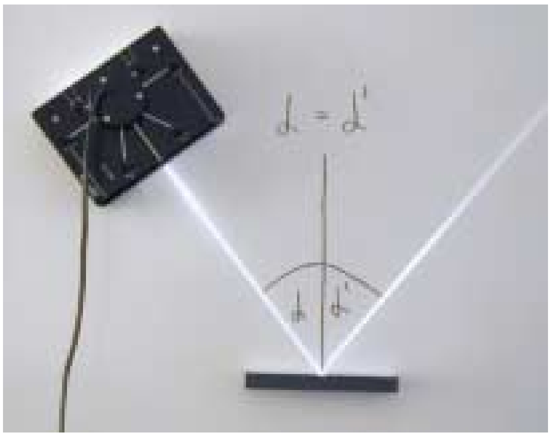
3B SCIENTIFIC® PHYSICS

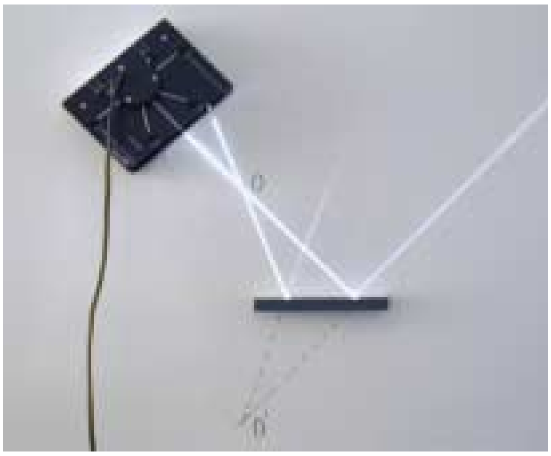
... going one step further

Sample experiments for Optics on magnetic boards, basic kit U14600 with Multiple-ray projector U40110

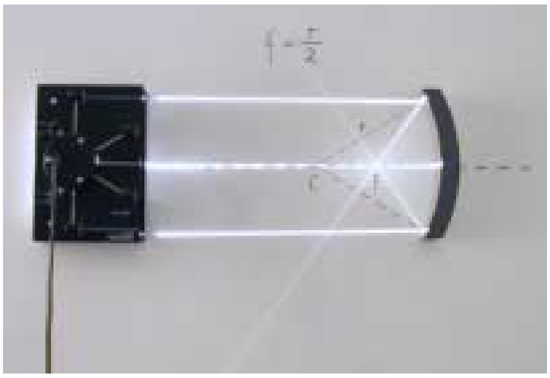
08/03 ALF



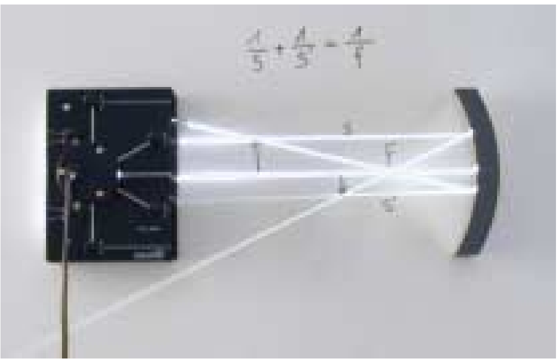
Exp.1: Reflection on a plane mirror
Demonstration of the law of reflection. An incident ray is projected to the mirror surface under the angle α and reflected under the same angle α'.



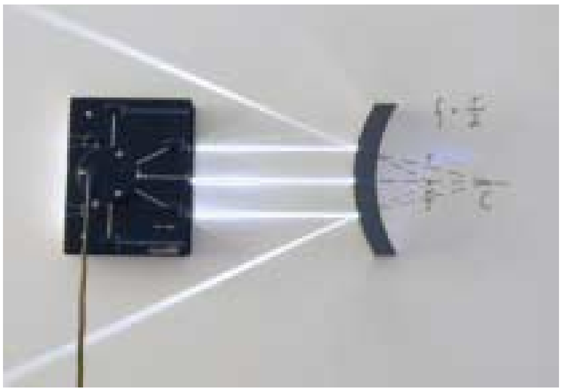
Exp.2: Virtual image in a plane mirror
Two rays of light are projected through point O to a plane mirror. The extensions of the reflected rays intersect in the image point O'.



