#22300 Young's Double Slit Apparatus

Purpose:

To illustrate the role of constructive and destructive interference in generating double slit interference patterns and to study the overall effect of phase differences between the two sources on the interference pattern.

Required Accessories:

No additional accessories are required.

Discussion:

The Young's double slit apparatus is a versatile demonstration tool built to scale 20,000 times larger than an actual experimental slit. Because of this attention to scale, actual calculations may be performed to confirm the location of the maxima and minima. The physical parameters that are modeled are a wavelength of 600 nanometers which corresponds to the wavelength of HeNe laser illumination and a variable slit separation of 4.5 microns and 2.25 microns.

The angular displacement of the bright fringes can be calculated directly using the above parameters and Young's double slit equation

$$\sin(\theta) = n\lambda/d$$

where

n = the order of a given "bright fringe". (n=0 represents the central bright fringe, n=1, 2, 3... represent those fringes with increasing separation from the central bright fringe.)

λ = the wave length of light used. (for the model, this would be 600 nanometers.)

d = the separation between slits (for the model, these values would be 4.5 microns for the wider slit, and 2.25 microns for the narrower slit.)

θ = the angle between the bright fringe in question and the line perpendicular (normal) to the plane of the double slit.

The calculated value for the location of the bright fringe can then be compared directly to the model by measuring the angle to the "bright fringe" with a protractor.

The model is also supplied with a phase adjusting lever to conveniently throw one of the slits out of phase with respect to the other. This illustrates the effect of phase differences on the interference pattern.

Operating Procedure:

The two wavelets move freely under the "screen". As they are slowly moved from zero degrees (on the white line) to larger angular displacements, you will notice locations where the white arcs on each wavelet begin to cross. These crossings represent constructive interference between two wave crests; a "bright spot". There will always be constructive interference at an angular displacement of zero degrees if both sources are in phase. Five maxima are obtainable with the larger slit opening (9 cm) and 3 maxima are obtainable with the narrower slit opening (4.5 cm).

The lever on the left side of the slit cover adjusts the phase difference between the two wavelets. This lever moves forward and back to provide a continuous adjustment of that wavelet's phase. For zero phase difference, this lever should be pushed forward toward the screen.

To change the slit separation, remove the nut that holds the cover plate over the wavelets. Remove the cover plate and move the base of the wavelets to the inner pair of holes to make the separation 4.5 cm, or the outer pair of holes for 9.0 cm separation. Replace the cover plate with the appropriate side facing up and fasten.

Time Allocation:

To prepare this product for an experimental trial should take less than ten minutes. Actual experiments will vary with needs of students and the method of instruction, but are easily concluded within one class period.