Diffraction and interference at the double slit

(Item No.: P1121101)

Curricular Relevance

Area of Expertise: Physik | **Education Level:** Klasse 10-13 | **Topic:** Mechanik | **Subtopic:** Schwingungen und Wellen | **Experiment:**

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	20 Minutes	2 Students

Additional Requirements:

Experiment Variations:

Keywords:

Introduction

Overview

A characteristic interference pattern can be observed behind a double slit at which plane waves meet. This interference pattern corresponds to the one obtained with two point wave generators located at the slits.

Material

From the accessory set 11260-12 (included in 11260-88):

Position No.	Material	Order No.	Quantity
1	Holder for plane wave generator		1
2	Plane wave generator		1
3	Barrier l = 10 mm		1
4	Barrier l = 30 mm		1
5	Barrier l = 71 mm		1

Method

Plane waves meet at a double slit. The width of the two slits is chosen is small compared to the wave-length, so that no interferences are possible within the waves passing through a slit.

The interference pattern is observed in the area behind the slits at different slit spacings and different wavelengths.

Set-up and procedure

Set-up

The plane wave generator is fixed to the internal exciter unit and is placed on the bottom edge of the rip-ple tank. A double slit is set up in the wave tray as shown in Fig. 1 with the help of the two 71 mm long obstructions and the 30 mm long obstruction. The slits should be roughly the same size.

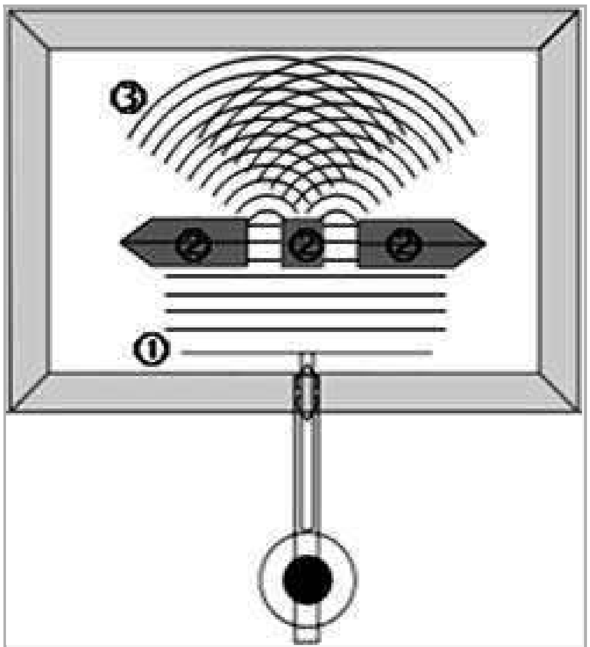

Figure 1: Arrangement for diffraction and interference at the double slit. The wave front produced by the planar wave generator (1) hits the double slit formed by the three barriers (2). Circular waves are emitted from both slits, which interfere behind the slits (3).

Procedure

The wave generator is carefully adjusted (see Chapter 0.1) and a frequency between 15 Hz and 30 Hz is set at the ripple tank. Initially the amplitude should be selected so that the plane waves are clearly identi-fied in front of the double slit. The amplitude is then increased until a clear interference pattern forms be-hind the double slit.

At the same frequency, the slit spacing is reduced by pushing the 30 mm barrier directly against one of the two 71 mm barriers and by placing the 10 mm barrier in the middle of the slit now created (Fig. 2).

