Diffraction of laser light

This demonstration shows that a beam of light is diffracted as it passes around a wire, highlighting the wave nature of light.

Teaching notes

We may talk casually about 'light waves', but students need to be convinced that light travels as a wave. This demonstration shows it.

Students will need to be familiar with two ideas: that waves diffract as they pass around an obstacle, and that waves interfere constructively and destructively when they overlap. These ideas can be shown using a ripple tank.

You can show diffraction and interference of light using single, double or multiple slits. However, students may find these difficult to appreciate. Diffraction by a simple wire is a more straightforward situation to explain. Students can also be asked to predict what will be seen on the screen when the wire is placed in the path of the light beam. They will probably expect to see a vertical shadow. The appearance of a diffraction pattern spread across the screen is a surprise worth exploring.

A laser is used because it is a convenient source of a narrow beam of light. It has the added advantage that it produces light of a single wavelength; white light would produce a similar effect but the diffraction pattern would not be as wide as different wavelengths (colours) would interfere at different points.

It is worth emphasising the extent to which light is diffracted as it passes around the wire. The diffraction pattern may be 50 cm wide when the diffracting wire is one metre from the screen. So light is being diffracted (bent) through an appreciable angle – perhaps 20 degrees.

You could investigate the effect of rotating the wire; can students predict what will happen? (A vertical wire produces a horizontal diffraction pattern; a horizontal wire will produce a vertical pattern.)

Equipment

- Laser pointer (or other laser source)
- Thin, straight wire, approx 25 cm
- Stand with 2 clamps
- Screen

Notes:

1. You will probably need to work in a darkened room.
2. A green laser works best as the human eye is most sensitive to green light.

Safety

Care should be taken to ensure that the laser beam does not shine directly into students' eyes. This can be avoided by fixing it firmly in a clamp directed away from the students and towards the screen. Ensure that there are no shiny, reflective objects close to the path of the beam.

Links

A sequence of experiments to show the diffraction of light and how this can be used to determine the wavelength of light:

http://www.practicalphysics.org/go/Collection_20.html

Credits

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