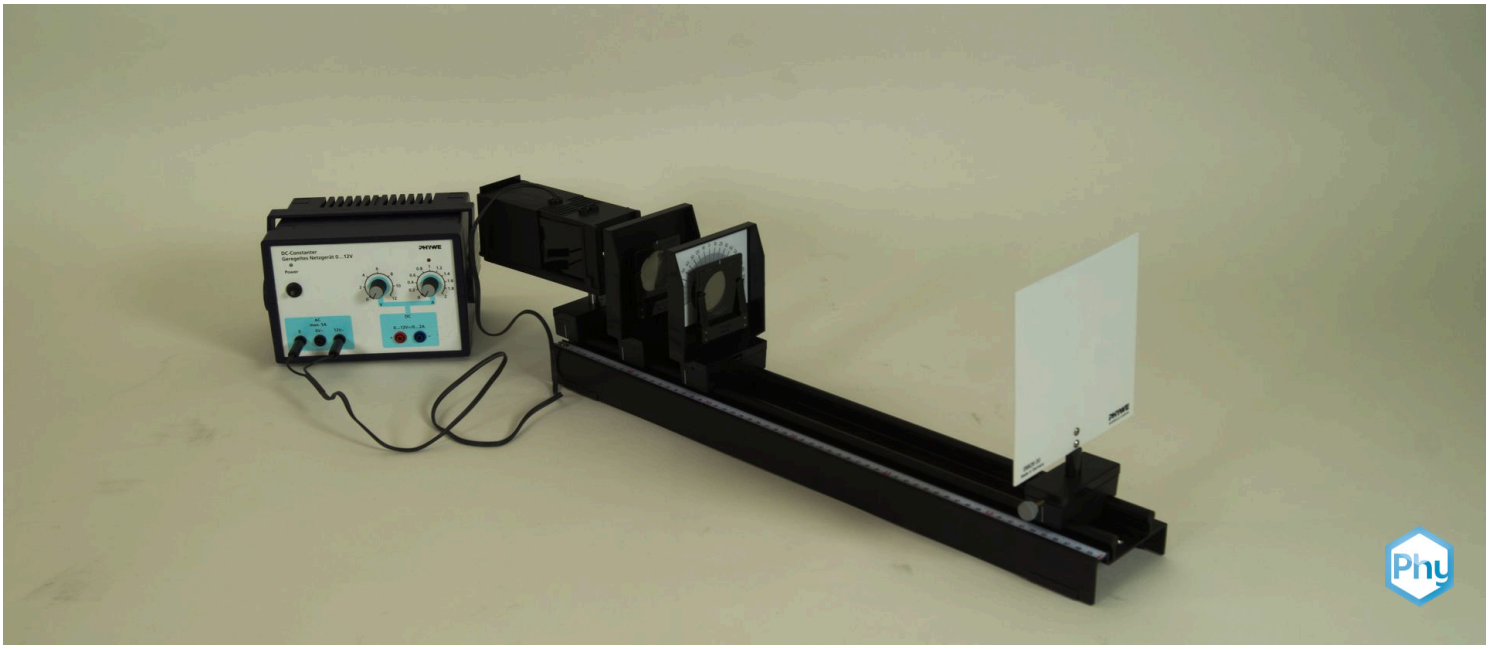
Polarisation with filters



Physics | Light & Optics | Wave properties of light

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/62e4ed5d932bae00030ac524

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Teacher information

Application

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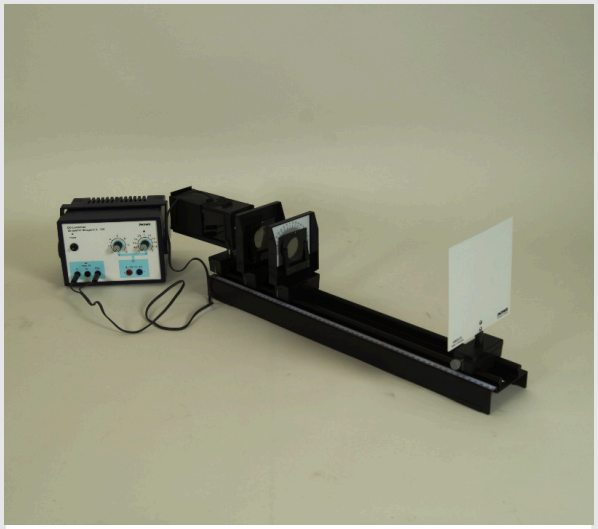

Experimental setup

Polarisers filter electromagnetic waves that have a certain polarisation. You can use polarisers to create linearly polarised light or to filter out interfering light sources that arise, for example, from unwanted reflections when taking photographs.

