# DOUBLE SLIT DIFFRACTION Exp-5

## Purpose

- To observe diffraction and interference effects of light passing through various apertures.
- To use the diffraction patterns produced by double slit apertures and to calculate the width of slits and distance between slits.

## Related topics

Huygens principle, interference, Fraunhofer and Fresnel-diffraction, coherence, laser.

## Equipment

- Laser, He-Ne 1.0 mw, 220 V AC
- Lens, mounted, f +20 mm
- Lens, mounted, f +100 mm
- Universal measuring amplifier
- Diaphragm, 3 single slits
- Multi-range meter
- Photocell

## Theory and Evaluation

### Two-beam interference: division of wave-front

The earliest experimental arrangement for demonstrating the interference of light is due to Young. Light from a monochromatic point source S falls on two pinholes $S_1$ and $S_2$ which are close together in a screen and equidistant from S(Fig ??). The pinholes act as secondary monochromatic point sources which are in phase, and the beams from them are superposed in the region beyond screen. In this region an interference pattern is formed [6].

It is well known that, path difference $\delta$ is $r_2 - r_1 \; = \; d \sin\theta$ and the condition for bright fringes, or constructive interference, at point P is;

$$d \sin\theta_{Bright} \; = \; m \; \lambda \tag{15}$$

When more than one slit is present, we must consider not only diffraction patterns due to the individual slits but also the interference patterns due to the waves coming from different slits. Notice the curved dashed lines in Figure 18, which indicate a decrease in intensity of the interference maxima as $\theta$ increases. This decrease is due to a diffraction pattern. Effect of two-slit interference and single slit diffraction pattern determine the outcome of the intensity pattern. it merely represents the single-slit diffraction pattern acting as an “envelope” for a two-slit interference pattern [17].

## Set-up, Procedure

***Caution: Never look directly into a non attenuated laser beam***

1. The experimental set-up is shown in Fig. 16. A broadened and parallel laser beam obtained with the lenses f = 20 mm and f = 100 mm.

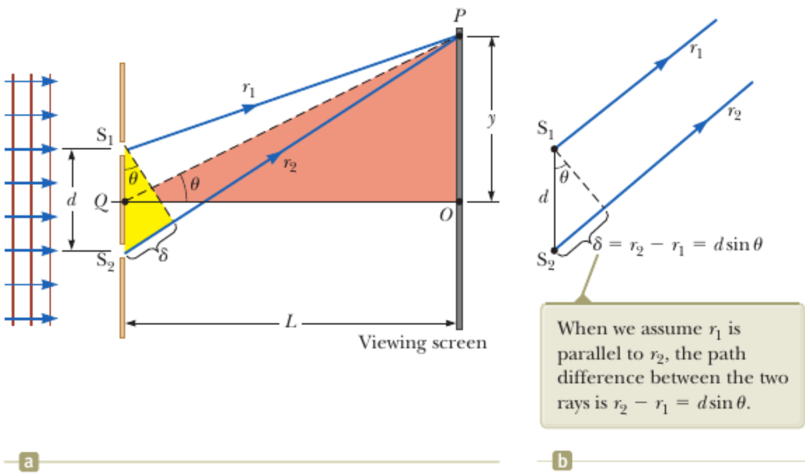


Figure 17: (a) Geometric construction for describing Young's double-slit experiment (not to scale). (b) The slits are represented as sources, and the outgoing light rays are assumed to be parallel as they travel to P. To achieve that in practice, it is essential that L $\gg$ d [17]

