

Linear polarisation

Task and equipment

Information for teachers

Additional Information

Because the photo-electric current of the solar cell depends very much on the intensity of the incident light, care must be taken that the distance between the lamp and the solar cell is not altered during the course of the experiment. Furthermore, the measurement is more precise the less stray light is able to fall onto the solar cell.

Linear polarisation

Task and equipment

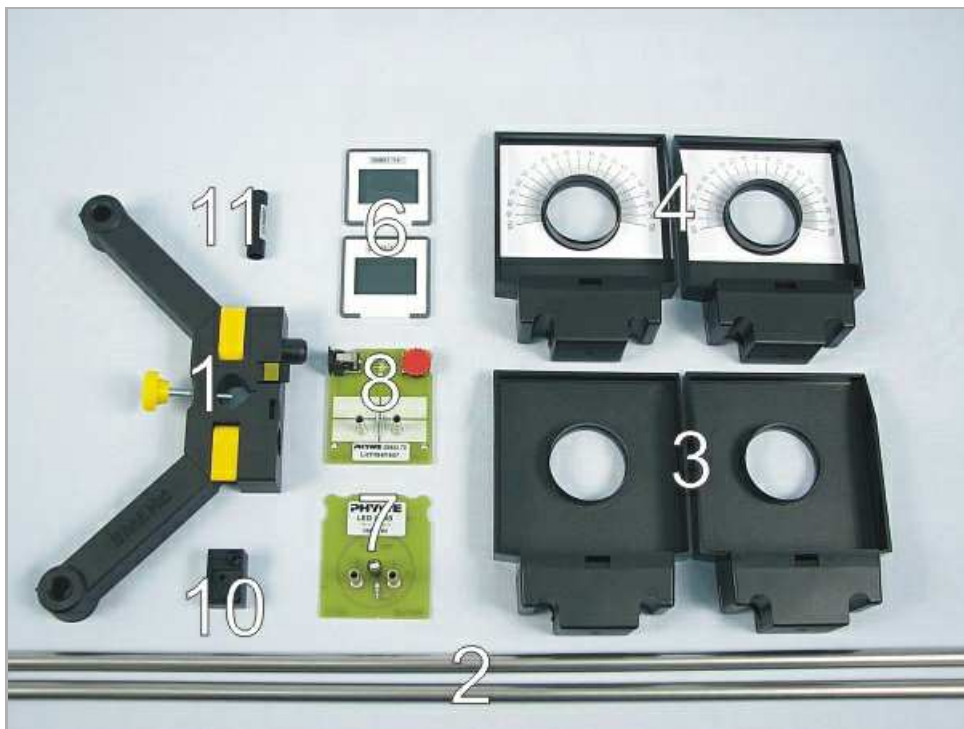
Task

How does light vibrate?

Light is an electro-magnetic transverse wave, which means that it vibrates at right angles to the direction of propagation. If the light is reflected by a glass pane it is polarised i.e. the degrees of freedom of the vibration are restricted and the wave then only vibrates in a single direction. If such polarised light falls onto a polarisation filter only allowing light through in one particular direction of vibration, the intensity of the light is attenuated or even blocked completely. Determine the dependency on the angle of the transmission of a polarisation filter by means of a photodiode. Determine the relationship between the angle of polarisation and the intensity of the transmitted light.



Equipment



Student's Sheet

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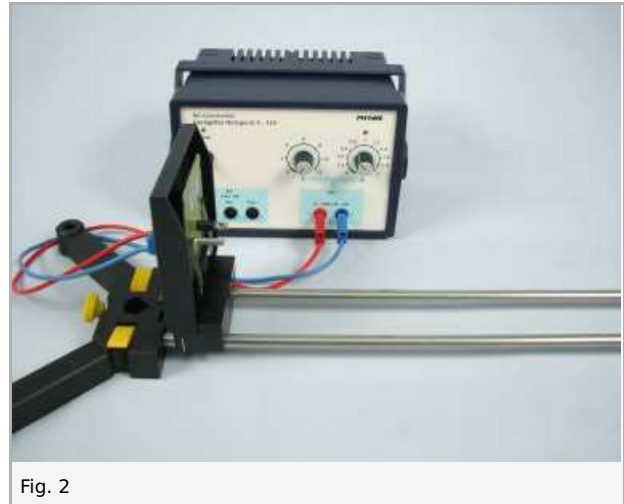
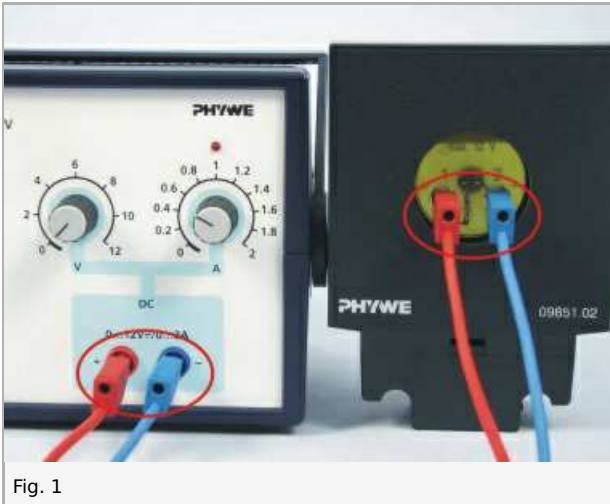


Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	2
3	Slide mount without angle scale	09851-02	2
4	Mount with scale on slide mount	09823-00	2
5	Diaphragm holder, attachable	11604-09	4
6	Polarisation filter, in slide frame, glassless	09851-14	2
7	LED - white, with series resistor and 4 mm plugs	09852-60	1
8	Light sensor with amplifier, adjustable	09852-70	1
9	Power supply, 5 V DC	09852-99	1
10	Stray light tube	09852-71	1
11	Stray light tube for LED, Di = 8 mm, l = 40 mm	09852-01	1
Additional material			
12	PHYWE power supply DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
13	DMM with NiCr-Ni thermo couple	07122-00	1
	Connecting cord, 32 A, 750 mm, red	07362-01	2
	Connecting cord, 32 A, 750 mm, blue	07362-04	2

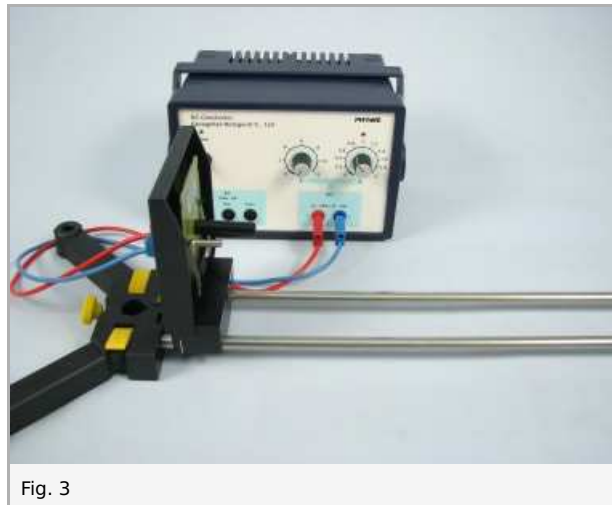
Set-up and procedure

Set-up

- For carrying out this experiment it is necessary for the room to be darkened.
- Insert the light emitting diode into an object holder as shown in figure 1.
- Connect the LED to the direct current source. Ensure that the poles are connected correctly!



- Fit the stray light tube over the LED.



- Now also insert the photodiode into an object holder.
- Fit the stray light tube over the photodiode.



Fig. 4



Fig. 5



Fig. 6



Fig. 7

- Connect the multimeter as a voltage meter (measuring range: 20 V) to the photodiode.

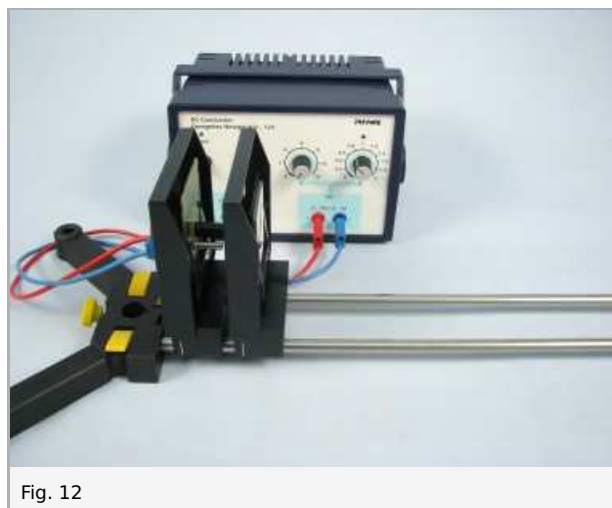


Fig. 8

- Place each of the two polarisation filters into an object holder with an angle scale and set them to 0°.



- Place the object holder with the first polarisation filter onto the optical bench so that the filter almost makes contact with the tube of the LED.



- Place the second polarisation filter as close as possible to the first one.



Fig. 13

- Place the photodiode onto the optical bench directly behind the 2nd polarisation filter.



Fig. 14

Procedure

- Turn the control for the amplification of the photodiode in the clockwise direction up to the stop (maximum amplification).



Abb. 15

- Set both polarisation filters to 0°!
- Adjust the LED voltage so that the photodiode operates in the sensitive range and is not overamplified. (The maximum measuring value is approx. 3.9 V - the LED should be adjusted so that the measured value is just below this and the photodiode can react both upwards and downwards).

