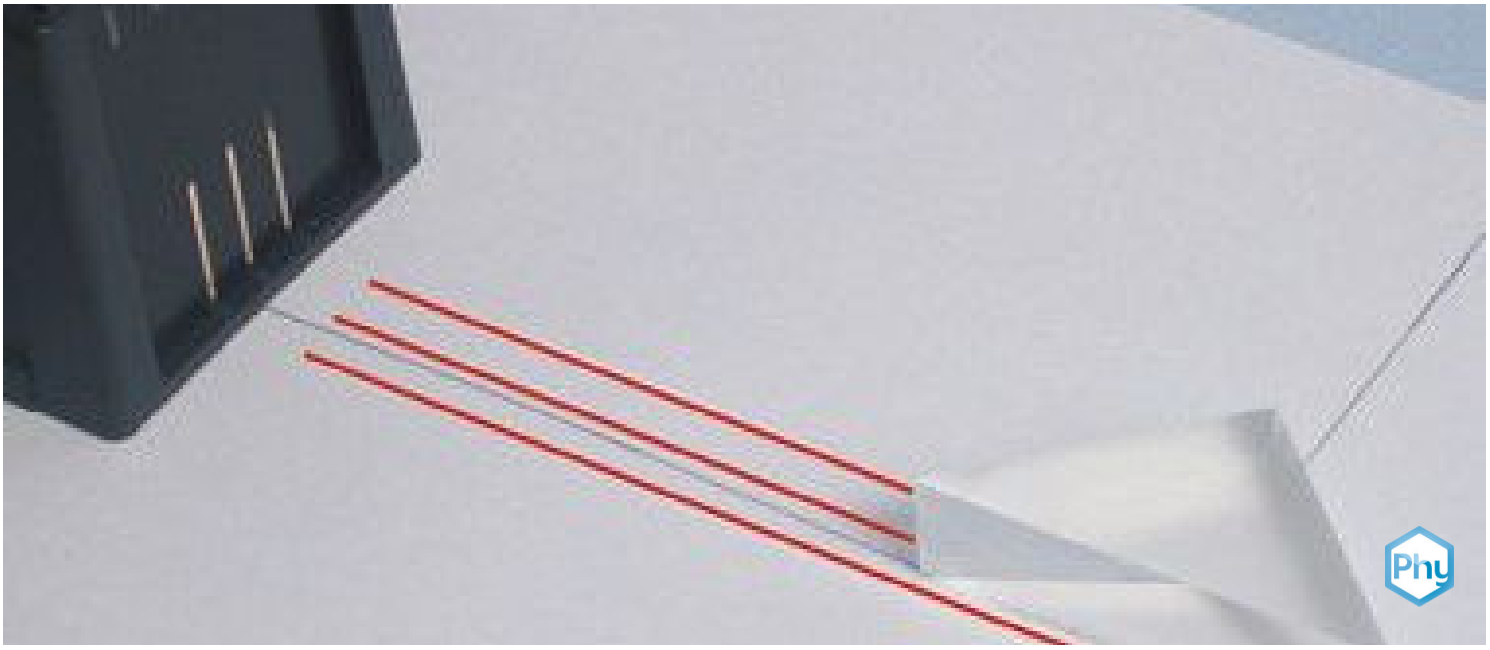
Reversing prisms



In this experiment, the students learns about another special case of the refraction of light at the prism, which is of great importance in technical applications (optical instrument construction). By examining and explaining the path of light, knowledge of the law of refraction and total internal reflection is consolidated.

Physics > Light & Optics > Reflection & refraction of light

Difficulty level	Group size	Preparation time	Execution time
medium	2	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/631b126016013c00032c6f82

PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

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Teacher information

Application

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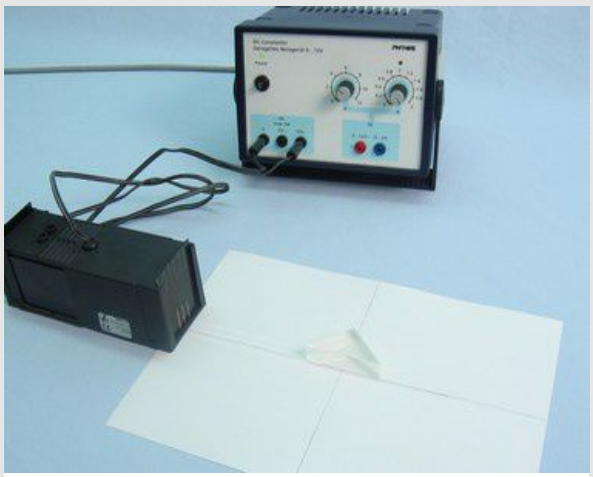

Inverted prism

An inverted prism is an optical prism. They are used, for example, in prism binoculars to make the laterally reversed and inverted intermediate images produced by the lens appear laterally correct and upright to the viewer. However, this requires two reversing prisms arranged one behind the other.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

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Other teacher information (1/4)

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Prior knowledge

Students should have previously learned the basics of straight-line propagation, reflection and refraction of light.

Principle

Narrow beams of light that strike the cathetus of a right-angled prism parallel to the hypotenuse are reversed in their order. Within the prism, the light beams are totally reflected at the hypotenuse.

Other teacher information (2/4)

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Learning objective

In this experiment, the students learns about another special case of the refraction of light at the prism, which is of great importance in technical applications (optical instrument construction). By examining and explaining the path of light, knowledge of the law of refraction and total internal reflection is consolidated.

Tasks

The students should recognise and understand the possibility of using a right-angled prism to invert light. The task is to investigate the path of two beams of light when incident parallel to the hypotenuse of a right-angled prism.

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Robert-Bosch-Breite 10
37079 Göttingen

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Other teacher information (3/4)

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Notes

If the supplementary accessories for colour mixing are available, the colour filters (09807-00) contained there can be used to colour the light path of the two light beams incident on the prism. The inversion of the light can thus be observed very well.

As it involves careful observation and marking of the light path of two intersecting beams of light, this experiment is demanding in terms of the students' abilities and experimental skills.

Other teacher information (4/4)

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Notes on set-up and procedure

A careful experimental set-up (incidence of light parallel to the optical axis) and conscientious adherence to the instructions for carrying out the experiment ensure optimal experimental success. In particular, make sure that the roughened side of the prism points downwards so that the light path inside the prism can also be observed.

The marking of the outlines of the prism in the individual parts of the experiment serves to completely sketch the light path. Difficulties may arise for the student as it is not possible to mark exactly inside the prism. Marking the places on the hypotenuse of the prism where the total reflection takes place is therefore necessary.

In this experiment, a three-slit diaphragm is deliberately used to enable a good comparison between refracted and totally reflected light beams and the unbroken light beam. This unbroken light beam can also be blanked out.

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Robert-Bosch-Breite 10
37079 Göttingen

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Safety instructions

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

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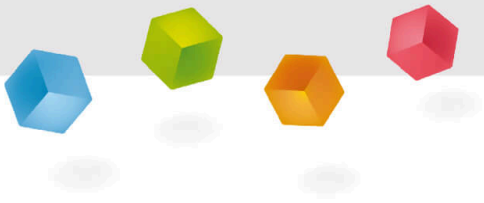

Student information

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Motivation

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An inverted prism is a reflective prism that is used to mirror the axis of a transmitted image. It exchanges two opposite sides of an image. For example, such prisms are used in reflex cameras to restore the original orientation of the image.

Light inversion in a reflex camera

Task

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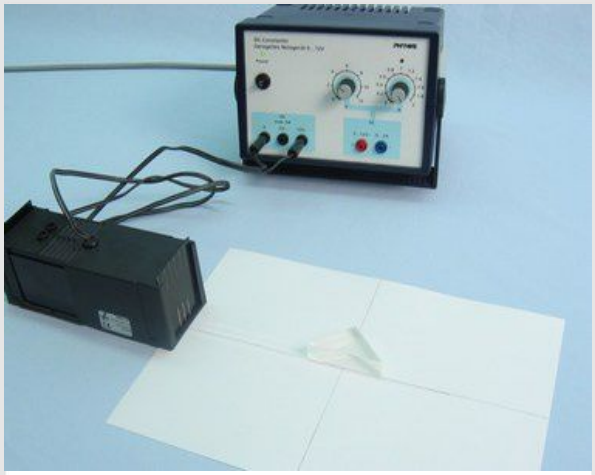

Experimental setup

An amazing prism

- Investigate the course of two light beams at incidence parallel to the hypotenuse of a right-angled prism.

