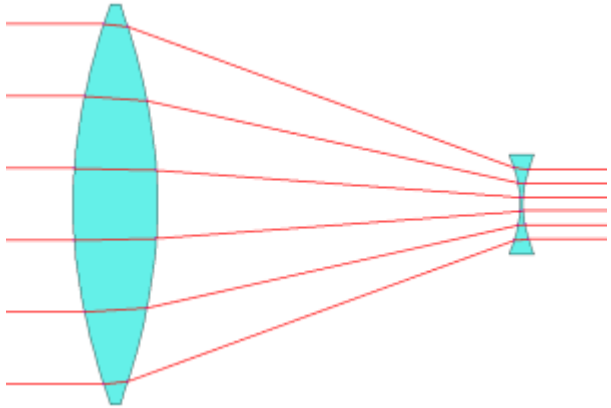
EP 324
Applied Optics

Topic 4

Mirrors



Department of

Engineering of Physics

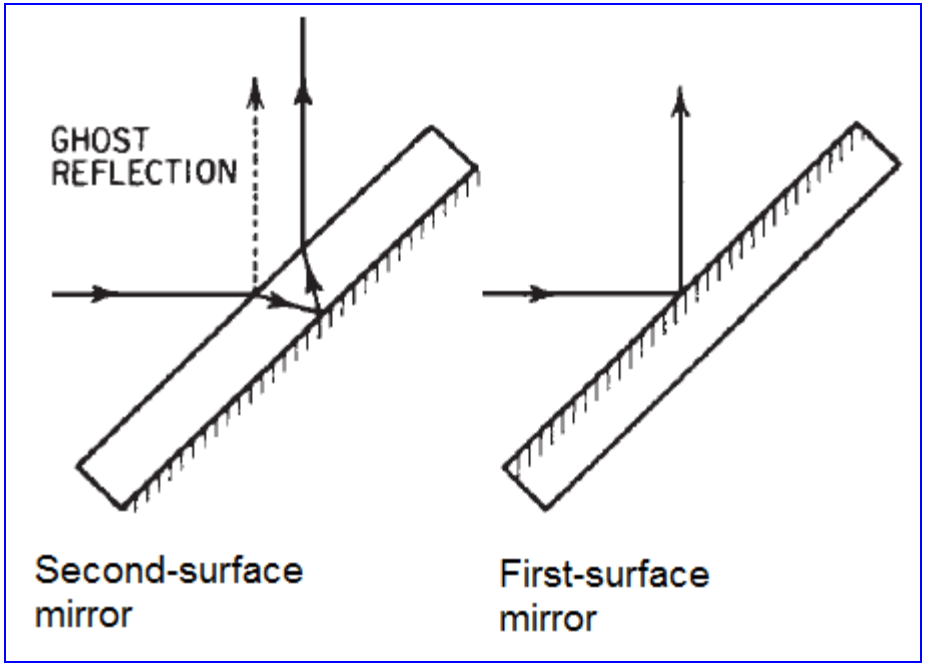
Gaziantep University

Oct 2015

Plane Mirror

For most applications, it is necessary that the mirrors be first-surface mirrors, as opposed to ordinary second-surface mirrors.

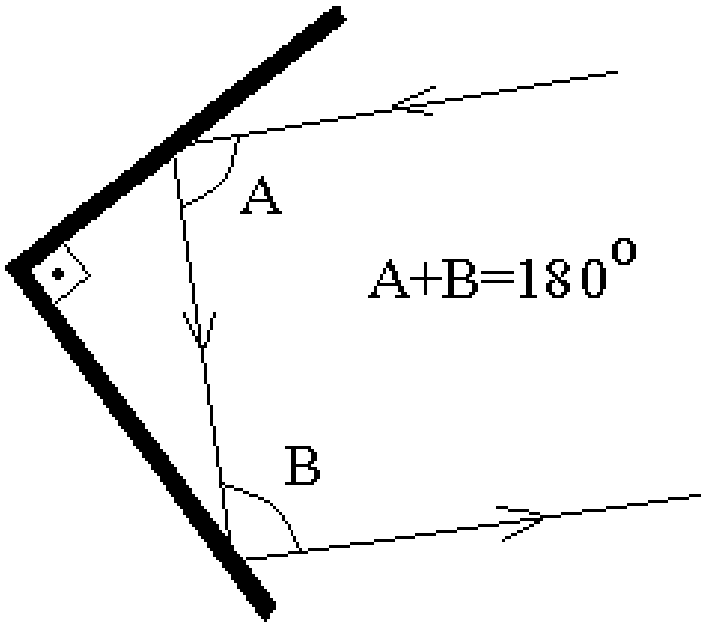
The first-surface mirror is usually preferable because it does not produce a *ghost* image as does the second-surface mirror.

