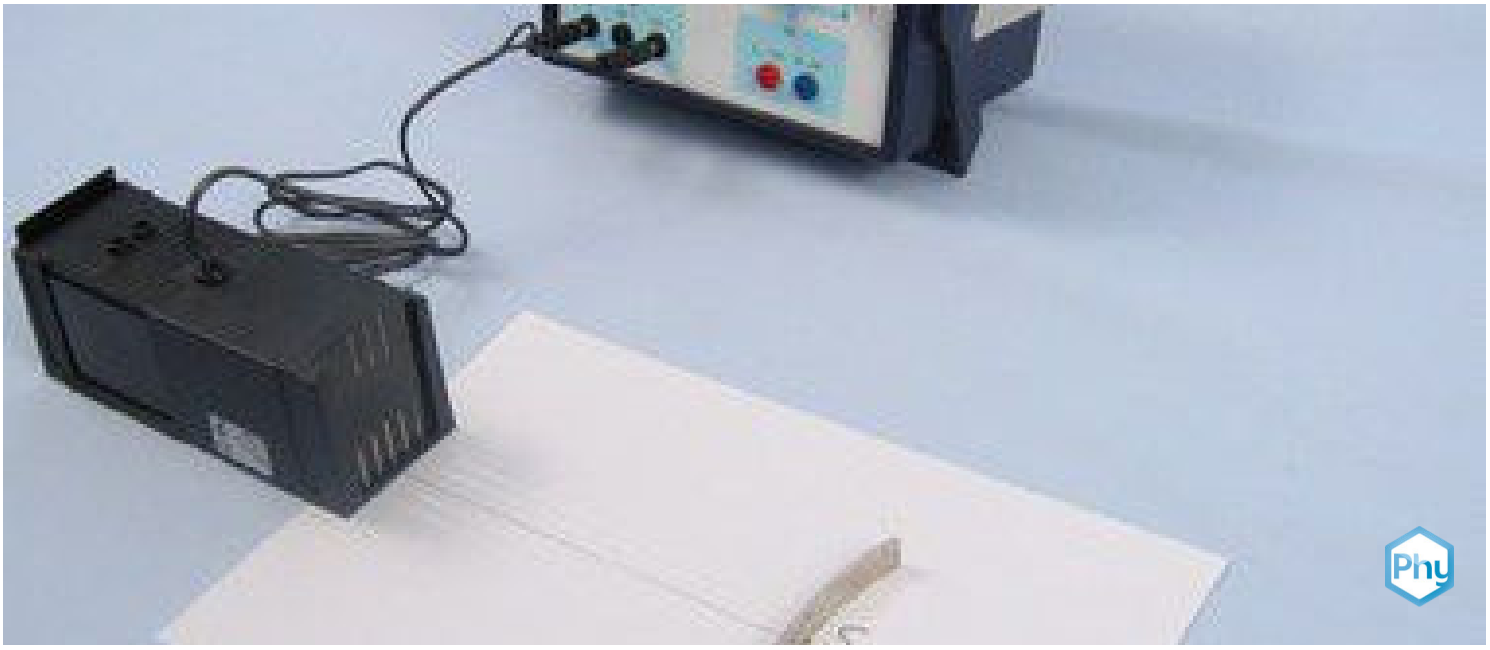
Reflection by a convex mirror



Physics > Light & Optics > Reflection & refraction of light

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

This content can also be found online at:

http://localhost:1337/c/631b119abce9830003710de8

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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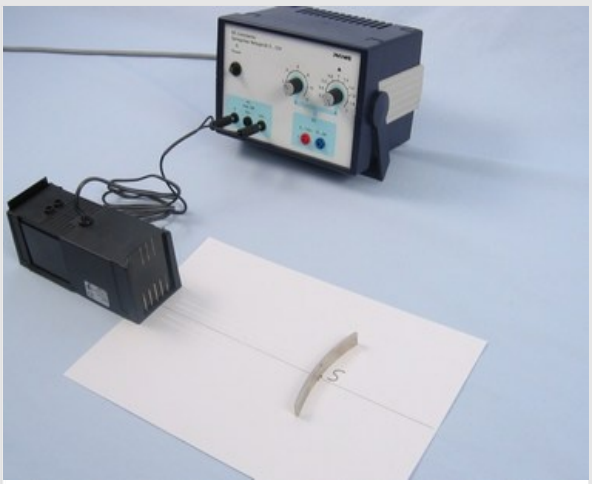

Reflection on convex mirror

A convex mirror is a mirror that is curved outwards. Often, partial surfaces of spheres are used onto which the light falls from the outside.

