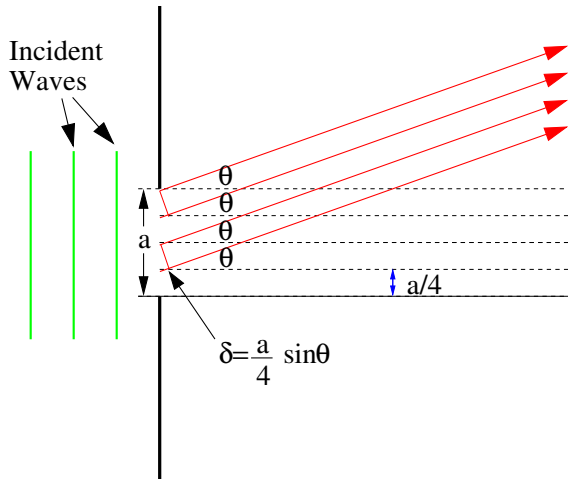


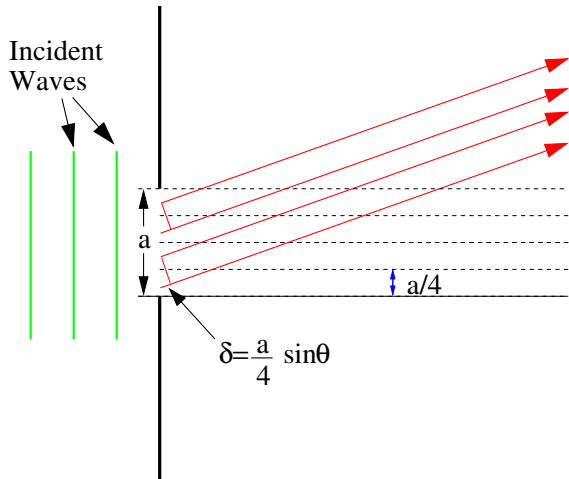












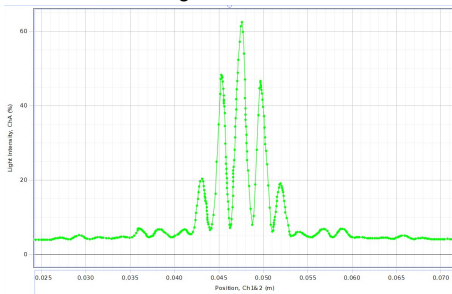
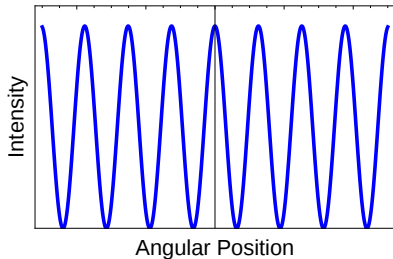
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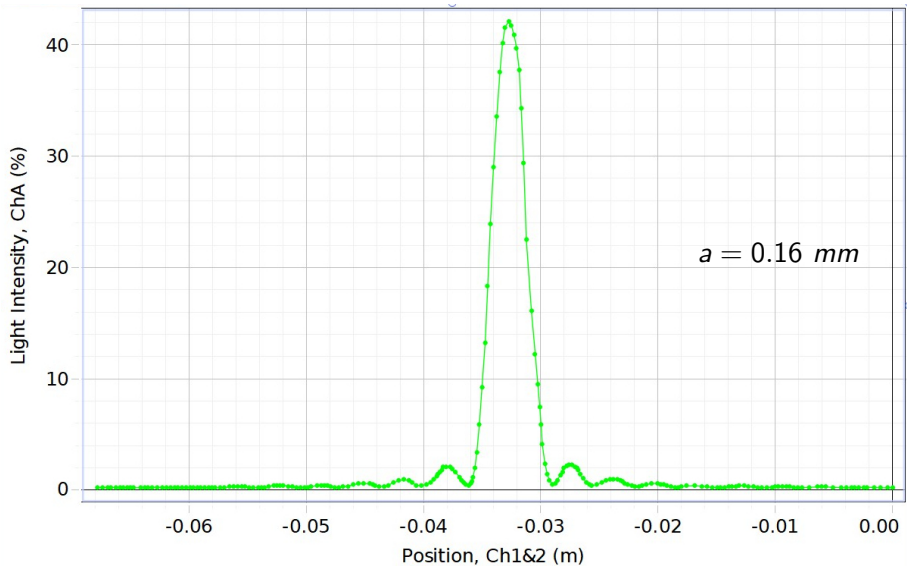


