Polarization by filters

Set-up and procedure

Information for teachers

Additional Information

During the investigations on interference the students should have understood that certain optical phenomena can only be explained by the fact that light has wave properties. Now we must investigate the nature of these light waves, i.e., whether they are longitudinal or transverse.
This experiment is suitable as an introduction to polarization and is not time-consuming. Setup and performance do not pose any problems.

Suggestions for Set-up and Performance

Conveniently, this experiment can be carried out in a semi-darkened physics lab. This will suffice for the students to recognize that crossed filters completely annul a light beam transmitted through them. The properties of real filters will be dealt with at a later point.
In the students' instructions we have specified that at the beginning of the experiment the two filters are not crossed. In this way we have tried to ensure that the rotation angles to be determined by the students are really the angles by which the transmission axis of the filters differ.

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Polarization by filters

Set-up and procedure

Task

Are light waves longitudinal or transverse?

Direct a beam of light through two polarization filters and investigate what happens when these are rotated at right angles to each other.

Student's Sheet

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Equipment

Position No.	Material	Order No.	Quantity
1	Light box, halogen 12V/20 W	09801-00	1
2	Bottom with stem for light box	09802-10	1
3	Support base, variable	02001-00	1
4	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	2
5	Meter scale for optical bench	09800-00	1
6	Lens on slide mount, f=+100mm	09820-02	1
7	Slide mount for optical bench	09822-00	1
8	Mount with scale on slide mount	09823-00	2
9	Screen, white, 150x150mm	09826-00	1
10	Polarising filter, 50 mm x 50mm	08613-00	2
11	Diaphragm holder, attachable	11604-09	2
12	PHYWE power supply DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

Task and equipment

Set-up and procedure

- Set up the optic bench with the two support rods and the support base and place the scale in position (Fig. 1 and Fig. 2).

Fig. 1

Fig. 2

- Assemble the light box according to Figures 3 and 4 and clamp it into the left part of the support base with the lens end pointing away from the optic bench (Fig. 5). Insert a light-tight diaphragm into the well in front of the lens (Fig. 6).

Fig. 3

Fig. 4

Fig. 5

Fig. 6

- Position the screen with a slide mount at the right-hand end of the optic bench (Fig. 7) and lens at approx. 6 cm.

Fig. 7

- Connect the light to the power supply (12 V~) and swith on the power supply (Fig. 8).

Fig. 8

- Insert the polarization filters into the two diaphragm holders and attach these to the scale mounts so that the markings are positioned above the zero points of the scales (Fig. 9).

Fig. 9

- Place one of the mounts with the polarization filter at approx. 20 cm on the optic bench (Fig. 10) and compare the brightness of the light spot on the screen before and after attaching the filters; note your observation in the report (Result - Observations 1).

Fig. 10

- Turn the filter through 90° and back again to 0°; observing the light spot all the while. Note your observation in the report (Result - Observations 2).
- Position a second mount with a polarization filter (known as analyzer, whereas the filter through which the light passes first is known as polarizer) at approx. 30 cm on the optic bench, making sure that the light spot on the screen remains visible; if this is not the case, remove either the polarizer of the analyzer from its mount, rotate through 90° and replace in mount;

the setup is now complete (Fig. 11).

Fig. 11

- Slowly rotate the diaphragm holder with the analyzer until a rotation angle of 90° (visible on the scale) has been reached; during this process observe the brightness of the light spot constantly and note your observation in table 1 in the report.
- Rotate the analyzer further than 90° until it reaches its original position; note your observation in table 1 in the report.
- Finally, rotate the polarizer, leaving the analyzer in its position. Note what you observe in the report (Result - Observations 3).
- Switch off the power supply.

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Report: Polarization by filters

Result – Observations 1

Compare the brightness of the light spot on the screen before and after attaching the filters:

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Result – Observations 2

Note down your observation during the turning of the filter:

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Student's Sheet

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Result – Table 1

Complete the table using "very bright", "bright" or "dark":

Rotation angle in °	Lightspot
0	very bright 1
45	bright 1
90	dark 1
180	very bright 1
270	dark 1
360	very bright 1

Result – Observations 3

Note down your observation during the rotation of the polarizer (polarization filter):

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Evaluation – Question 1

Summarize the results of your observations.

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Evaluation – Question 2

How can we interpret these observations?

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Evaluation – Question 3

Try to explain how a polarization filter (polarizer) works.

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