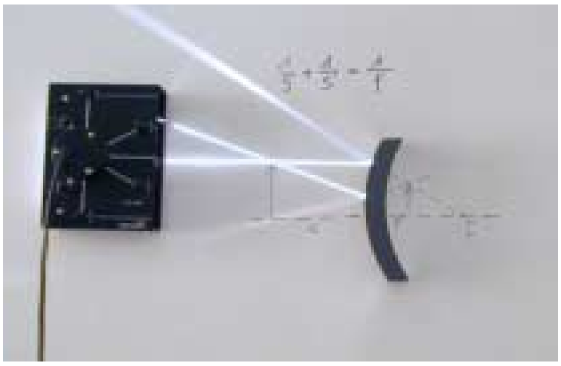
Exp.3: Focal length of a concave mirror
The centre of curvature C of the concave mirror is located by means of a ray which reflects on itself. Rays parallel to the principal axis intersect in the focal point F. The distance of the centre of curvature C is twice as long as the distance of the focus F.
$f = r/2$
In case the rays are non-parallel to the optical axis, the reflected rays intersect in a point on an axis which is referred to as the focal plane. The focal plane passes through the focal point and is perpendicular to the optical axis.



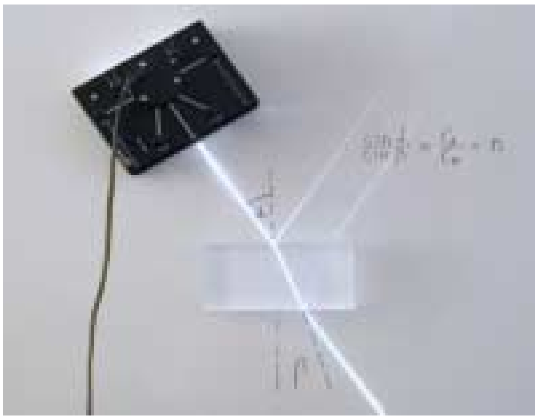
Exp.4: Real image formed by a concave mirror
The optical axis is located by means of a ray which reflects on itself. Two rays of light, one parallel to the optical axis and the other through the focal point F, are made to intersect at the object point (upright arrow). The reflected rays intersect at the image point (inverted arrow).



Exp.5: Focal length of a convex mirror
The centre of curvature C of the concave mirror is located by means of a ray which reflects on itself and is extended behind the mirror. The reflections of two parallel rays are also extended in the same manner until they intersect in the focal point. The distance of the center of curvature C is twice as long as the distance of the focus F. f = r/2
In case the rays are non-parallel to the optical axis, the reflected rays intersect in a point on an axis which is referred to as the focal plane. The focal plane passes through the focal point and is perpendicular to the optical axis.

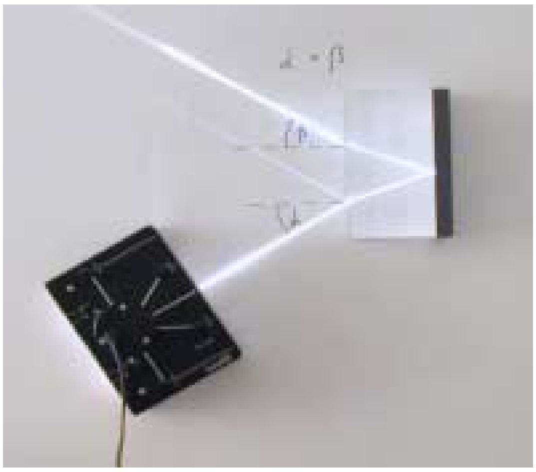


Exp.6: Virtual image formed by a convex mirror
Two rays, one of them parallel to the optical axis; are made to intersect at the object point (upright arrow). The extensions of the reflected rays are drawn behind the mirror. The virtual image (inverted arrow) is erect and smaller than the object.



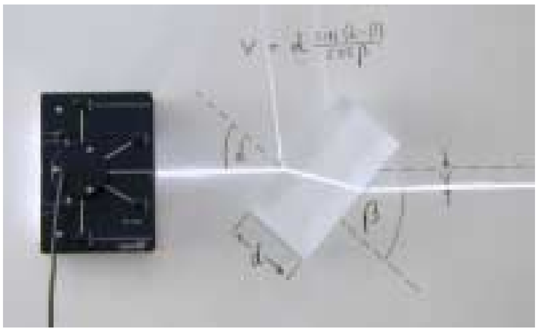
Exp.7: Refraction from a less dense to a more dense medium

A pencil of light is projected at the upper surface of the plane-parallel plate. The normal and the extension of the refracted ray are drawn on the white board. The phenomenon of refraction is clearly visible. If light passes from a less dense to a more dense medium the refraction angle β is smaller than the incidence angle α.