An example of a convex mirror is a Christmas tree ball. If you look at the reflection in the ball, you see an upright, reduced image.

In everyday life, convex mirrors are used in road traffic in order to be able to see large areas.

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Other teacher information (1/3)

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Prior knowledge

The students should have previously learned the basics of the straight-line propagation of light. In addition, they should know and be able to apply the law of reflection. The terms parallel rays, focal point rays and centre rays should be known.

Principle

Convex mirrors have a characteristic beam path. The reflected light rays appear to come from a point behind the mirror. Light beams incident on the convex mirror parallel to the optical axis run outwards after reflection, they diverge. Light rays incident along the optical axis are reflected within themselves.

Other teacher information (2/3)

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Learning objective

The aim of this experiment is to observe the reflection at the convex mirror and to experimentally determine the focal point and thus the focal length. By observing a selected light beam, the students should be led to the realization that the law of reflection obtained from a flat mirror is universally valid and can therefore also be applied to the convex mirror.

Tasks

In this experiment, we observe how light is reflected by a convex mirror. The first part deals with the experimental determination of the focal point and the focal length. In the second part, the angular dependence of the reflection is examined.

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Other teacher information (3/3)

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Notes on set-up and procedure

Analogous to the experiments on the concave mirror, care must be taken that the adjustment of the concave mirror (centre of the outwardly curved surface is at point S on the optical axis) and the light box (incidence of the (central) narrow beam of light along the optical axis to check the correct position - "0° method") is carried out very carefully by the student in order to arrive at a clear and convincing experimental result.

Difficulties could arise for the students due to the fact that, similar to the plane mirror, virtual images are created with the convex mirror and thus a backward extension of the reflected light beams must be made.

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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We encounter mirrors every day in a wide variety of designs. A special type of mirror is the so-called convex mirror. These are mirrors that are curved outwards.

An example of a convex mirror is a Christmas tree ball. If you look at the reflection in the ball, you see an upright, reduced image.

In everyday life, convex mirrors are often used in road traffic to be able to see large areas. For example, in tight curves or at blind spots.

Image of a traffic mirror

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Tasks

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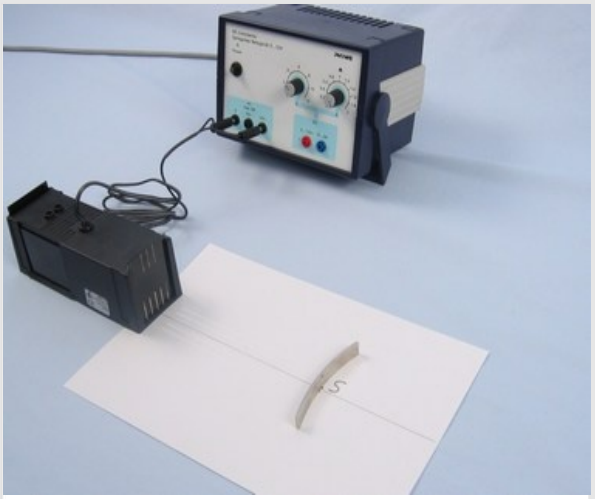

Experimental setup

How is the light reflected at the convex mirror?

Investigate the reflection of light from the convex mirror and experimentally determine both the focal point and the focal length.

Investigate the angle at which a selected light beam is reflected from the convex mirror.

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Equipment

Position	Material	Item No.	Quantity
1	Light box, halogen 12V/20 W	09801-00	1
2	Mirror, concave-convex	09812-00	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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Additional material

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

Set-up

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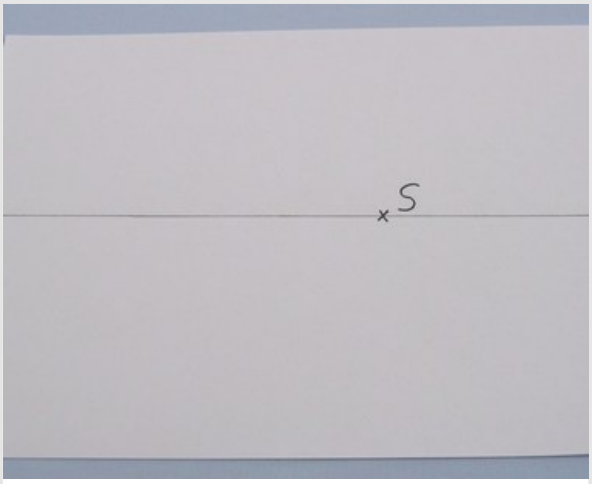

Preparation of the DIN-A4 sheet

Experiment part 1: Reflection at the convex mirror

- Prepare a sheet of paper as shown on the left. The line on the paper is the optical axis and the point S is the apex.