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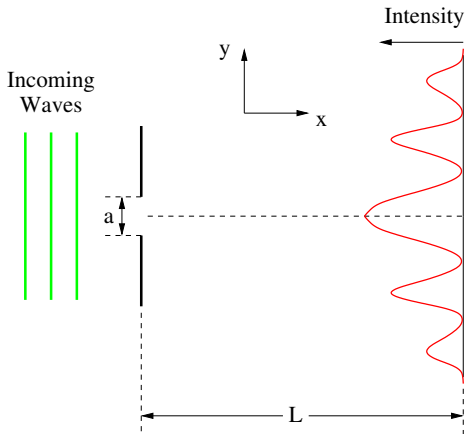






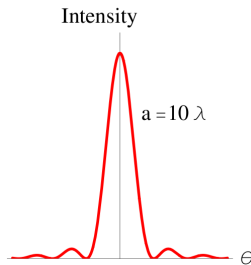
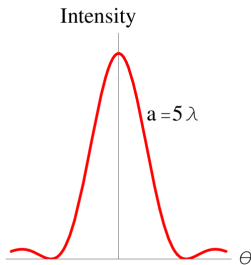
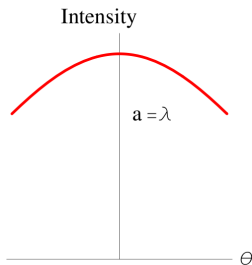


A laser beam of wavelength  $\lambda = 6328 \text{ \AA}$  is shone on a single slit of width  $a = 1.0 \text{ mm}$ . If a screen is placed a distance  $L = 0.40 \text{ m}$  away, then how far from the central maximum is the first dark spot on each side of the central maximum? What is the angular size of the central peak?



$$I = I_m \left( \frac{\sin \alpha}{\alpha} \right)^2 = I_m \left( \frac{\sin \left( \frac{\pi a}{\lambda} \sin \theta \right)}{\frac{\pi a}{\lambda} \sin \theta} \right)^2$$

$$\alpha = \frac{\pi a}{\lambda} \sin \theta \quad \theta \equiv \text{angular position}$$



If

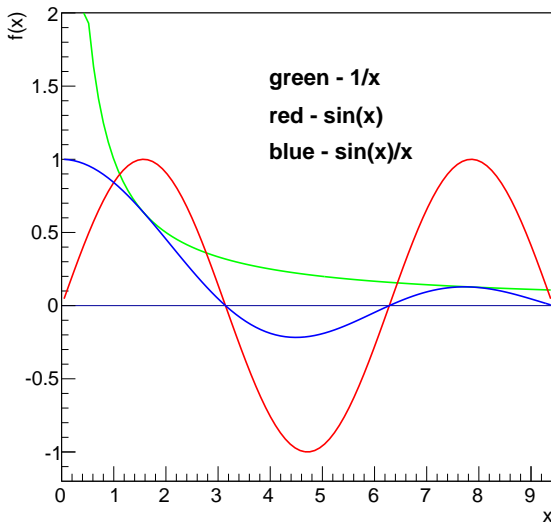
$$f(a) = g(a) = 0$$

and

$$\lim_{x \rightarrow a^+} \frac{f'(x)}{g'(x)} = A$$

then

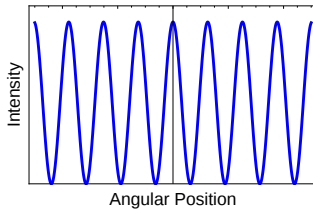
$$\lim_{x \rightarrow a^+} \frac{f(x)}{g(x)} = A$$