Exp.8: Refraction from a more dense to a less dense medium

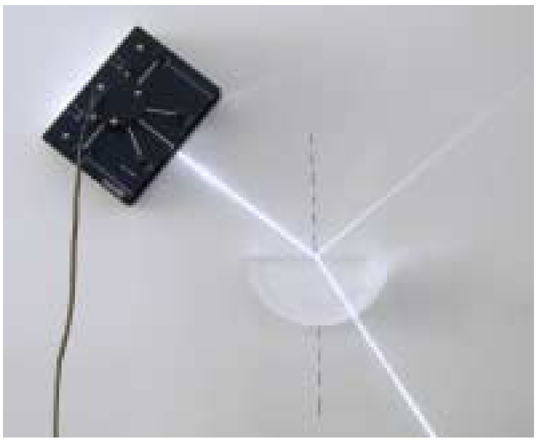
The plane mirror is set behind the plane-parallel plate. It produces a return pencil of light which demonstrates the deviation away from the normal when the ray passes from the more dense to the less dense medium. Incident angle α and emergent angle β are equal.



Exp.9: Parallel displacement by a plane-parallel plate

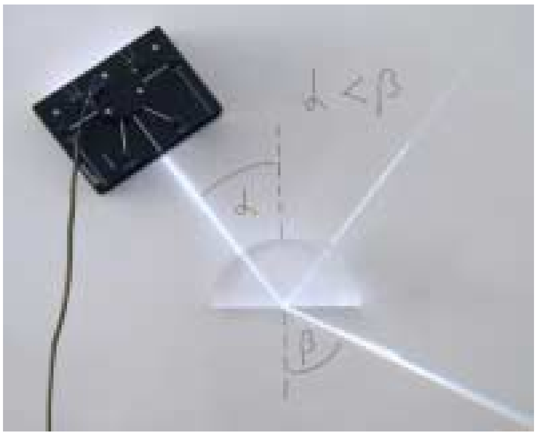
If a light ray passes through a plane-parallel plate its direction is not changed. The shift v of the outgoing ray can be determined by using the formula:

$v = d*\sin(\alpha-\beta)/\cos\beta$



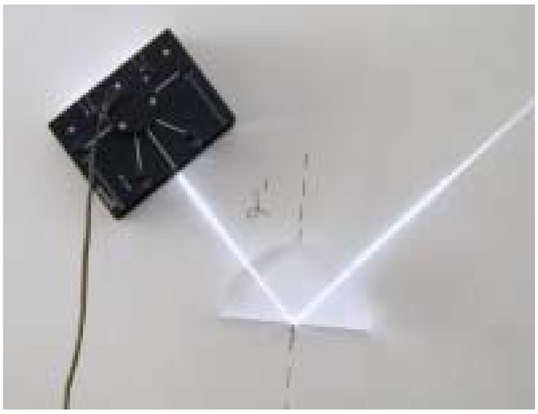
Exp.10: Semi-circular body – Light incident at the center

If a light ray passes through the centre of curvature of a semi-circular body it will emerge perpendicular to the tangent at the point of emergence and will undergo no second deviation.



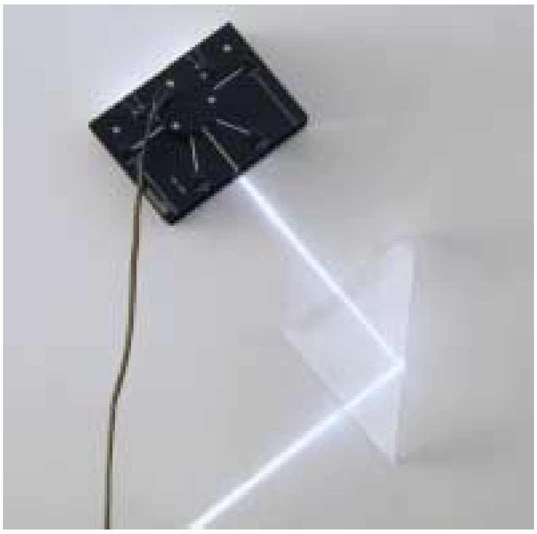
Exp.11: Semi-circular body – Light incident at right angle to tangent

If a light ray perpendicular to the tangent passes through a semi-circular body it will not be deviated. The ray is refracted at the point of emergence with the refraction angle β, which is larger than α. It is bent away from the normal. Partial internal reflections occur at incident angles smaller than the critical angle in the dense medium.