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Equipment

Position	Material	Item No.	Quantity
1	Light box, halogen 12V/20 W	09801-00	1
2	Block, rectangular triangle	09810-03	1
3	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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Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
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Additional equipment

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Position	Material	Quantity
1	Ruler (approx. 30cm)	1
2	White paper (DIN A4)	1

Set-up

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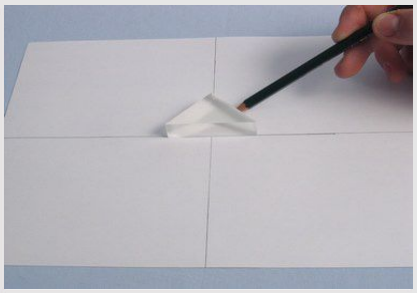
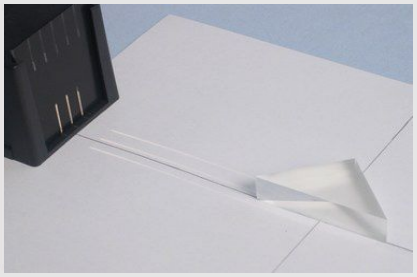
- Draw an exactly right-angled cross of lines in the middle of your paper, as shown on the right.
- Place the prepared sheet of paper across the table in front of you.
- Place the rectangular model body (roughened side down) with the hypotenuse on the horizontal line of the line cross.
- Carefully mark the outline of the prism with thin pencil strokes.
- Insert the triple slit diaphragm into the light box on the lens side and place it about 5 cm from the cathetus of the prism at the edge of the paper.





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Procedure (1/3)

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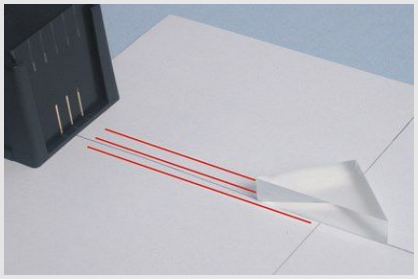
- Connect the light box to the power supply unit (12 V ~).
- Move the light box until the middle light beam is about 3 mm away from the optical axis and parallel to it. The lower light beam runs unbroken below the hypotenuse of the prism.
- Observe the course of the two narrow beams of light incident on the prism inside and outside the prism.
- Write down your observations.



Procedure (2/3)

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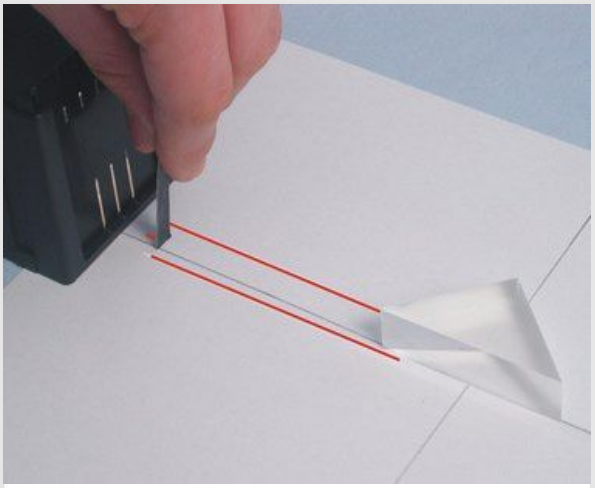
- Cover the middle beam of light in front of the prism as shown in the illustration on the right. Observe and note your results.
- Mark the course of the light beam before and after the prism with two crosses each.
- Also mark the place where this light beam meets the hypotenuse.



