

In 1818, Augustin Fresnel submitted a paper on the theory of diffraction for a competition sponsored by the French Academy. His theory represented light as a wave, as opposed to a bombardment of hard little particles, which was the subject of a debate that lasted since Newton's day. Siméon Poisson, a member of the judging committee for the competition, was very critical of the wave theory of light. Using Fresnel's theory, Poisson deduced the seemingly absurd prediction that a bright spot should appear behind a circular obstruction, a prediction he felt was the last nail in the coffin for Fresnel's theory.

However, Dominique Arago, another member of the judging committee, almost immediately verified the spot experimentally. Fresnel won the competition, and, although it may be more appropriate to call it "the Spot of Arago," the spot goes down in history with the name "Poisson's bright spot" like a curse.

*Reference: Optics (2nd edition) by Eugene Hecht*

Fresnel Diffraction (near-field diffraction)

The point source or the screen are relatively close to the obstacle forming the diffraction pattern.

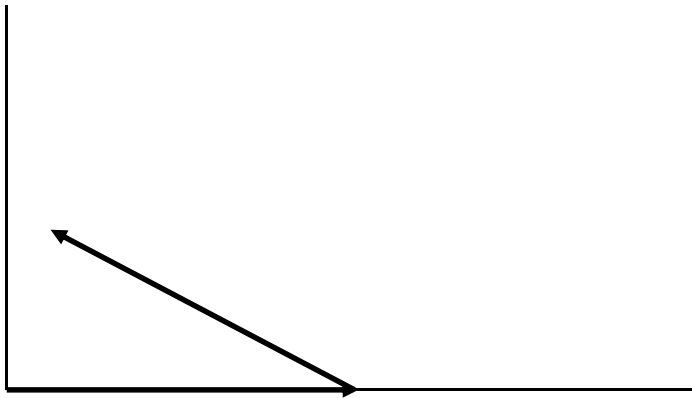
Fraunhofer diffraction (far-field diffraction)

The source, obstacle and screen are far enough away from each other that all lines from the source to the obstacle can be considered parallel, and all lines from the source to the screen can be considered parallel.

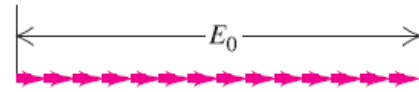
At a particular point in space, the electric field from two sources add according to the phasor diagram below. Is the resulting intensity greater or smaller than if only one source was present?

a) greater

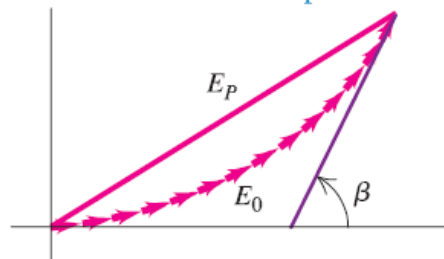
b) smaller



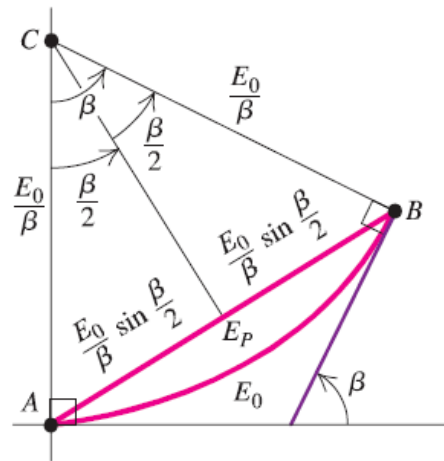
(b) At the center of the diffraction pattern (point  $O$ ), the phasors from all strips within the slit are in phase.

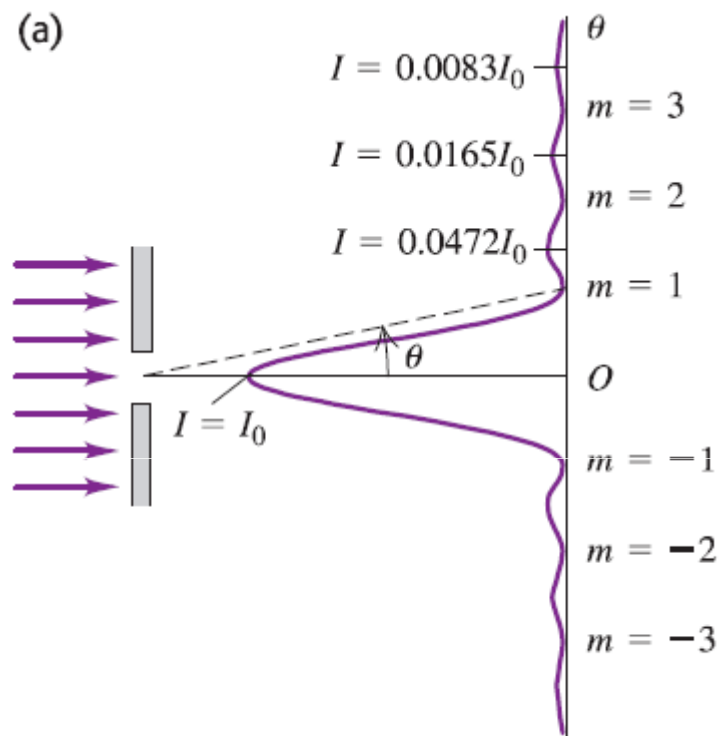


(c) Phasor diagram at a point slightly off the center of the pattern;  $\beta$  = total phase difference between the first and last phasors.



(d) As in (c), but in the limit that the slit is subdivided into infinitely many strips





Will the separation between the first dark fringes get larger or smaller if the slit width is made larger?

a) Larger

b) Smaller