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Thermo, Wave Motion and Optics (PHYS 201)

Participation 4

In the lecture, we solved the problem of the interfence of light for the double slits experiment, using the superposition prinicple. Now suppose a configuration of three slits as shown in the figure below.

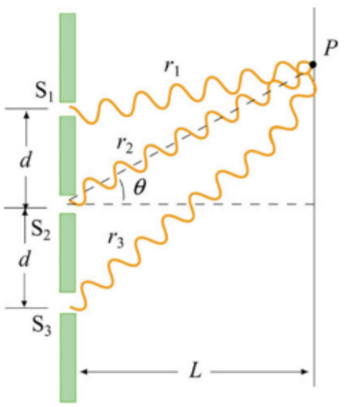

Figure 1

1. Using the same procedures we adapted, deduce that the total intensity of light recivied at the screen in such a case as function of θ takes the following form:

$$I = \frac{I_0}{9}\left[1 + 2\cos\left(\frac{2\pi d\sin\theta}{\lambda}\right)\right]^2.$$

Solution.

$$E_1 = E_0\sin(\omega t) \tag{1}$$
$$E_2 = E_0\sin(\omega t + \phi) \tag{2}$$
$$E_3 = E_0\sin(\omega t + 2\phi) \tag{3}$$
$$\phi = \frac{2\pi d}{\lambda}\sin\theta \tag{4}$$

From phasor diagram:

$$E = E_0(1 + 2\cos\phi) \tag{5}$$
$$I \propto E^2 \tag{6}$$
$$I = kE^2 \tag{7}$$
$$= k\left[E_0(1 + 2\cos\phi)\right]^2 \tag{8}$$

For $\phi = 0$:

$$I_0 = 9kE_0^2 \implies k = \frac{I_0}{9E_0^2} \tag{9}$$

$$I = \frac{I_0}{9}\left[1 + 2\cos\left(\frac{2\pi d \sin\theta}{\lambda}\right)\right]^2 \tag{10}$$

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2. To understand what this implies, plot I/I_0 versus $d\sin\theta/\lambda$.