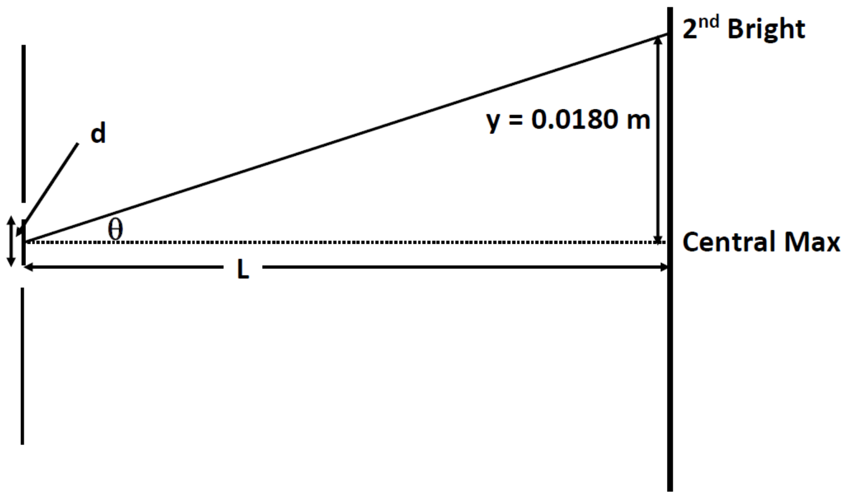
4. In a Young's double-slit experiment the separation *y* between the second-order bright fringe and the central bright fringe on a flat screen is 0.0180 m when the light has a wavelength of 425 nm. Assume that the angles that locate the fringes on the screen are small enough so that sin θ ≈ tan θ. Find the separation *y* when the light has a wavelength of 585 nm.



Bright Fringes in a double-slit experiment have the defining equation

$$d\sin(\theta) = m\lambda$$

Tangent of the angle can be found by

$$\tan(\theta) = \frac{y}{L}$$

Using the approximation suggested

$$\tan(\theta) = \frac{y}{L} \approx \sin(\theta)$$

So our bright condition becomes

$$d\sin(\theta) = m\lambda = d\left(\frac{y}{L}\right)$$

Solve for separation y

$$y = \frac{m\lambda L}{d}$$

So for the first wavelength we have

$$y_1 = \frac{m\lambda_1 L}{d} = \left(\frac{mL}{d}\right)\lambda_1$$

And for the second

$$y_2 = \left(\frac{mL}{d}\right)\lambda_2$$

Since the combination $\left(\frac{mL}{d}\right)$ never changes, we can solve for y_2 by dividing the equations

$$\frac{y_2 = \left(\frac{mL}{d}\right)\lambda_2}{y_1 = \left(\frac{mL}{d}\right)\lambda_1}$$

Solve for y_2

$$y_2 = y_1\left(\frac{\lambda_2}{\lambda_1}\right) = (0.0180\ m)\left(\frac{585\ nm}{425\ nm}\right) = 0.0248\ m$$

$$\boxed{y_2 = 0.0248\ m}$$

Dr. Donovan's Classes Page	Dr. Donovan's PH 202 Homework Page
NMU Physics Department Web Page	NMU Main Page

Please send any comments or questions about this page to ddonovan@nmu.edu

This page last updated on January 7, 2021