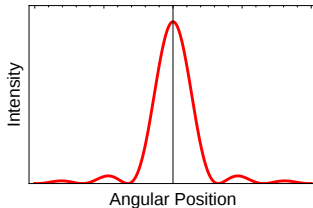
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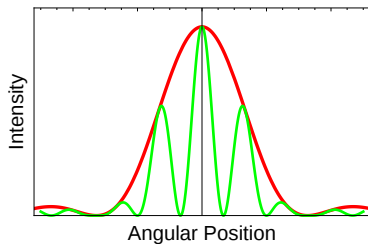
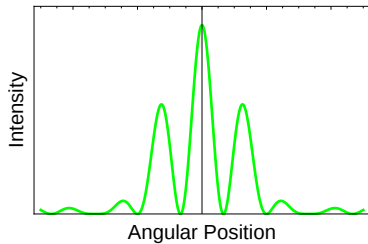


## Interference

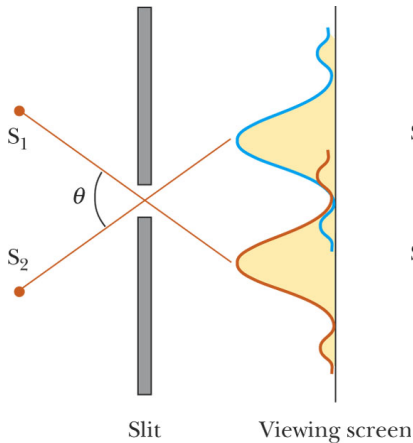


## Diffraction



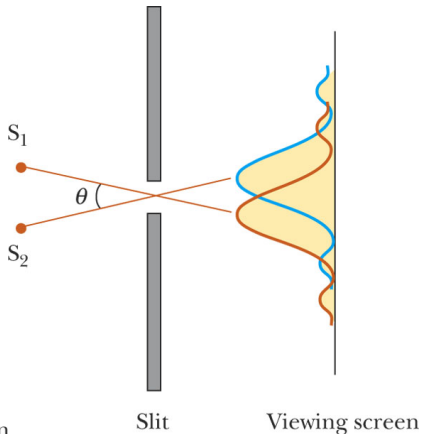






(a)

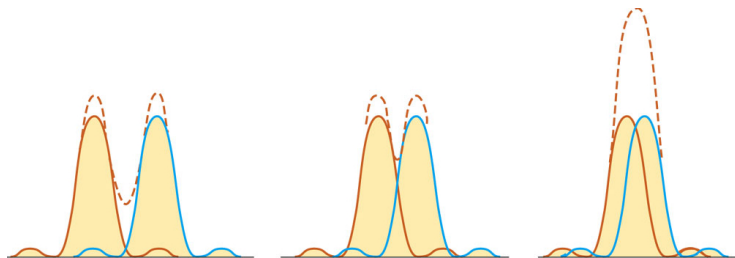
© 2006 Brooks/Cole - Thomson



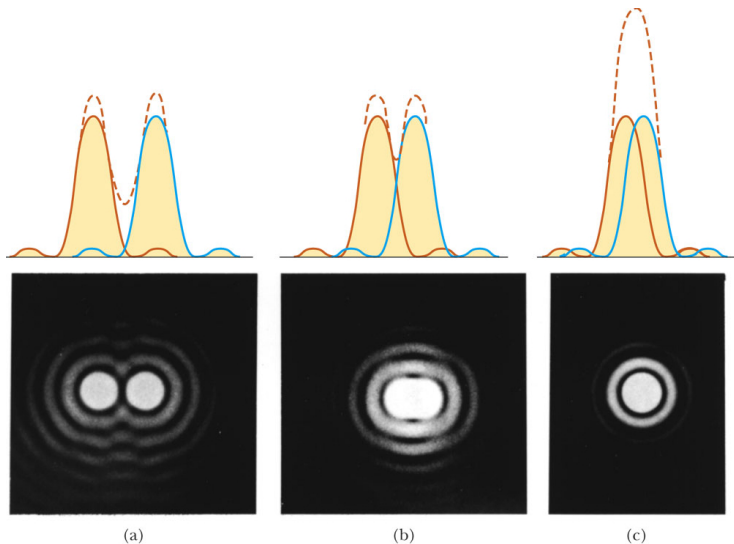
(b)

© 2006 Brooks/Cole - Thomson

Demo is [here](#)



