

## 4. Experiment contents

### 1) Single-slit diffraction

- a) Put two AA batteries into the battery box. Turn on power switch of the instrument. Laser 3 will emit red laser beam. Beam divergence angle can be adjusted by turning the focusing lens on the laser head.
- b) Insert Sheet #1 (element dimensions are shown in Figure 2) into the holding slot on the instrument body and rotate the adjustment hand wheel to bring Slit 1 into the optical path. Diffraction strips of single slit 1 can be observed on the receiving screen as shown in Figure 3. (Please set the distance of the screen from the instrument larger than 0.5 m, or use a wall or white board at remote as the receiving screen).

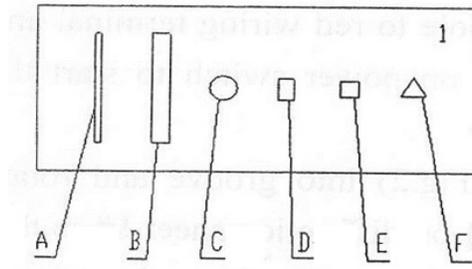


Figure 2: Elements on Sheet #1

- A. Slit 1: width 0.1 mm, B. Slit 2: width 0.3 mm, C. Circular hole: diameter 0.45 mm,  
D. Rectangle hole: 0.4 mm  $\times$  0.25 mm, E. Square hole: 0.3 mm  $\times$  0.3 mm,  
F. Triangle hole: 0.4 mm  $\times$  0.4 mm  $\times$  0.4 mm.

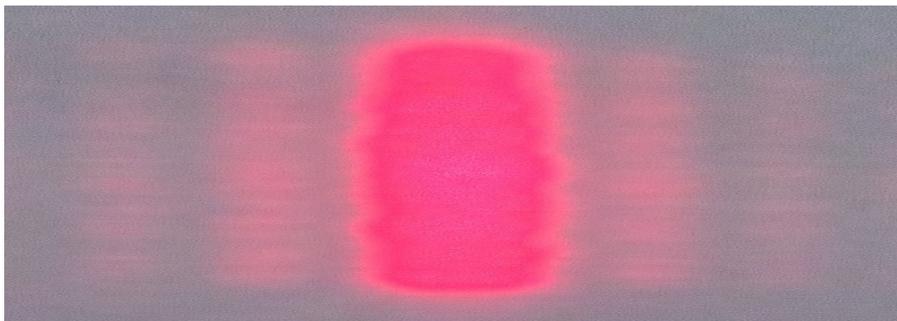


Figure 3. Diffraction of Slit 1: width 0.1 mm.

- c) Continually rotate the hand wheel to select Slit 2 entering the optical path. Changes of stripe interval of diffraction pattern can be observed, as shown in Figure 4.

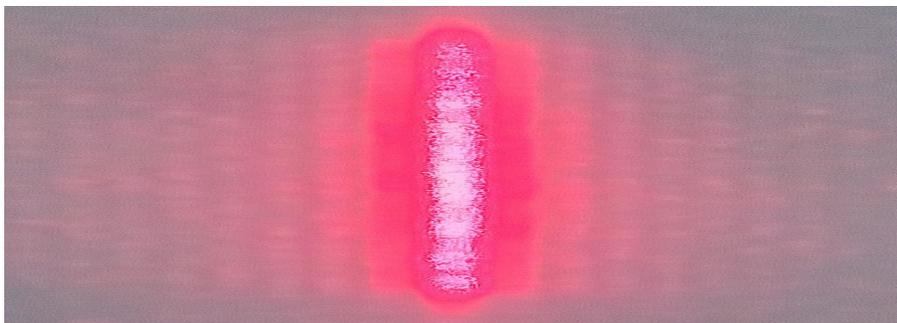


Figure 4. Diffraction of Slit 2: width 0.3 mm.

## 2) Circular hole diffraction

Same as the previous step, rotate the hand wheel to select the circular hole entering optical path, and observe diffraction pattern of a circular hole, see Figure 5.



Figure 5. Diffraction of circular aperture: diameter 0.45 mm.

## 3) Rectangle hole diffraction

Same as the previous step, rotate the hand wheel to select the rectangle aperture entering optical path, and observe diffraction pattern of a rectangle hole, see Figure 6.