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Procedure (1/5)

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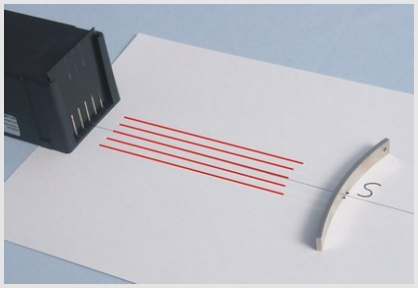
- Place the convex mirror with the centre of the outer convexity on the point S. Insert the five-slit diaphragm into the light box on the lens side and place it at the edge of the paper about 10 cm from the convex mirror.



- Connect the light box to the power supply unit (12 V ~).
- Move the light box until the middle of the five narrow light beams runs exactly along the optical axis (pencil line). If you have adjusted carefully, this light beam will be reflected in itself. If necessary, you have to turn the convex mirror a little.

Procedure (2/5)

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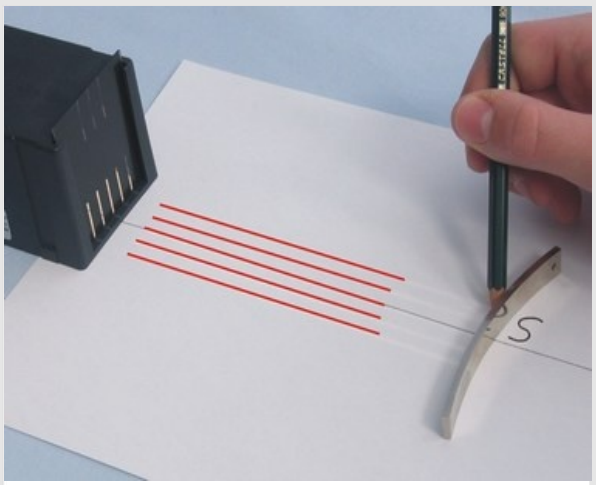

Outline of the camber mirror

- Transfer the outer outline of the camber mirror onto your sheet of paper without moving it.
- What can you say about the course of the outer light beams? Write down your observations.
- Mark the incident and reflected light beams; use different colours.

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Procedure (3/5)

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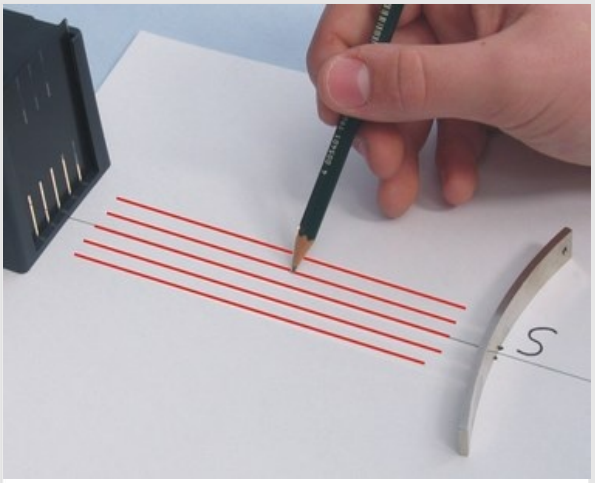

Markings on the convex mirror

- Switch off the power supply and remove the light box and the mirror from the sheet of paper.
- Connect the marks that belong together so that the course of the light beams before and after the reflection at the convex mirror becomes clear.
- Extend the reflected light rays backwards beyond the mirror by dashed straight lines.
- Designate the intersection of the extension with F. Where is this intersection point?
- Determine the distance of the point F from the apex S and note the measured value.

Procedure (4/5)

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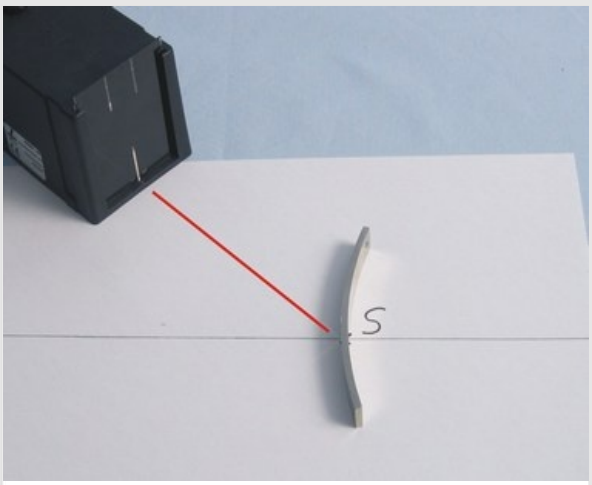