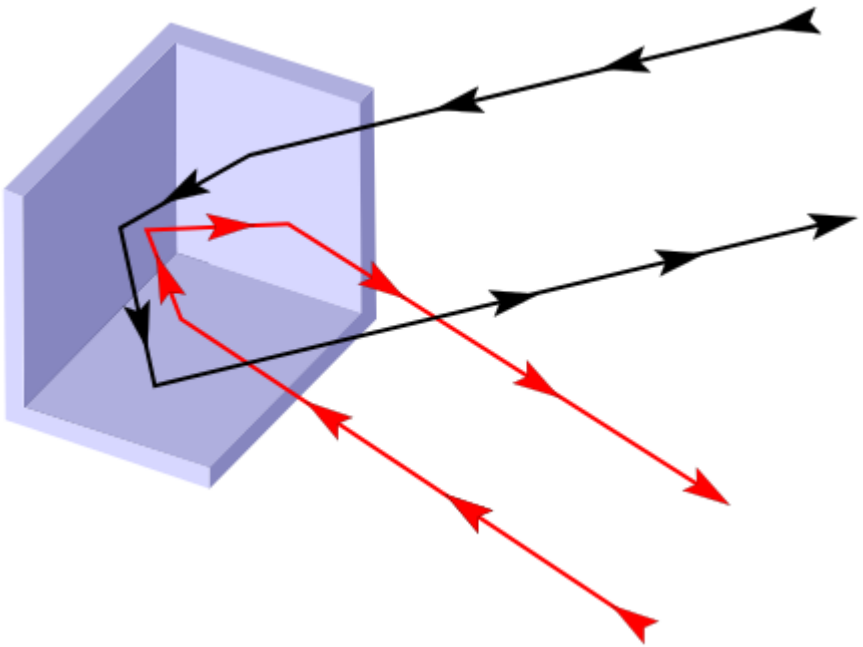


First-surface mirrors are usually made with vacuum deposited aluminum films protected by a thin transparent over coating of silicon monoxide or magnesium fluoride.

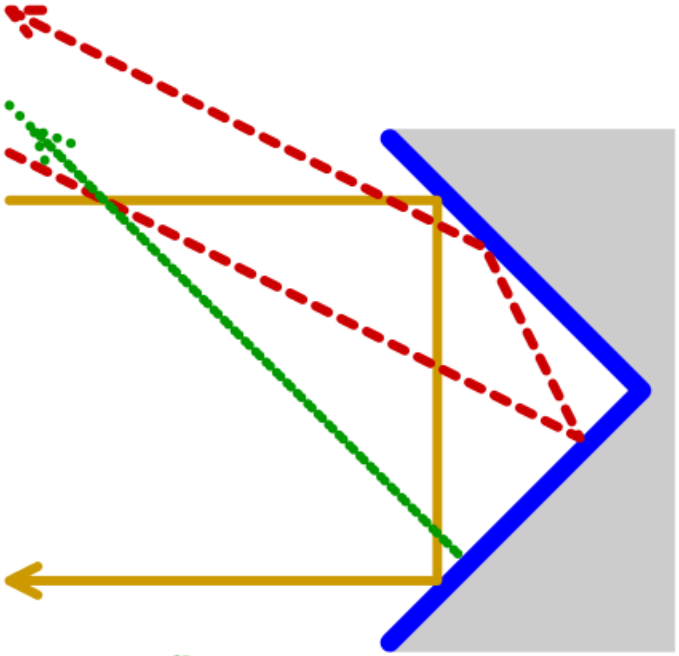
RetroReflectors

This is a surface that reflects light back to its source with a minimum of scattering.