Covering the centre light beam

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Tel.: 0551 604 - 0
Fax: 0551 604 - 107

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Procedure (3/3)

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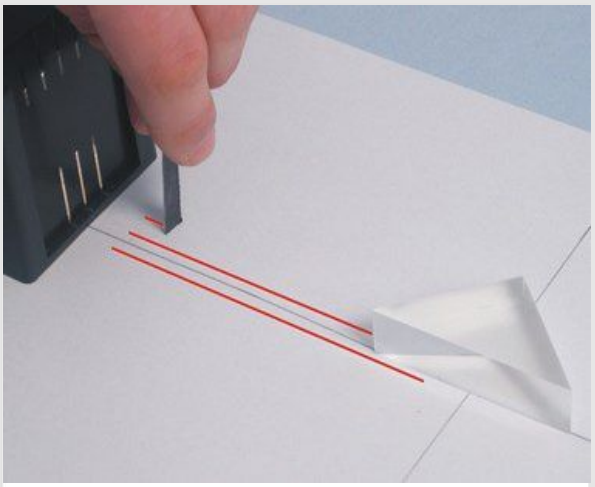

Covering of the upper light beam

- Now cover the upper light beam in front of the prism, as shown on the left.
- Observe and note your results.
- Mark the course of the light beam as before, using a different colour.
- Switch off the power supply unit.

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Report

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37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Task 1

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10°

Connect the matching crosses so that the course of the light beams becomes visible outside and, after appropriate connection, also inside the prism.

What can you say about the position of the light beams in front of and behind the prism in relation to the optical axis?

In front of and the prism, the narrow light beams diverge. Behind the prism, they run parallel to each other and parallel to the optical axis.

In front of and behind the prism, the narrow light beams run parallel to each other and parallel to the optical axis.

In front of and the prism, the narrow light beams run parallel to each other and parallel to the optical axis. Behind the prism they diverge.

Task 2

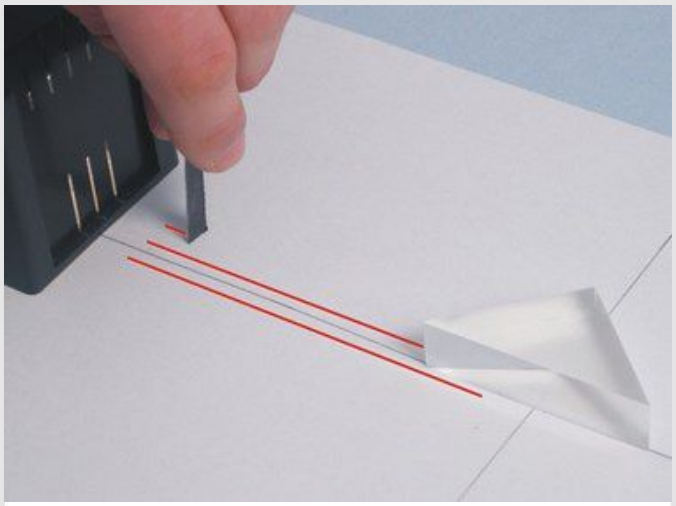
PHYWE

Consider the following sentence on the result of this experiment:

Narrow beams of light that strike the cathetus of a right-angled prism parallel to the hypotenuse are reversed in their order.

○ True ○ False

Check



upper light beam is faded out

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37079 Göttingen

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Task 3

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Which phenomenon occurs inside the prism? Fill in the blanks.

Inside the prism, the narrow bundles of light are totally _____ at the hypotenuse (interface between _____ and _____). The _____ is greater than the _____ of total reflection, so that the light is no longer _____ but _____.

reflected | border angle | refracted | angle of incidence | reflected | air | glass

Check

Task 4

PHYWE

A prism used as in this experiment is called an inverted prism. Why?

An object observed through such a prism appears inverted because the light beams coming from the centre and from the bottom and end of the object are reversed in their order.

An object observed through such a prism appears inverted because the light beams coming from the centre and from the top and end of the object are reversed in their order.

An object observed through such a prism appears inverted because the light beams coming from the top and bottom of the object are reversed in their order.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

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Slide	Score / Total
Slide 18: Position of the light beams in relation to the optical axis	0/1
Slide 19: Incidence of narrow light beams parallel to the hypotenuse	0/1
Slide 20: Appearance within the prism	0/7
Slide 21: Definition of an inverted prism	0/1

Total 0 / 10

Solutions Repeat

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Fax: 0551 604 - 107
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