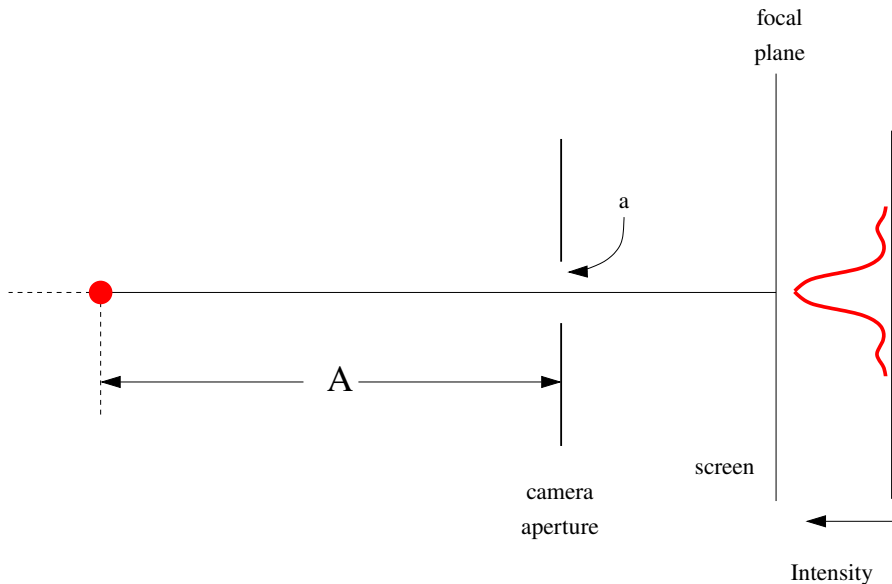
See more [here](#).

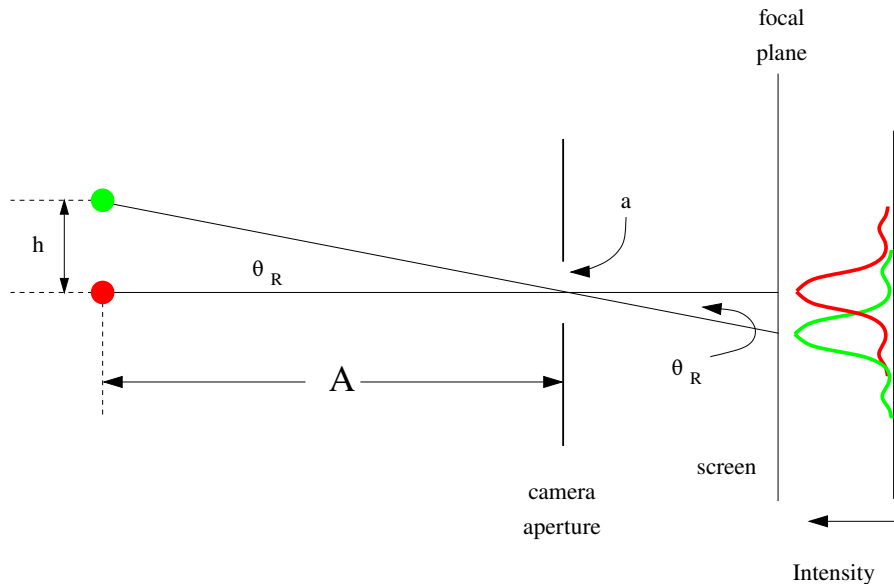


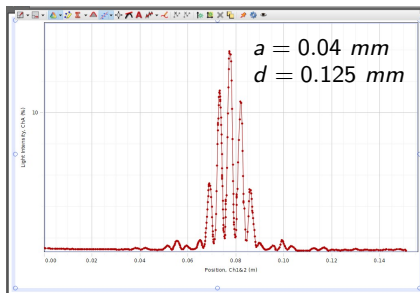
See more [here](#).