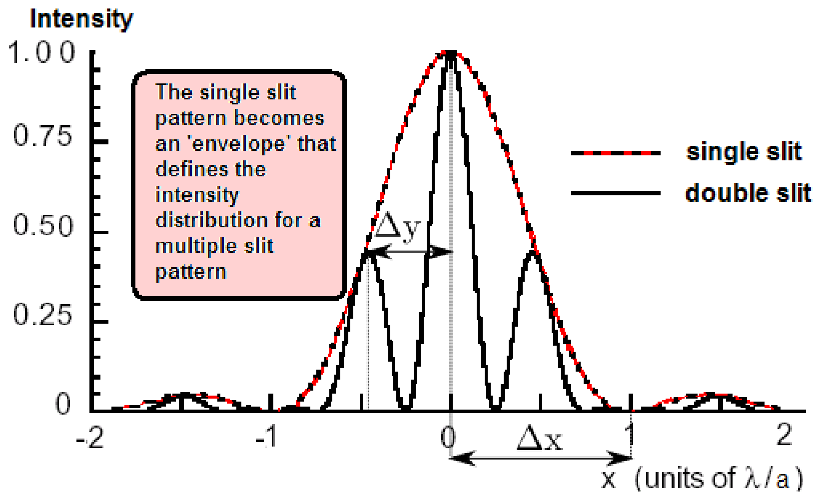


Figure 18: The combined effects of two-slit and single-slit interference [4]

2. Make sure that laser beam impinge centrally on the photocell. The photocell is situated at the centre of its shifting range. The slit diaphragm is then set onto the photocell.

3. Set diaphragm with a double slit which is to be investigated into diaphragm support. It must be made sure that the slit is placed centred and perpendicularly to the beam. Two slits must receive the same luminous intensity.

4. Plug in the power supply for the laser. Turn on the laser. The laser and the measurement amplifier should be warmed up for about 15 minutes before work starts, so as to avoid bothersome intensity fluctuations during measurements.

5. By using screw of zero adjustment of amplifier, make sure that zero is readed by multimeter with covered photodiode.

6. Change the position of the photocell by 0.5mm and record the responding intesity values from the multimetre. Record your value in Table below.

7. Repeat step 6 for the other diaphragms.

8. Measure the L, difference between slits and screen, record your value in Table below.

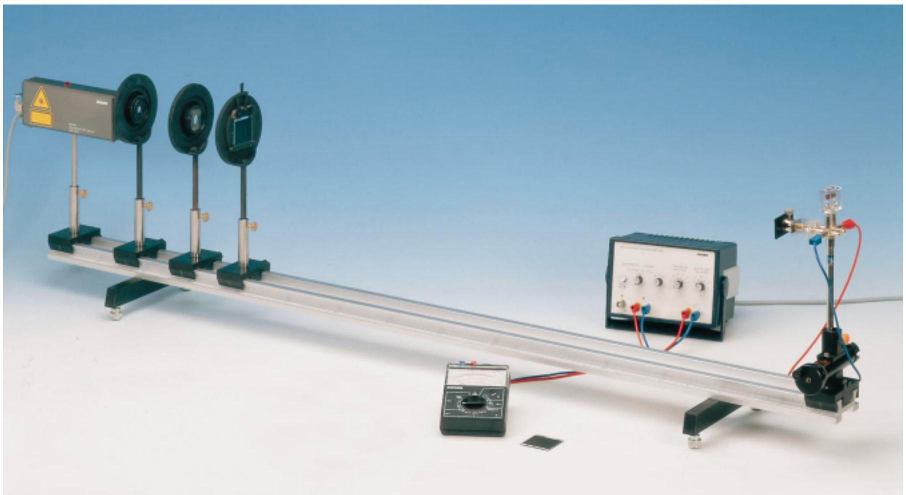

Figure 19: Experimental set-up for the investigation of the diffraction intensity of slits. (Component locations on the optical bench: laser = 2.5 cm; lens f/20 mm = 14 cm; lens f/100 mm = 27 cm; slits = 32.5 cm; slide mount lateral adjustm, calibr. = 139.5 cm) [8]

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# GEBZE TECHNICAL UNIVERSITY

# PHYSICS DEPARTMENT

# OPTICS LABORATORY

# EXPERIMENT REPORT
# DOUBLE SLIT DIFFRACTION

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DATA and RESULTS

Name:______________________ TA:______________________

Department:______________________

Partners:______________________

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