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Other teacher information (1/3)

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Principle

The function of a polarising filter is based on the absorption of one component of the light, while the other component is almost exclusively transmitted. The absorption depends on the direction of polarisation relative to the optical axis, i.e. one can determine the polarisation by rotating the filter.

Learning objective

Students should observe the optical effect of a polarising filter and deduce that light (in classical physics) is transverse waves.

Other teacher information (2/3)

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Task

Have the students send a beam of light through two polarising filters and investigate what happens when they are turned against each other.

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Other teacher information (3/3)

- After it was shown in the physics lessons during the treatment of interference that there are phenomena that can only be explained within the framework of classical physics if the wave character of light is assumed, the question of whether these are longitudinal or transverse waves is pursued.
- The result of this experiment, which takes little time and is easy to perform, confirms that light waves must be transverse waves.

Safety instructions

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- The general instructions for safe experimentation in science lessons apply to this experiment.

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Student information

Motivation

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Polarising filters in photography

Polarisation filters (polarisers) filter electromagnetic waves (e.g. light) that have a certain polarisation. One can use polarisers to produce linearly polarised light or to filter out interfering light sources that arise, for example, from unwanted reflections when taking photographs. In addition, polarisation filters are used for liquid crystal displays, which are often installed in computer monitors and mobile phones.

How does a polarising filter work?

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Tasks

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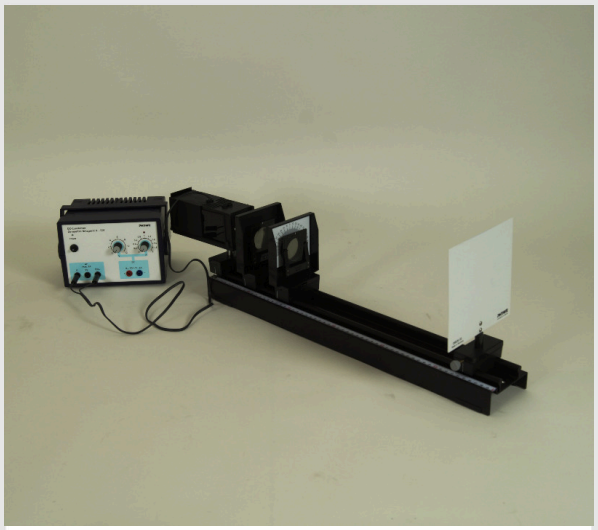

Experimental setup

Send a beam of light through two polarisation filters and investigate what happens when they are turned against each other.

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Equipment

Position	Material	Item No.	Quantity
1	Optical profile-bench for student experiments, l = 600 mm	08376-00	1
2	Light box, halogen 12V/20 W	09801-00	1
3	Bottom with stem for light box	09802-20	1
4	Lens on slide mount, f=+100mm	09820-02	1
5	Slide mount for optical bench	09822-00	2
6	Mount with scale on slide mount	09823-00	1
7	Screen, white, 150x150 mm	09826-00	1
8	Diaphragm holder, attachable	11604-09	2
9	Polarising filter, 50 mm x 50mm	08613-00	2
10	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

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Set-up (1/3)

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- Assemble the optical bench from the two tripod rods and the variable tripod base.

Set-up (2/3)

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- Place the base with the stem under the light box and clamp it into the left part of the tripod base so that the lens side faces away from the optical bench.

