Apparatus Competition
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Ann Arbor, MI

Diffraction Demo

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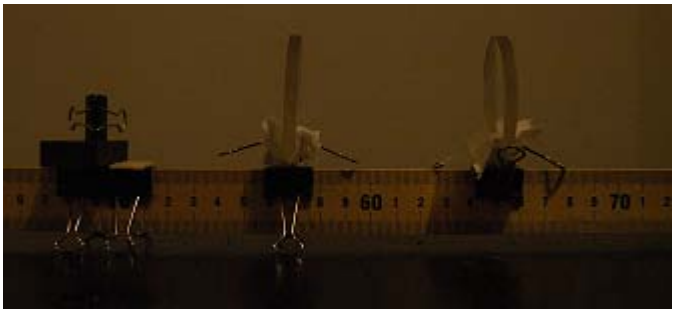
Abstract

A ruler, green pointer laser, binder clips, and two lenses are used to create an apparatus which demonstrates various diffraction patterns. These diffraction patterns demonstrate how light 'bends' around barriers, and how light interferes to create bright and dark fringes.

Construction of Apparatus:



- Large binder clips are used to balance the meter stick.
- Lenses are placed in small binder clips, and sticky foam is used to attach it to another binder clip, placed on the ruler.
- A magnet is placed on top of a binder clip and above this another small binder clip. The map pin is placed on top of the binder clip.

    - Alternative: Cut the center from an index card, tape a piece of hair or thin wire over the center, and place the card in a small binder clip. Use double sided tape to attach to a binder clip on the ruler.
- Two magnets are placed under the green laser. The clip is used to press the 'on' button.
- The map pin will need to be adjusted so the pin head is in the center of the beam of light.
- Point the apparatus to a white screen or board. For best results, place the ruler about four meters from the screen.
- This will work with one lens, different focal lengths, and without any lenses. It may work with red lasers; however green produces the clearest results.

Use of Apparatus:

This apparatus is used to demonstrate different diffraction patterns, including Young's Double Slit and Poisson's Spot.

Diffraction takes advantage of the wave-theory of light. According to the Huygens-Fresnel principle light will not stop when it reaches an object. Each edge of an illuminated object is considered a new point source of light. These point sources will interfere with each other which will create bright and dark fringes. These fringes are the diffraction patterns.

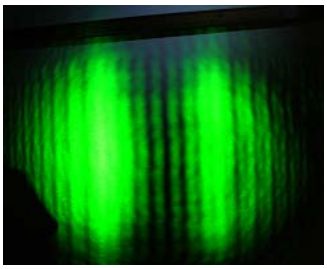
Young's Double Slit Experiment takes advantage of two slits placed close together. Light travels through both slits. Light hits the sides and diffracts or 'bends', which creates a line of dark and bright bands. This can be described by

$$\frac{n\lambda}{d} = \frac{x}{L}$$

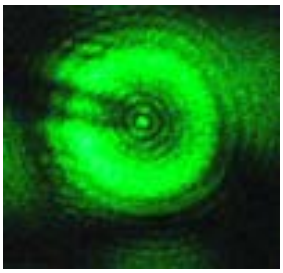
where n is the band observed (where the center is 0), λ is the wavelength of light, d is the distance between the slits, x is the distance between the center and the band observed, and L is the distance from the slits to the screen.

According to Babinet's principle, an opaque object will produce the same diffraction as a hole of the same size. This means that a piece of hair or a thin piece of wire will produce the same diffraction patterns as a slit of the same width. The diameter of the hair or wire will be the value for'd' in the equation for Young's double slit.

The use of a map pin creates a pattern known as Poisson's Spot. Light diffracts around the spherical head and creates rings in the pin's shadow, as well as a central bright spot.



Diffraction due to a wire.



Diffraction due to a map pin.

Cost:

Item	Number	Unit Cost	Total Cost	Source
Green Laser	B001AAVVM0	$13.00	$13.00	www.amazon.com
Magnets	CB60NMAG	$0.20	$0.60	www.themagnetsource.com
- 20 cm lens	B001D7E9QA	$5.00	$10.00	www.amazon.com
large binder clips		$3.19	$3.19	www.officedepot.com
small binder clips		$2.99	$2.99	www.officedepot.com
Double Sided Foam		$3.19	$3.19	www.officedepot.com
Map Pin/Tack	866060	$3.29	$3.29	www.officedepot.com

Other Supplies:
Napkin, paper towel, or paper
Meter stick
Hair
Index card
Tape
White screen, paper, or board