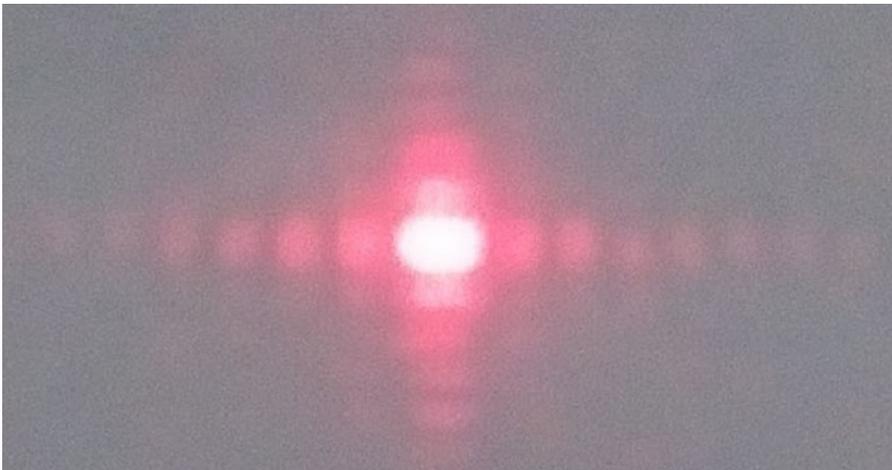


Figure 6. Diffraction of rectangle aperture: 0.40 mm  $\times$  0.25 mm

## 4) Square hole diffraction

Same as the previous step, rotate the hand wheel to select the square hole entering optical path, and observe diffraction pattern of a square hole, see figure 7.

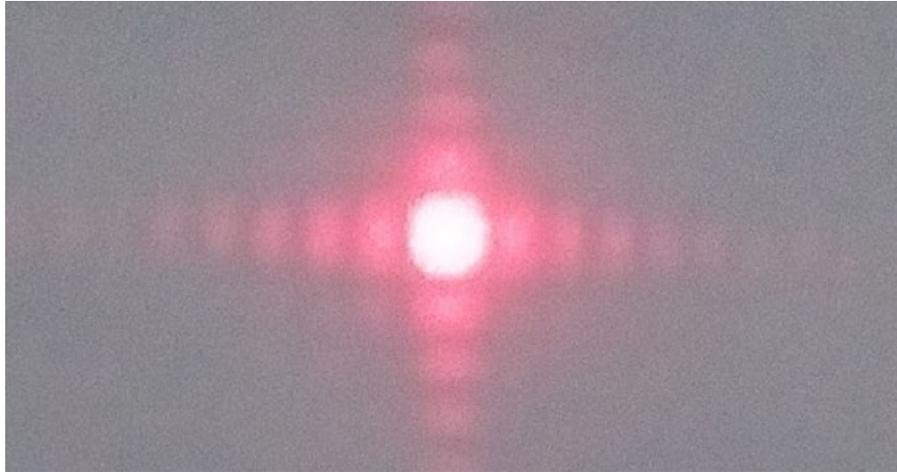


Figure 7. Diffraction of square aperture:  $0.30 \text{ mm} \times 0.30 \text{ mm}$

### 5) Triangle hole diffraction

Same as the previous step, rotate the hand wheel to select the triangle hole entering optical path, and observe diffraction pattern of a triangle hole, see Figure 8.



Figure 8. Diffraction of triangle aperture:  $0.40 \text{ mm} \times 0.40 \text{ mm} \times 0.4 \text{ mm}$

### 6) Young's double-slit interference

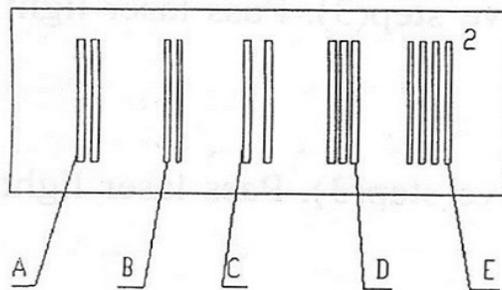


Figure 9: Elements on Sheet #2

A. Double-slit 1:  $a = 0.1 \text{ mm}$ ,  $b = 0.2 \text{ mm}$ , B. Double-slit 2:  $a = 0.075 \text{ mm}$ ,  $b = 0.175 \text{ mm}$ ,

C. Double-slit 3:  $a = 0.1$  mm,  $b = 0.3$  mm, D. Triple-slit:  $a = 0.1$  mm,  $b = 0.15$  mm,  
E. Quadruple-slit:  $a=0.075$ ,  $b=0.175$  mm. (here  $a$  is slit width and  $b$  is distance between slits)

Insert Sheet #2 (element dimensions are shown in Figure 9) into the holding slot on the instrument body and rotate the adjustment hand wheel to bring Double-slit 1 into the optical path. Interference fringes of double-slit 1 can be observed on the receiving screen, see Figure 10 (Please set the distance of the screen from the instrument larger than 0.5 m).

