

Instructions :

- Duration : 2 Hours
 - The goal of this working lab is to build the electronic circuits studied in the courses and understand the concepts behind them with practical circuits.
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1 Materials

2 Introduction: Theory

1. Use a paper to draw and describe the diffraction process with 1 slit.
2. Do the same with a double-slit experiment.
3. Consider now, 2 electro-magnetic waves arriving at a screen, they form an angle θ with the normal incidence. They have the same frequency f and same wavelength λ . They are described by the equations :
 - (a) $E_1(t) = E_0 \sin \omega t$
 - (b) $E_2(t) = E_0 \sin \omega t + \phi$
4. Express the equation of the electro-magnetic wave at the screen $E(t) = E_1(t) + E_2(t)$
5. Express ϕ as function of the path length difference.
6. Calculate the intensity $I \approx \langle E^2(t) \rangle$.
7. For what value of ϕ , you have a maximum of intensity? And the minimum? Explain your choices.
8. Finally, express the angle θ as function of D , the distance Slit-Screen and x_m , the distance between the order 0 and m maxima.

3 Experiment 1: Simple slit

3.1 Preparation

- Place the laser in front of the slit at a comfortable distance.
- Place the screen/blackboard at $\sim 1 - 2$ m from the slit. Put a A4 page to avoid any reflection from the blackboard.
- Choose a simple slit. Note down the opening length d .

3.2 Manipulations

1. Measure the distances x_m between the maximum of intensity and the center (x_1 are the ones next to the center, x_2 are the second order...).

2. Plot x_m as function of m and try to fit a curve from the points. From the slope, deduce d , the opening length of the slit.
3. Deduce d , using the Bragg's law : $d \sin \theta = m\lambda$. Is the answer coherent with the chosen slit ?
4. Choose a different slit and repeat the experiment. What is happening to the diffraction pattern?
5. Replace the slit with one of your hair, what do you observe for the diffraction pattern. What is the size of your hair?

4 Experiment 3: Double slit

4.1 Preparation

- Replace the simple slit by the double slit experiment.

4.2 Manipulation

1. Measure the distance of the interference pattern Δx .
2. Deduce the distance between the two openings e using the interference formula.
3. Repeat the manipulation with a different distance e . Are the values coherent?