Answer on Question #50688, Physics, Optics

Discuss the concept of missing orders with particular reference to double slit diffraction pattern

Answer:

Interference happens when wave amplitudes add together algebraically in space and time. When two crests meet, we get – what a surprise, a big crest – interference is constructive. When a crest meets a trough, we get zero disturbance- destructive interference.

Diffraction is the spreading of a wave round an edge. There's only a change in the wave direction at the edge of the gap(s).

This means that diffraction can be observed in a double-slit interference pattern. Essentially, this is because each slit emits a diffraction pattern, and the diffraction patterns interfere with each other. The shape of the diffraction pattern is determined by the width (W) of the slits, while the shape of the interference pattern is determined by d, the distance between the slits. If W is much larger than d, the pattern will be dominated by interference effects; if W and d are about the same size the two effects will contribute equally to the fringe pattern. Generally what you see is a fringe pattern that has missing interference fringes; these fall at places where dark fringes occur in the diffraction pattern. So, put another way, we see the broad diffraction envelope and underneath it, the equally spaced interference fringes. When an interference fringe sits underneath a diffraction minimum, we can't see it. These are termed **missing orders**.

Intensity maxima:

$$\sin\theta = \frac{n\lambda}{d}, \quad n = 0, 1, 2, 3, \dots$$

intensity minima:

$$\sin\theta = \frac{\left(n + \frac{1}{2}\right)\lambda}{d}, \quad n = 0, 1, 2, 3, \dots$$

The diffraction pattern that is actually observed from the double slit is the theoretical double slit maximum pattern shown in Figure 3 -- from Equations -- modulated by the single slit minimum pattern -- from Equation $\sin\theta = \frac{n\lambda}{w}$ -- shown in Figure 4. The result is shown in Figure 5. Note that some of the double-slit maxima have nearly zero intensity as they coincide with single slit minima, as shown in Figure 4.

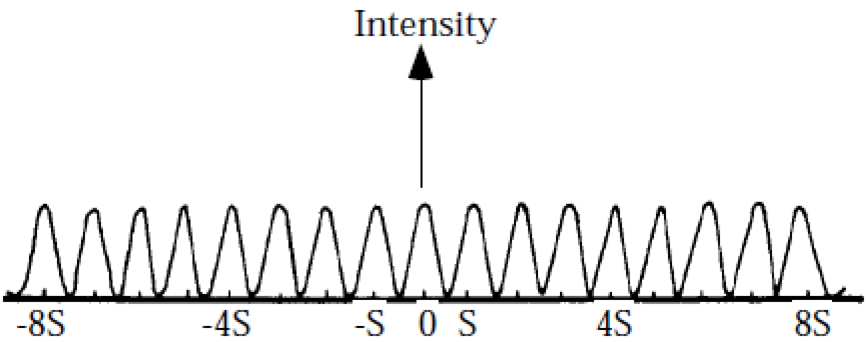

Figure 3

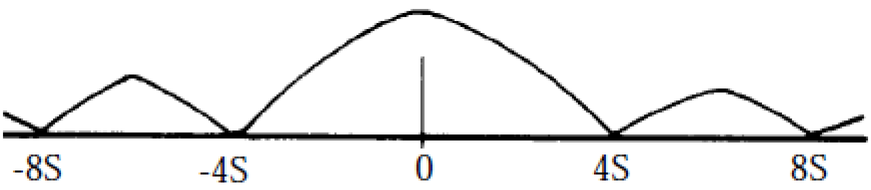

Figure 4

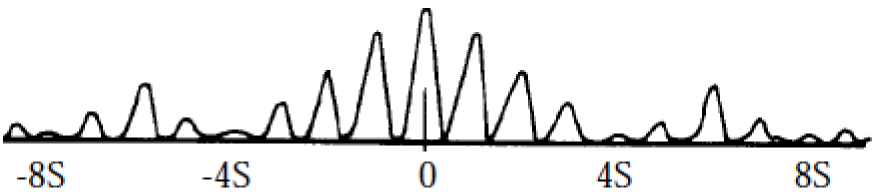

Figure 5