Continually rotate the hand wheel to select double-slit 2 entering the optical path. Changes of fringe interval of interference pattern can be observed, see Figure 11.

Continually rotate the hand wheel to select double-slit 3 entering the optical path. Changes of fringe interval of interference pattern can be observed, see Figure 12.

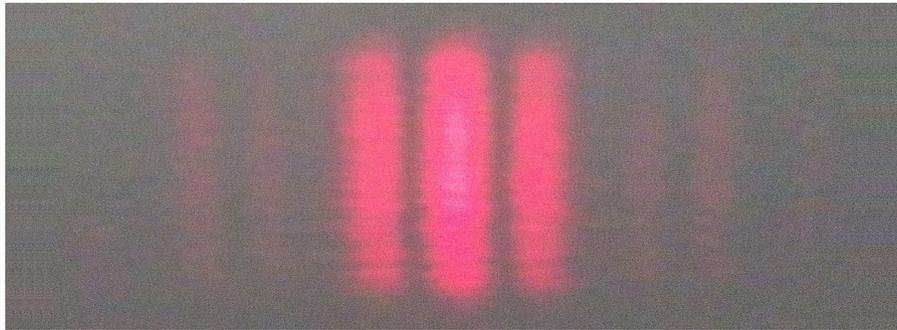


Figure 10. Interference of double-slit 1:  $a = 0.1$  mm,  $b = 0.2$  mm

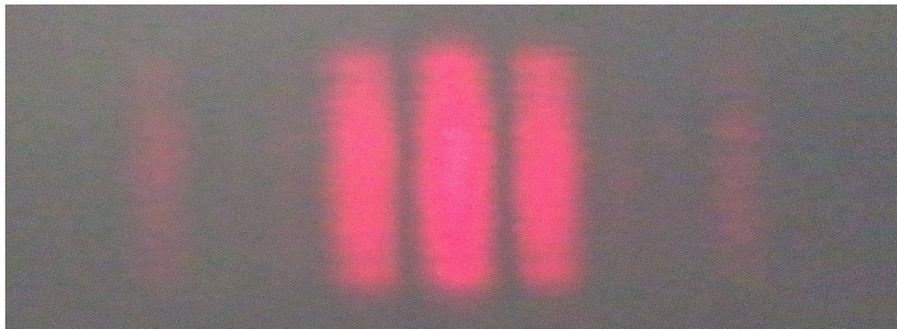


Figure 11. Interference of double-slit 2:  $a = 0.075$  mm,  $b = 0.175$  mm

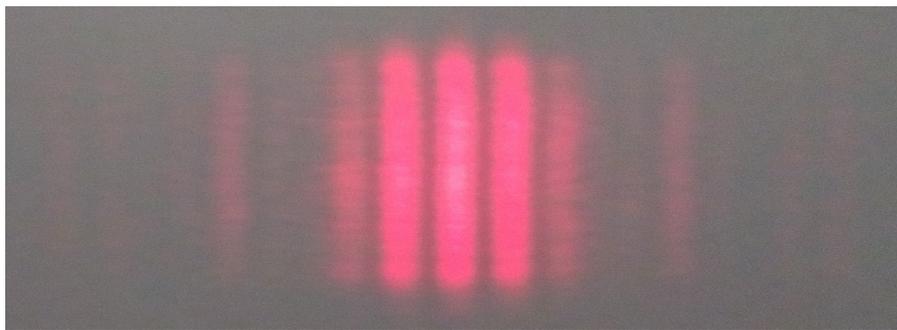


Figure 12. Interference of double-slit:  $a = 0.1$  mm,  $b = 0.3$  mm

### 7) Triple-slit interference

Same as the previous step, rotate the hand wheel to select the triple-slit entering optical path, and observe interference pattern of a triple-slit, see Figure 13.

