

Lloyd's experiment using water waves

Objects of the experiment

- Investigating interference of circular water waves using the waves reflected at a straight barrier.
- Comparing the interference image with that of two-beam interference.

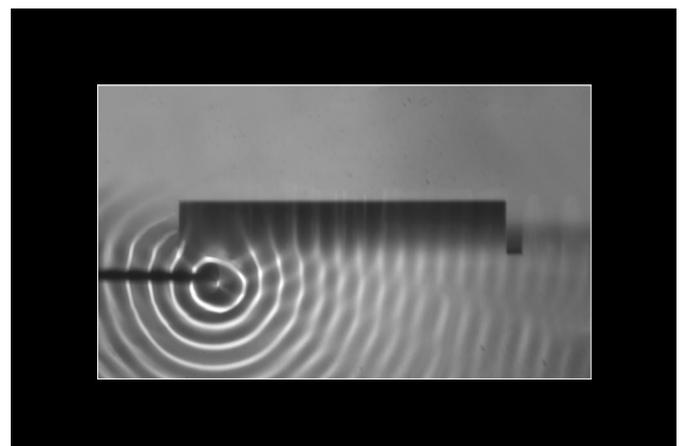
Principles

In 1837, *Lloyd* first described an interference experiment in which a second light source coherent to the first was produced by means of reflection. To do this, he caused a part of the light beam to fall at a near glancing angle on a mirror and superposed the reflected light on the direct light.

This experiment can also be carried out using water waves by setting up a point-type exciter at a suitable distance from a reflecting barrier. The result is an interference pattern which is equivalent to that obtained for two-beam interference with two coherent individual exciters (see "Two-beam interference of water waves" (P1.6.5.1))

This equivalence becomes particularly clear when a second point-type exciter is placed at the imaginary location of the mirror image of the first exciter.

Fig. 1 Investigating interference of circular water waves using the waves reflected at a straight barrier (photograph)



Apparatus

1 Wave trough with motor stroboscope 401 501

additionally required:

Dish soap

Setup

Set up the experiment as shown in Fig. 2.

- Set up the wave trough so that it is not subject to shocks and vibrations; observe all information given in the Instruction Sheet.
- Connect two point-type exciters for double excitation 8 cm apart.
- Raise one of the point-type exciters out of the water using adjusting screw (h).
- Place the reflecting barrier in the middle of the wave tank parallel to the long side of the tank (see Fig. 3).

Carrying out the experiment

- If necessary, rotate the stroboscope disk out of the beam path using knurled screw (f) so that the glass pane in the bottom of the wave trough is completely illuminated.
- Using knob (e), set a frequency of approx. 25 Hz, and carefully increase the excitation amplitude using knob (d) until wave fronts are clearly visible (see Instruction Sheet for wave trough).
- Vary the immersion depth as necessary with adjusting screw (h).

- Observe the position and number of interference maxima and minima.
- Re-insert the second wave exciter in the water at the mirror point of the first excitation center and observe the interference image on both sides of the reflecting barrier.
- If necessary, adjust the immersion depths with adjusting screws (h) until the interference patterns on both sides of the reflecting barrier are identical.
- Carefully slide the reflecting barrier length-wise and remove it from the wave trough. Observe the changes in the interference pattern.

Note: The change in the position of the interference hyperbolas can be observed particularly clearly by continuously decreasing or increasing the frequency.

Measuring example

Fig. 1 shows a photograph as the measurement example.

Results

The interference pattern which is formed by superposing circular waves with the waves reflected from a straight barrier correspond to one half the interference image created using a double exciter.

When exciters are operated on both sides of the reflecting barrier, the interference pattern corresponds to that of the double exciter, even though the circular waves of the two exciters cannot influence each other.

The minima and maxima of the interference pattern lie on hyperbolas with the exciter center and its mirror image as the focal points, just as for two-beam interference.

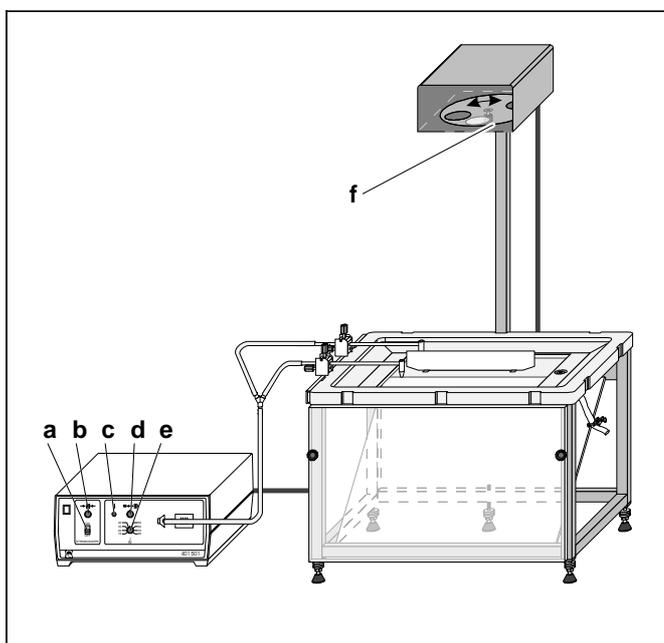


Fig. 2 Setup for Lloyd's experiment

- a Stroboscope switch
- b Knob (for fine adjustment of stroboscope frequency)
- c Pushbutton (single-wave excitation)
- d Knob (for adjusting amplitude of wave excitation)
- e Knob (for adjusting frequency of wave excitation)
- f Knurled screw (for manually turning stroboscope disk)

Fig. 3 Connecting the double exciter and setting up the reflecting barrier

- h Adjusting screws (for setting immersion depth)