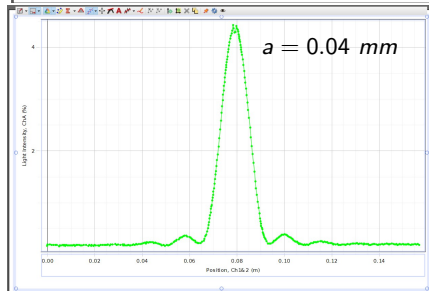
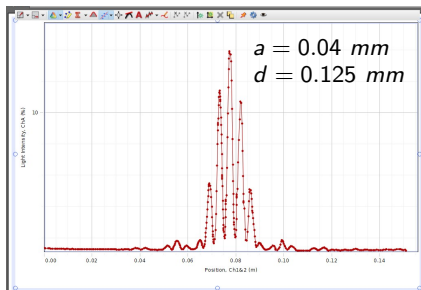
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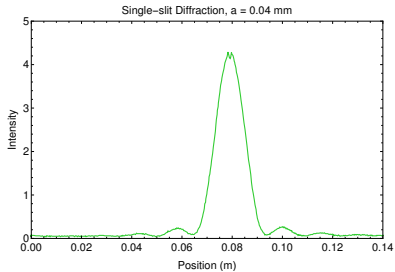
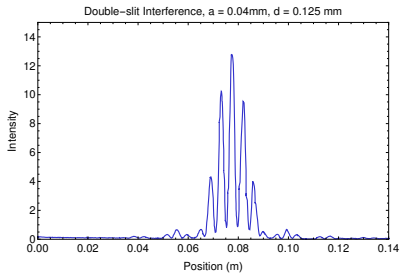


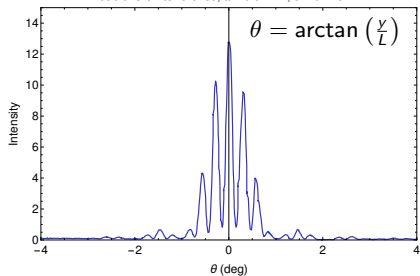
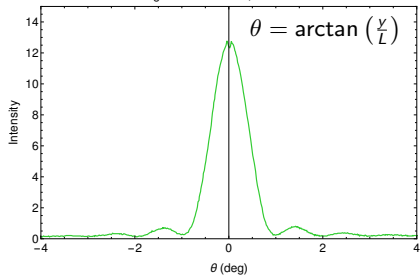




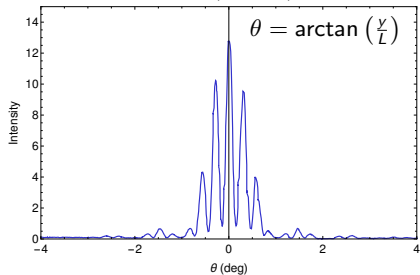




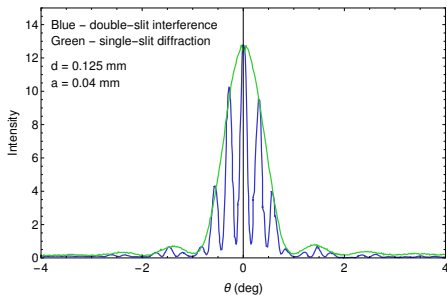
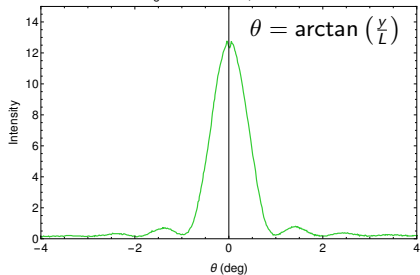


Double-slit Interference,  $a = 0.04\text{mm}$ ,  $d = 0.125\text{ mm}$ Single-slit Diffraction,  $a = 0.04\text{ mm}$ 

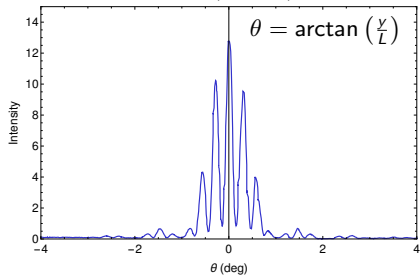
Double-slit Interference,  $a = 0.04\text{mm}$ ,  $d = 0.125\text{ mm}$



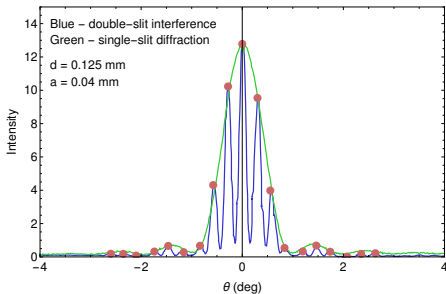
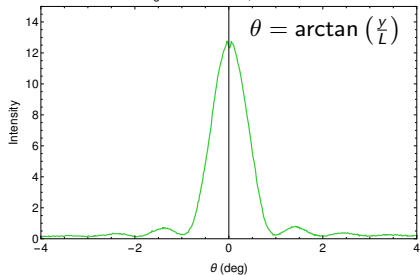
Single-slit Diffraction,  $a = 0.04\text{ mm}$