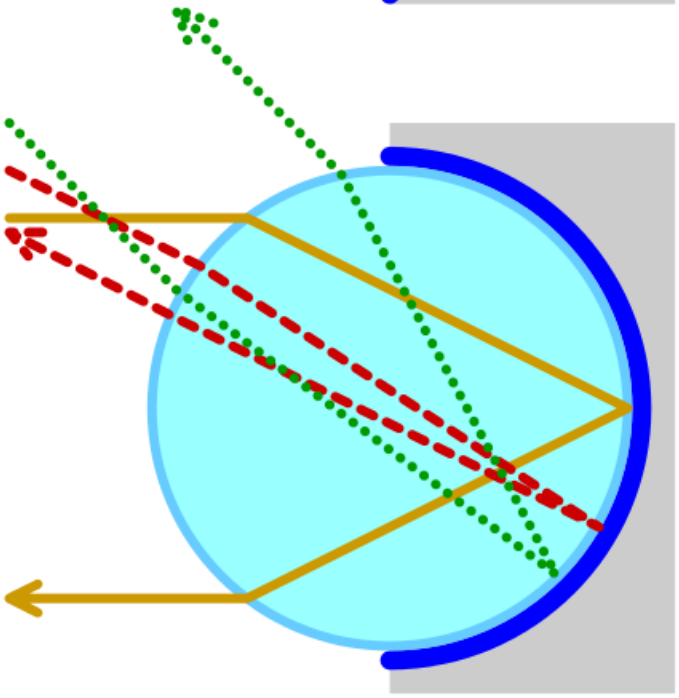




Corner Refroreflector



Spherical Retroreflector

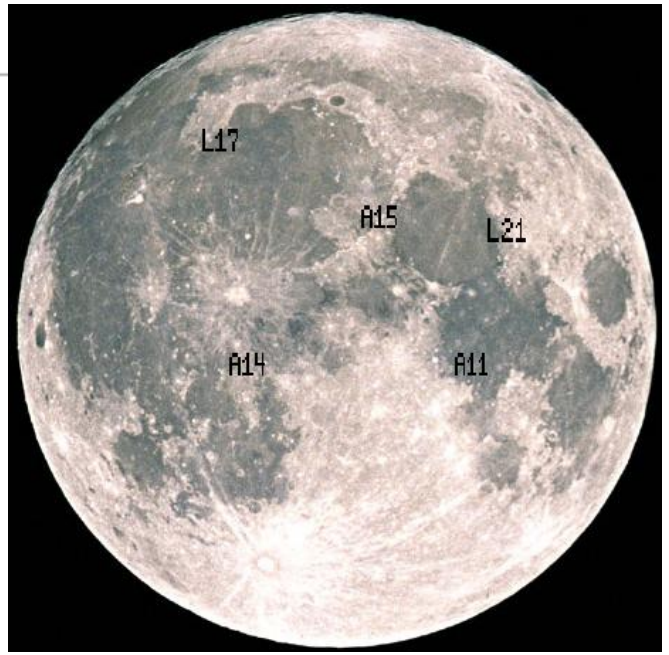


Reflectors placed by the United States

Name	Mission	Date	Location
Lunar Ranging Retro Reflector (LRRR)	Apollo 11	21 July 1969	—
LRRR	Apollo 14	31 January 1971	3.6453° S 17.471361° W
LRRR	Apollo 15	31 July 1971	26.1°N 3.6°E

Reflectors placed by the Soviet Union

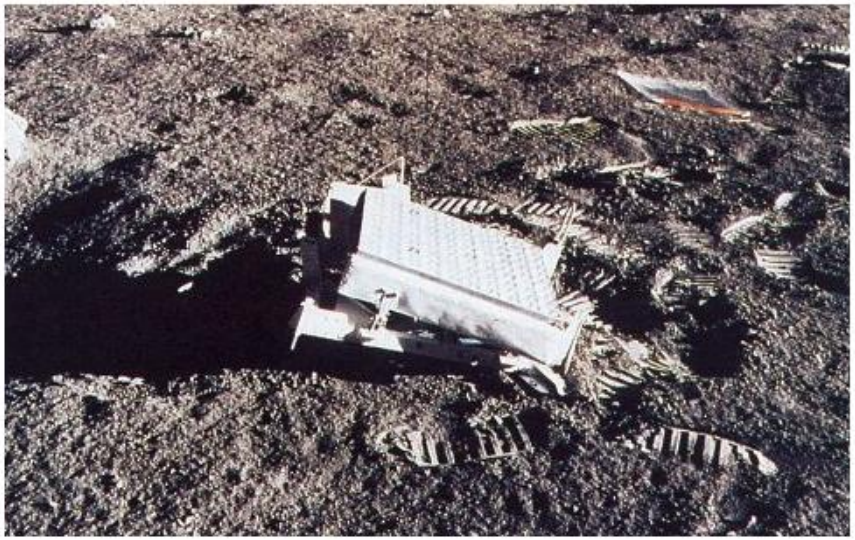
Name	Mission	Location
Lunokhod 1	Luna 17	38.17° N, 325.06° W
Lunokhod 2	Luna 21	25.85° N, 30.45° E