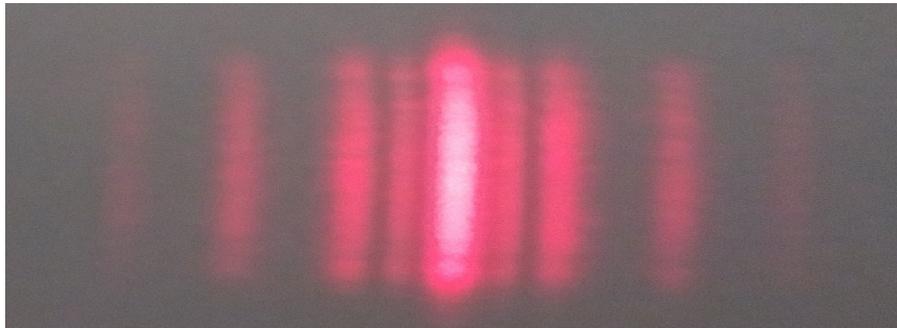


Figure 13. Interference of triple-slit:  $a = 0.1$  mm,  $b = 0.15$  mm

### 8) Quadruple-slit interference

Same as the previous step, rotate the hand wheel to select the quadruple-slit entering optical path, and observe interference pattern of a quadruple-slit, see Figure 14.

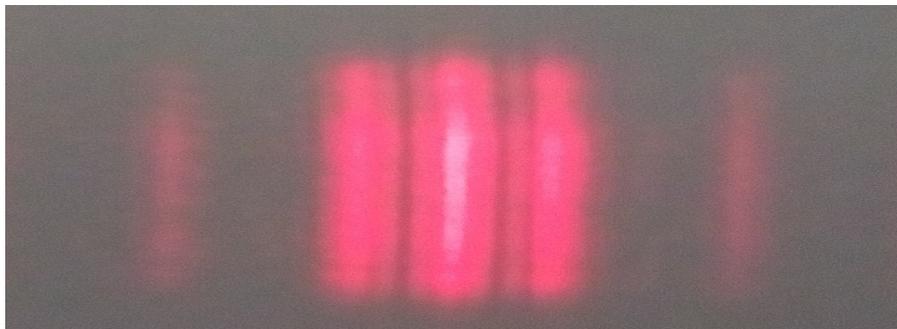


Figure 14. Interference of quadruple-slit:  $a = 0.075$  mm,  $b = 0.175$  mm

### 9) Single wire diffraction

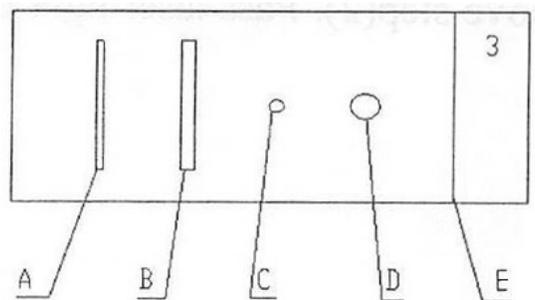


Figure 15: Elements on Sheet #2

- A. Single wire 1: width = 0.1 mm, B. Single wire 2: width = 0.2 mm,
- C. Circular disk 1: diameter = 1 mm, D. Circular disk 2: diameter = 2 mm,
- E. Sharp edge.

Insert Sheet #3 (element dimensions are shown in Figure 15) into the holding slot on the instrument body and rotate the adjustment hand wheel to bring Single wire 1 into the optical path. Diffraction stripes of single wire 1 can be observed on the receiving screen, see Figure 16

(Please set the distance of the screen from the instrument larger than 0.5 m).

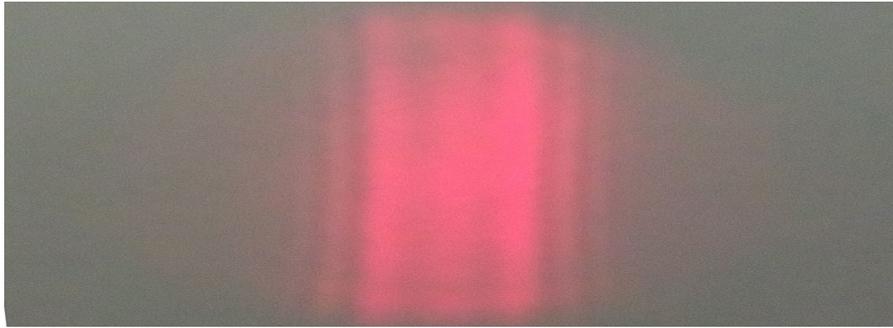


Figure 16. Diffraction of single wire 1: width = 0.1mm

Continually rotate the hand wheel to select Single wire 2 entering the optical path. Changes of diffraction strip interval can be observed, see Figure 17.