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Set-up (3/3)

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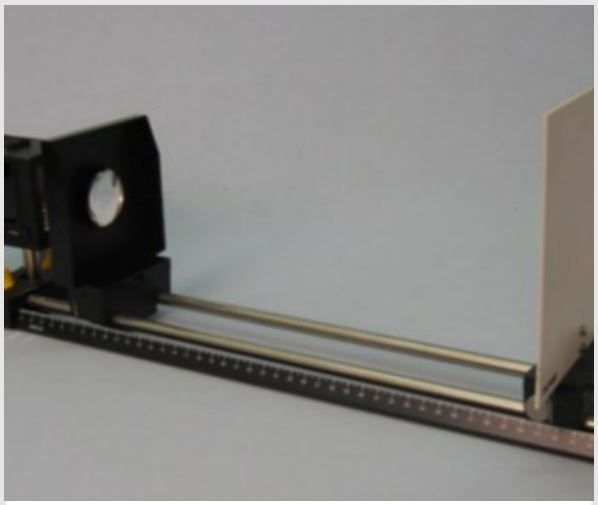

Optical bench with luminaire, lens, aperture and shade

- Slide an opaque screen in front of the luminaire lens.
- Place the shade at the right end and the lens about 4 cm away from the lamp on the optical bench.

Procedure (1/3)

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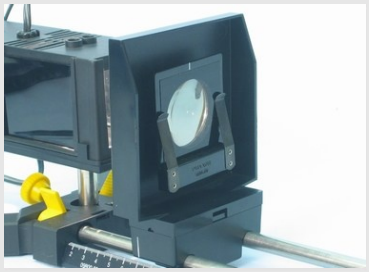

- Connect the lamp to the power supply unit (12 V~).
- Slide a polarising filter (the polariser) into an aperture holder and place it on the rim of the lens.

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Procedure (2/3)

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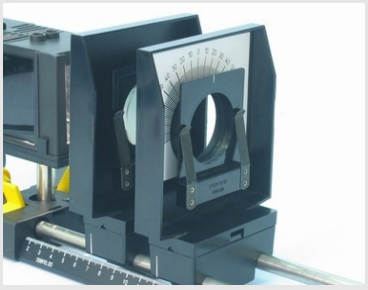

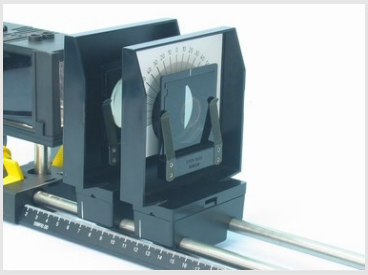

- Place the holder with the scale on the optical bench at a distance of about 5 cm from the lens and put the second aperture holder on top of it.
- Slide the second polarising filter (the analyser) into this aperture holder and make sure that the light spot is still visible on the screen. If this does not happen, turn the polariser 90°.

Procedure (3/3)

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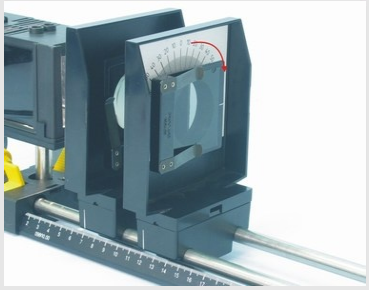

- Now slowly rotate the last aperture holder until the angle of rotation, which can be read on the scale, reaches 90°. Pay attention to the brightness of the light spot.
- Turn the aperture holder beyond 90° until it has reached its initial position. Note down your observations in Table 1 in the report.
- Finally, turn the filter on the lens and don't move the other one. What do you notice? Write down your observations.
- Switch off the power supply unit.

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Report

Table 1

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Describe the light spot qualitatively and note in the third column at which angle of rotation the light spot is identical.

Rotation angle	Light spot	angle of rotation
0°		
45°		
90°		
135°		
180°		
270°		
360°		

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Task 1

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What do you observe when you turn the polarising filter on the lens?

- ☐ The observations are the same as before.
- ☐ At a rotation angle of 90°, the light spot is dark.
- ☐ The light spot changes its shape.

Check

Task 2

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Summary of observation (fill in the missing words):

When the polarisation filters are rotated from 0° to [ ]° against each other, less and less [ ] can pass through. At the [ ] 90°, the incident light is erased. The observations can be explained by the fact that the [ ] has the character of transverse waves. Only portions of the light that have [ ] planes of vibration pass through any [ ]. The light that has already passed through one polarising filter can therefore no longer pass through the other if the two filters are crossed by [ ]° with respect to each other.

Check

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Slide	Score / Total
Slide 19: Rotation of the filter	0/2
Slide 20: Summary of the observation	0/7

Total 0 / 9

Solutions | Repeat | Export text

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