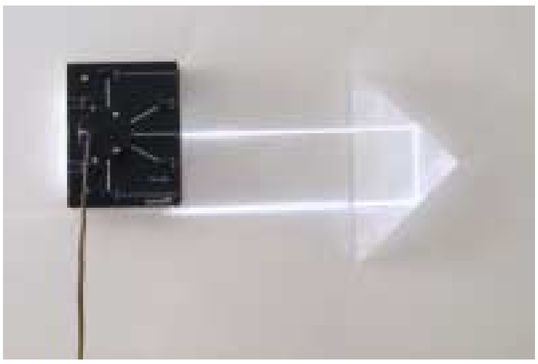
Exp.12: Semi-circular body – Critical angle

A pencil of light is projected along the extension of a radius of the disc. The semi-circular body is rotated until total internal reflection occurs. The critical angle α can easily be measured.



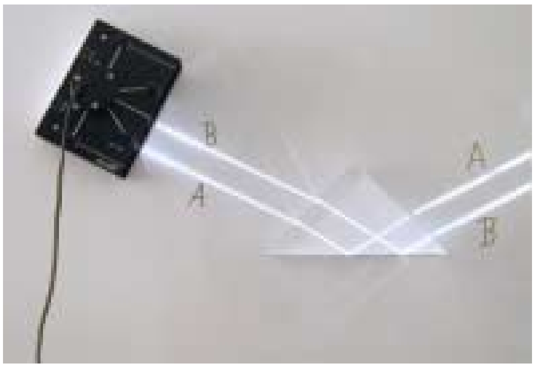
Exp.13: Triangular Prism- Total internal reflection, 90° deviation

When the ray impinges the edge of the triangular prism, it is totally reflected. If the prism is slightly adjusted reflection and refraction can be observed. The 90° deviation is used in the design of some modern periscopes.

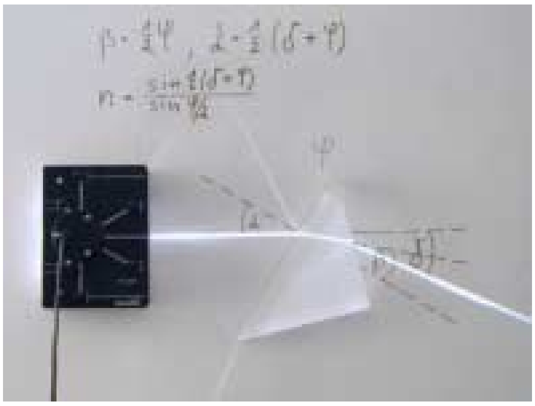


Exp.14: Triangular Prism- Total internal reflection, 180° deviation

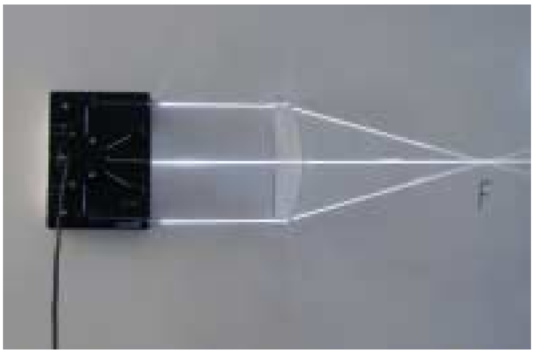
The conditions for total reflections are fulfilled on both edges of the prism. The basic principle of prism binoculars is demonstrated.



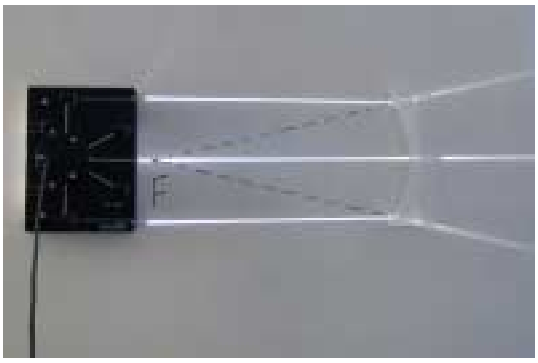
Exp.15: Reversing prism
In this experimental setup total internal reflection and refraction cooperate to reverse the positions of the two parallel rays.



