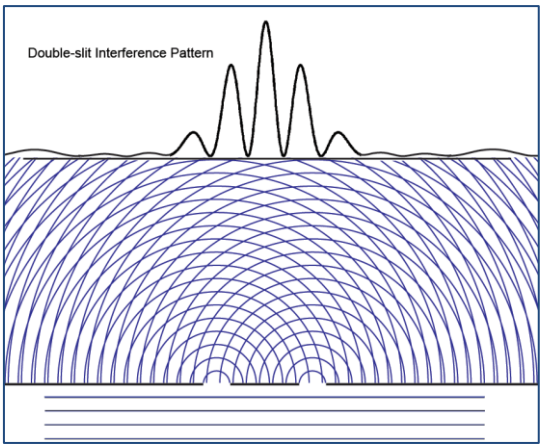
Young's double slit experiment.



Aim

To investigate the interference of light through two parallel slits as a wave-like behaviour.

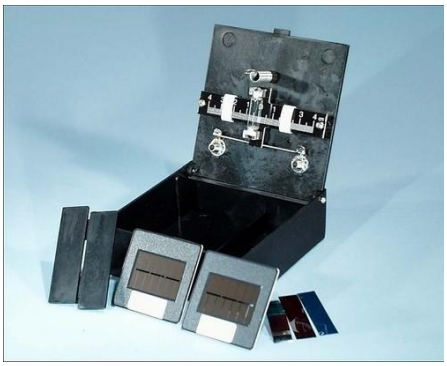
Background Theory

In 1801 Thomas Young obtained evidence of the wave nature of light. Light from a single source falls on a slide containing two closely spaced slits. If light consists of tiny particles, we would expect to see two bright lines on a screen placed behind the slits. But Young observed a *series* of bright lines. He was able to explain this result as a **wave interference phenomenon**. Because of diffraction, the waves leaving the two small slits spread out from the edges of the slits. This is equivalent to the interference pattern of ripples produced when two rocks are thrown into a pond.

In general, the distance between slits is very small compared with the distance from the slits to the screen where the diffraction pattern is observed. The rays from the edges of the slits are essentially parallel. Constructive interference will occur on the screen when the extra distance travelled by the rays from one slit is a whole number of wavelengths different from the distance travelled by rays from the other slit. Destructive interference occurs when the difference in the distance travelled is an odd number of half-wavelengths.

Equipment

- diffraction kit (lamp, scale and terminals)
- power source and leads
- photographic slide set of double slits of various widths
- coloured filters (red, blue and red/clear/blue)



Method

1. Open and raise the lid of the diffraction kit. Set it vertically so that when you are standing 2 metres away you are directly viewing the inside face of the lid.
2. Using a pair of leads, connect the terminals on the lid to an AC/DC power source set at 8 volts.
3. Look at the line of the vertical filament. If it has any curvature, rotate the globe in its holder until the filament appears as close to a straight line as possible when viewed from the front.
4. From a distance of 2 metres, view the filament through the double slit photographic slide (cover the unused slits with both thumbs), holding the slide close to the eye and keeping the slit parallel to the filament. You can use the white slide markers on the scale as indicators for the spread of the first dark band. Record your observations.
5. Repeat step 4 using different slit widths.
6. Repeat step 4 using coloured filters.

Data and analysis

Describe and draw the patterns observed on a blank piece of paper. Keep in mind the discussion questions you will need to answer when recording data.

Discussion questions

1. If light were not a kind of wave but a stream of particles, what pattern would you expect to see?
2. What happens to the diffraction pattern as you move closer to and further from the filament?
3. Comment of the patterns observed during the experiment. How did the pattern change as the slit separation was increased?
4. How does the diffraction pattern change when using the coloured filters?

Conclusions

(Comment on the patterns observed. Do they confirm that diffraction occurs for light? Does this confirm or contradict the wave model of light?)

Write up your experiment and results in your Interactive notebook.