Set-up experimental part 2

Experiment part 2: Course of selected light beams after reflection

- Prepare a second sheet of paper in the same way as in the first part of the experiment. Place the convex mirror again with the centre of the outer convexity on the point S.
- Now insert the slit diaphragm into the light box on the lens side and switch on the power supply again (12 V ~).
- Let the narrow beam of light fall obliquely on the convex mirror exactly in the point S come to mind.

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Procedure (5/5)

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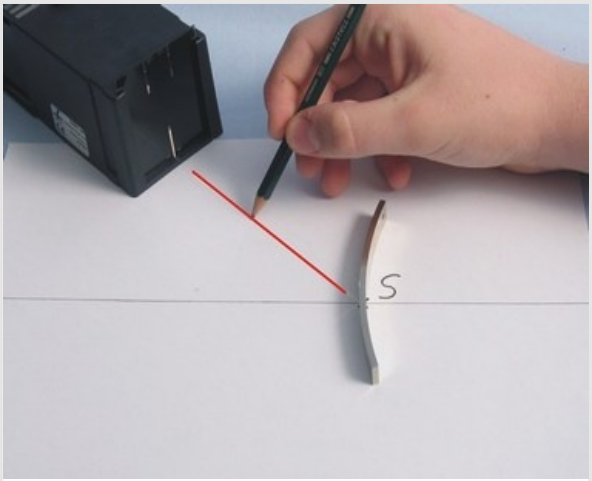

Markings of the light beam

- Observe the light beam reflected by the convex mirror. Mark the course of the incident and reflected light beams twice with crosses.
- Switch off the power supply and remove the light box and the mirror from the sheet of paper.
- Connect the marks that belong together so that the course of the light beam before and after the reflection at the convex mirror becomes clear.
- Measure the angle of incidence and the angle of reflection of the light beam. Write down the results of your measurements.

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Report

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Task 1

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How are light beams incident parallel to the optical axis reflected at the convex mirror?

The light beams incident on a convex mirror parallel to the optical axis are thus reflected,

- that they intersect at a point (the focal point F) lying on the optical axis.
- that one cannot determine a certain course after reflection.
- that they run outwards after reflection, i.e. diverge.

Task 2

PHYWE

Why is a beam of light incident along the optical axis reflected into itself?

In the case of a light beam incident along the optical axis on a convex mirror, the angle of incidence and thus the angle of reflection is 0°. It is reflected into itself.

○ True ○ False

Check

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Task 3

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Look at your experiment result from the first part of the experiment. Where do the parallel incident light rays on the convex mirror seem to come from after reflection?

- ○ The light rays reflected from the convex mirror appear to come from a point in front of the mirror.
- ○ The light rays reflected from the convex mirror appear to come from a point behind the mirror.

Check

Task 4

PHYWE

Double the distance with the compass $\overline{FS}$ (1st partial test) along the optical axis.

You get as a further intersection point M. Construct an arc around M with radius $\overline{MS}$ and compare this arc with the outline of the camber mirror. What can you determine?

The arc around M with the radius $\overline{MS}$ is identical with the curvature of the mirror, from which it follows that M is the centre of curvature. It holds: $f = 2MS$.

- ○ True
- ○ False

Check

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Task 5

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Fill in the gaps in the text using your measurement results for the angle of incidence and the angle of reflection for the course of the beam oblique to the vertex. S incident light beam after reflection.

The angle of incidence is equal to the [ ]. In the direction of the [ ] S light beams incident on the convex mirror are reflected according to the law of reflection, because the convex mirror intersects at the vertex S the optical axis [ ].

Check

Task 6

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What are applications for convex mirrors?

- ☐ Traffic mirrors
- ☐ Christmas tree balls
- ☐ Bathroom mirror
- ☐ Radio telescopes
- ☐ Polished spoon backs

Check

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Slide	Score / Total
Slide 19: Reflection of parallel rays at the camber mirror	0/1
Slide 20: Properties of the optical axis	0/1
Slide 21: Origin of the parallel rays reflected at the camber mirror	0/1
Slide 22: Determination of the focal length	0/1
Slide 23: Angle of incidence and reflection at the camber mirror	0/3
Slide 24: Applications for camber mirrors	0/3

Total 0 / 10

Solutions Repeat

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