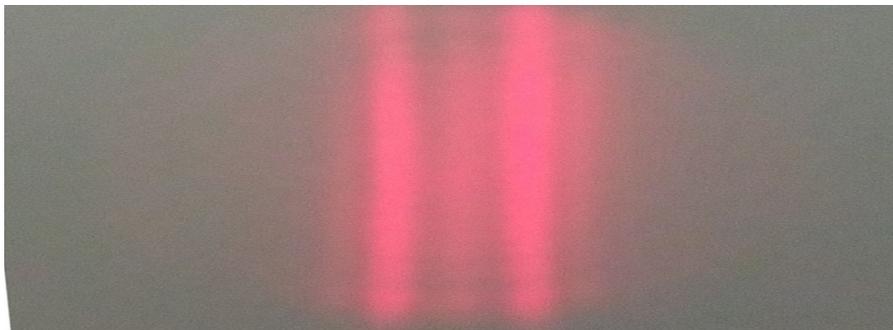


Figure 17. Diffraction of single wire 1: width = 0.2mm

### **10) Circular disk diffraction**

Rotate the hand wheel to select Circular disk 1 entering the optical path. Move the receiving screen from near to far and during this process, observe the brightness change in the center of the diffraction pattern. At a proper distance, a Poisson's spot of the diffraction pattern can be observed, i.e. a bright spot in the center surrounding with annuli stripes, see Figure 18. (Distance for this experiment is about 1.2 m).

Rotate the hand wheel to select Circular disk 2 entering the optical path. Repeat the above step to find the central bright spot and compare result with the previous disk, see Figure 19.

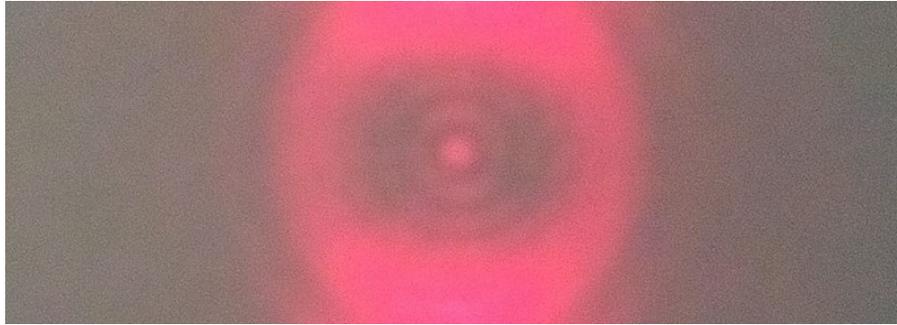


Figure 18. Diffraction of circular disk 1: diameter = 1 mm



Figure 19. Diffraction of circular disk 2: diameter = 2 mm

### 11) Sharp edge diffraction

Rotate the hand wheel to select the sharp edge entering the optical path. Observe the diffraction pattern of a sharp edge, see Figure 20.

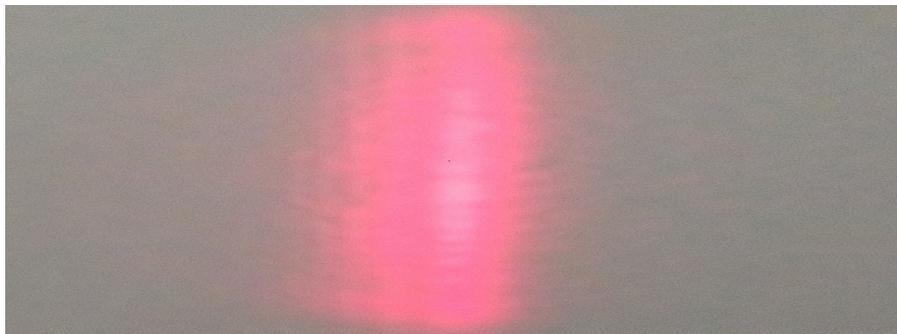


Figure 20. Diffraction of sharp edge