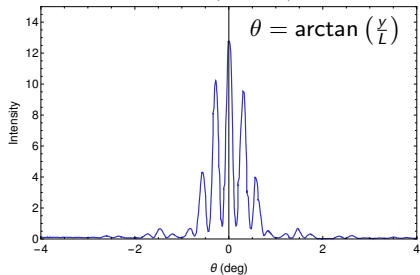
Double-slit Interference,  $a = 0.04\text{mm}$ ,  $d = 0.125\text{ mm}$



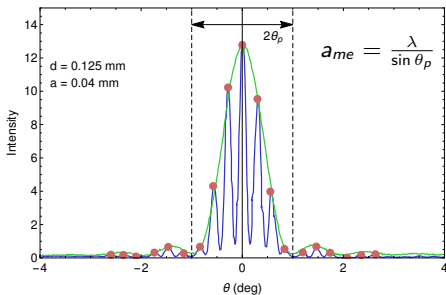
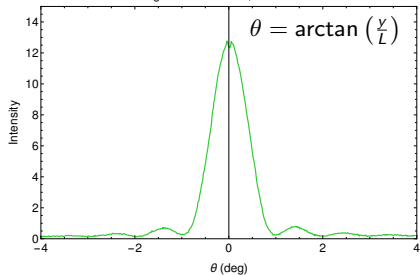
Single-slit Diffraction,  $a = 0.04\text{ mm}$



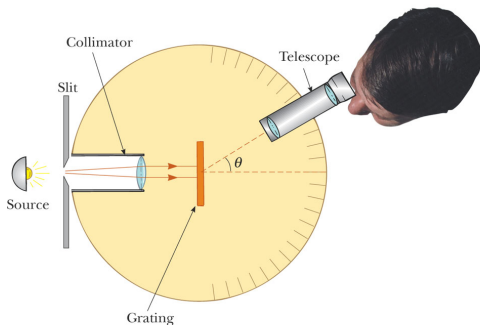
Double-slit Interference,  $a = 0.04\text{mm}$ ,  $d = 0.125\text{ mm}$



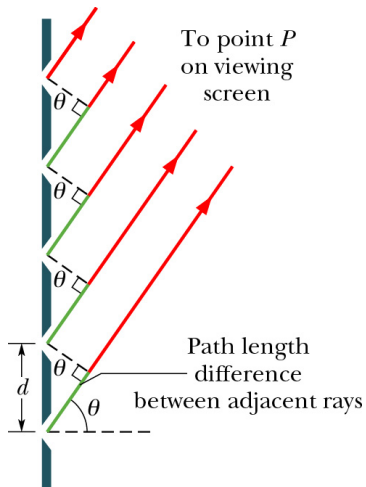
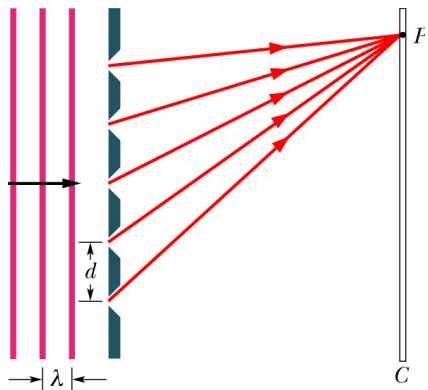
Single-slit Diffraction,  $a = 0.04\text{ mm}$

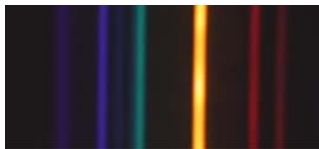


Light of wavelength  $\lambda = 600 \text{ nm}$  is incident normally on a diffraction grating in a spectrometer. Two adjacent maxima occur at angles given by  $\sin \theta_1 = 0.2$  and  $\sin \theta_2 = 0.3$ . The fourth-order maxima are missing. What is the separation between adjacent slits?



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Visible emission spectrum of helium.