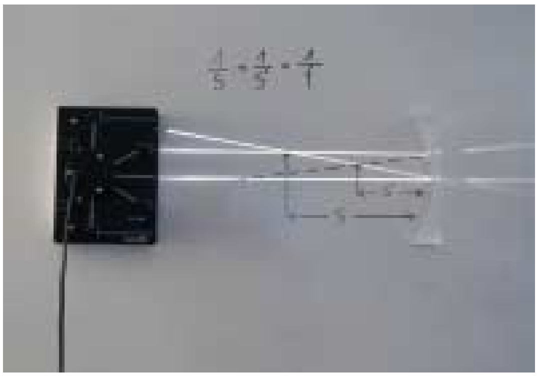
Exp.16: Angle of minimum deviation
The deviation of a pencil of light through the prism is most easily observed when the light passes through the prism just below one of the 45° angles. The angle of minimum deviation is quickly found experimentally.



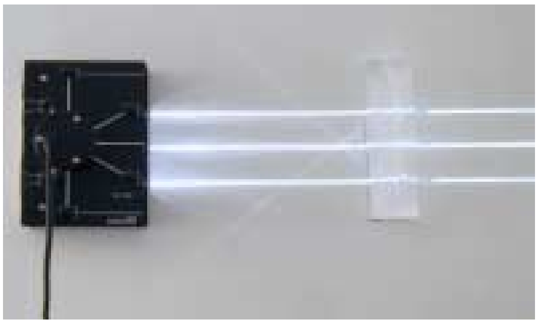
Exp.17: Focal Length of a plano-convex lens
The focal length of a plano-convex lens is determined by two rays parallel to the optical axis. They intersect in the focal point F.



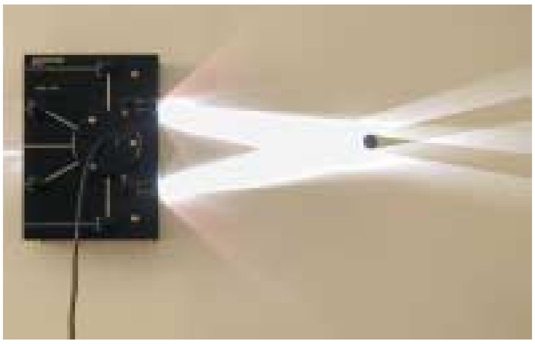
Exp.18: Focal Length of a plano-concave lens
Two rays parallel to the optical axis are refracted by the plano-concave lens. Extensions of the refracted rays are drawn on the board until they intersect in the focal point F.



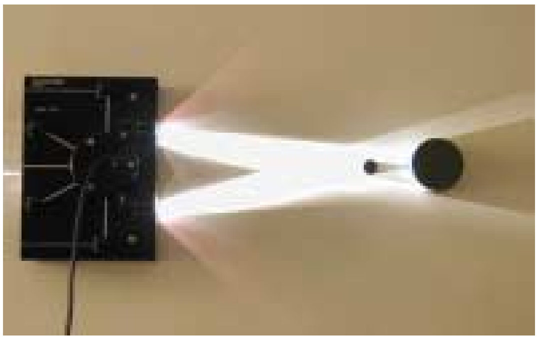
Exp.19: Virtual image formed by a concave lens
Two pencils of light, one parallel to the optical axis and the other through the optical centre, intersect in the object point. The refracted ray due to the parallel ray is extended until it intersects the ray passing through the centre. The virtual image is smaller than the object



Exp.20: Cancelling out of the refraction
When light rays pass through an object made up of a concave and a convex lens with the same curvature the refraction is cancelled out.



Exp.20: Shadow casting
Light rays from the reverse side of the multiple-ray projector are used for experiments on shadow-casting.



Exp.21: Eclipse of the sun
The two round shadow-casting bodies are placed on the board to represent the moon and the earth. When the moon's shadow strikes the earth a solar eclipse can be observed, partial in the penumbral and total in the umbral shadow..