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- Record the value measured at the photodiode in table 1.

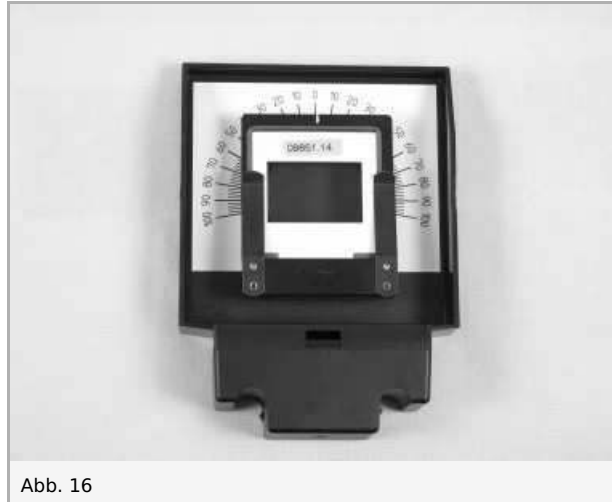


Abb. 16

- Rotate the second polarisation filter (the one closer to the photodiode) in 10° steps clockwise until 100° is reached; record the voltage value at the photodiode in table 1.

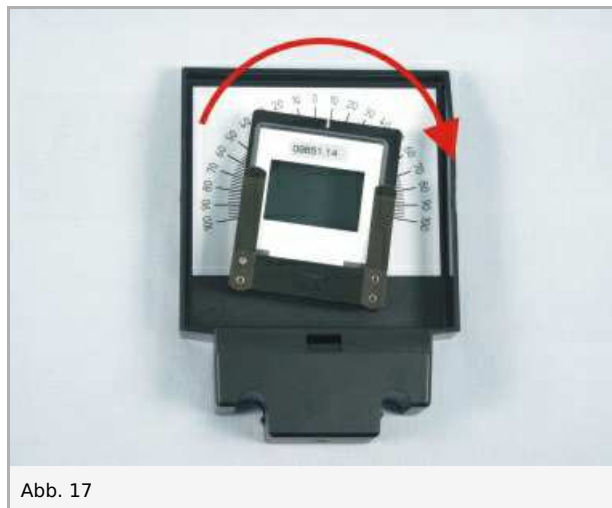


Abb. 17

- Then the two polarisation filters are reset to 0° and rotated in 10° steps until 100° is reached. The measured values are again recorded.

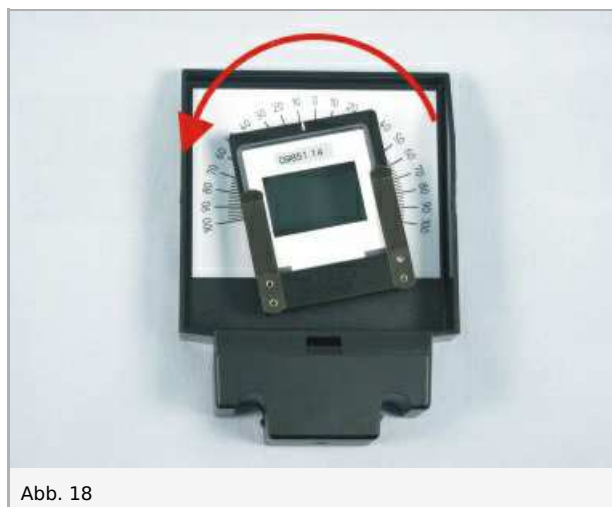


Abb. 18

Note

- In order to prevent imprecision when the angles are set, the object carrier is removed from the rail for adjusting the angle.
- While the experiment is being carried out, the distance between the LED and the photodiode must not be altered. The photodiode is very sensitive to any change in the distance and this would falsify the measured values!

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Report: Linear polarisation

Result - Table 1

Supplement the table 1 with the voltage at the photodiode.

Note: The positive rotations are in case that the first filter is turned right. The negative rotations are in case that the first filter is turned left. The filter is on 0° if the rotations have the value 0° .

Rotation / °	Voltage at the photodiode / V	
0	3.931	1
10	3.858	1
20	3.644	1
30	3.198	1
40	2.464	1
50	1.804	1
60	1.136	1
70	0.580	1
80	0.219	1
90	0.090	1
100	0.182	1
-10	3.834	1
-20	3.567	1
-30	3.198	1
-40	2.46	1
-50	1.812	1
-60	1.146	1
-70	0.56	1
-80	0.224	1
-90	0.094	1
-100	0.182	1

Evaluation - Question 1

Determine the function of the relationship between measured voltage and rotation (see table 1).

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Evaluation - Question 2

Formulate a property of linearly polarised light.

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Evaluation - Question 3

Take one of the polarisation filters and look at a clear blue sky. Rotate the filter - what do you notice? What conclusions do you come to?

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