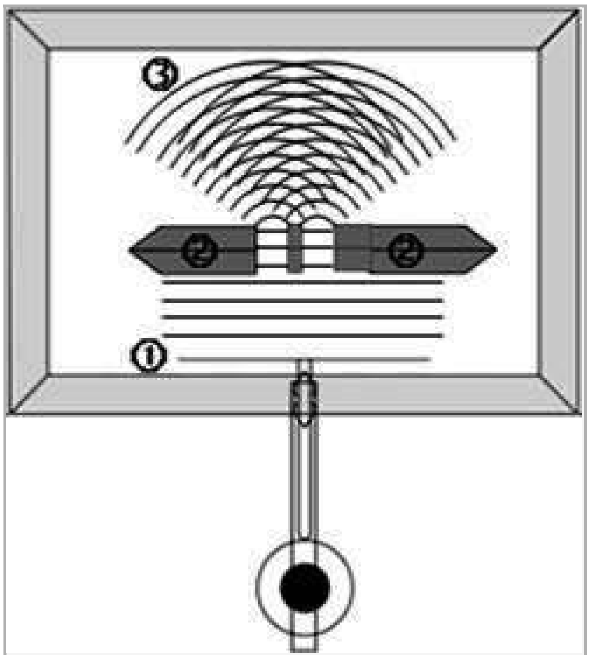

Figure 2: Experiment arrangement for diffraction at a double slit with reduced slit spacing. The wave front produced by the planar wave generator hits the double slit formed by the four barriers. Circular waves are emitted from both slits, which interfere behind the double slit.

The interference pattern is now observed and compared with the one formed with the larger slit spacing (Fig. 1).

The exciter frequency is then varied to examine the effect of the wavelength on the interference pattern.

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Evaluation and results

Results

A waveband can be seen in the middle of the image moving vertically to the slit connection line and away from it. Symmetrically to this band bands without wave generation alternate with clear, marked wavebands (Fig. 3).

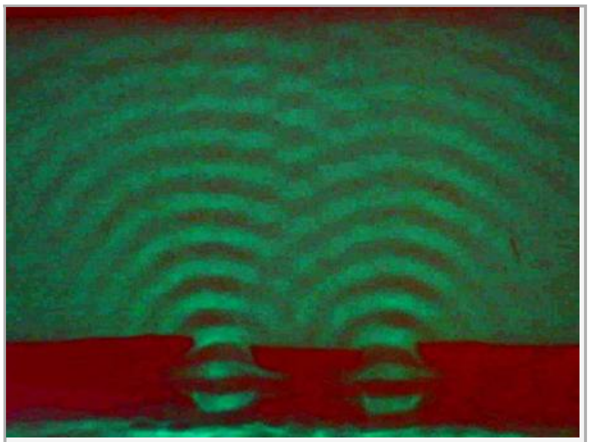

Figure 4: Snapshot as shown in Fig. 1. The circular waves emanating from both slits and which interfere behind the double slit can be clearly identified.

If the slit spacing is reduced while the wavelength remains constant, the distance between the middle of the adjacent wavebands increases (Fig. 4). This phenomenon can also be clearly seen in a comparison of Figures 1 and 2. The same effect is also achieved if the wavelength is increased while keeping a constant slit spacing.

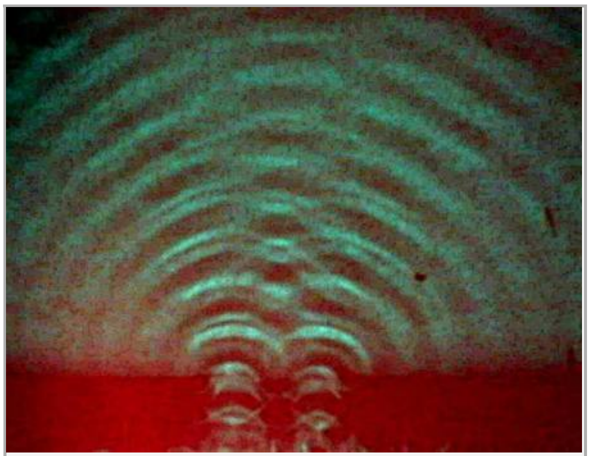

Figure 5: Snapshot as shown in Fig. 2. The circular waves emanating from both slits and their interference behind the double slit are clearly seen. Compared to Fig. 4 it can be seen that the distance between the two wave-bands has increased.

Interpretation

The two slits are exciter centres of two circular wave trains. The reason for this is Huygen's principle. These wave trains interfere in the area behind the slits in the same way as the wave trains produced by two point wave generators (see OW 3.2).

Note

The diffraction at the double slit is not observed in such a pure form if the experiment is carried out with light waves. In optics, slit widths which are a multiple of the wavelength are used for intensity reasons. Therefore, the interferences of the waves emanating from the various single slit locations are superimposed on the interference pattern of the double slit (see OW 4.1).