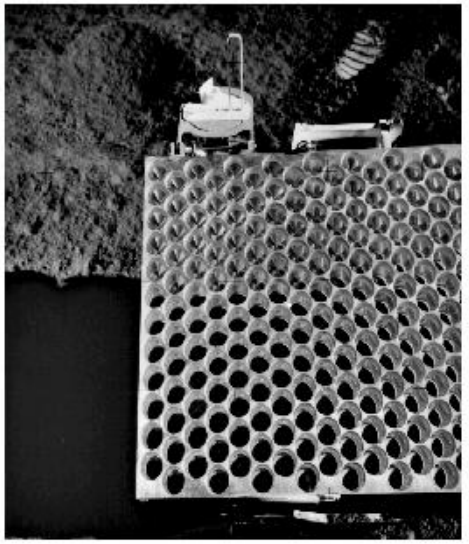
en.wikipedia.org

RetroReflectors on Moon

Apollo 11



Apollo 14



Apollo 15

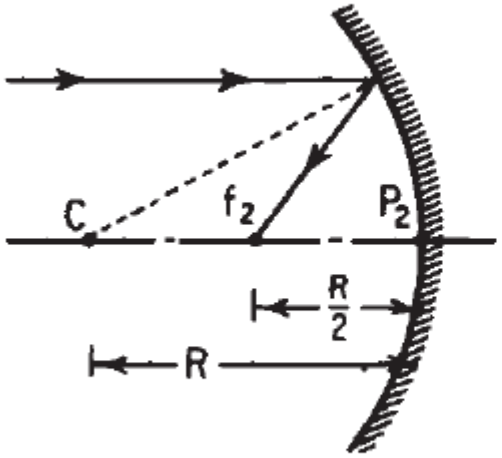
See also video:

https://www.youtube.com/watch?v=lGpNiRkmxSA

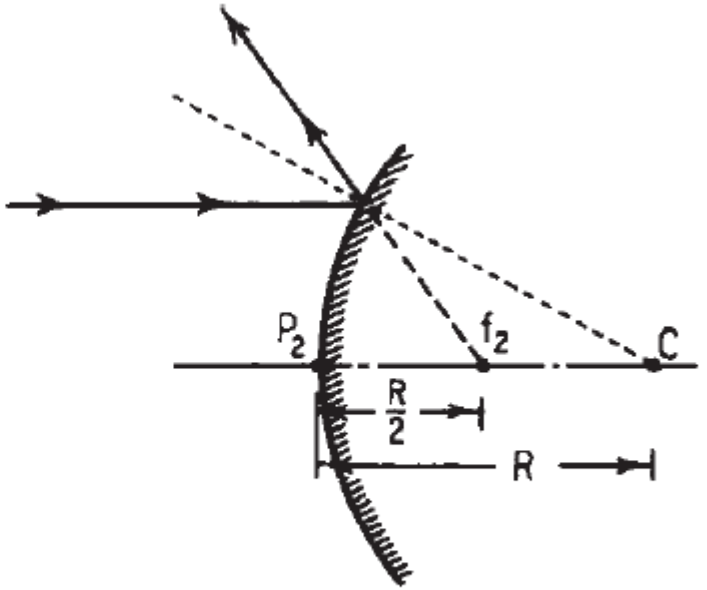
Spherical Mirrors

A curved mirror surface has a focal length and is capable of forming images just as a lens does.

The location of the focal point is about f = R/2.



CONCAVE MIRROR
(CONVERGING)



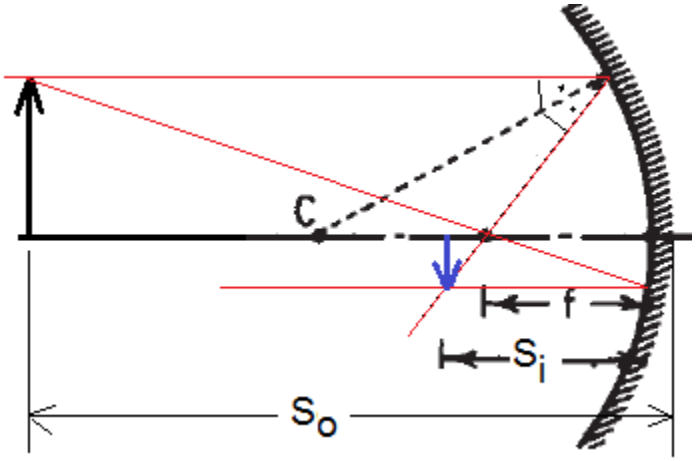
CONVEX MIRROR
(DIVERGING)

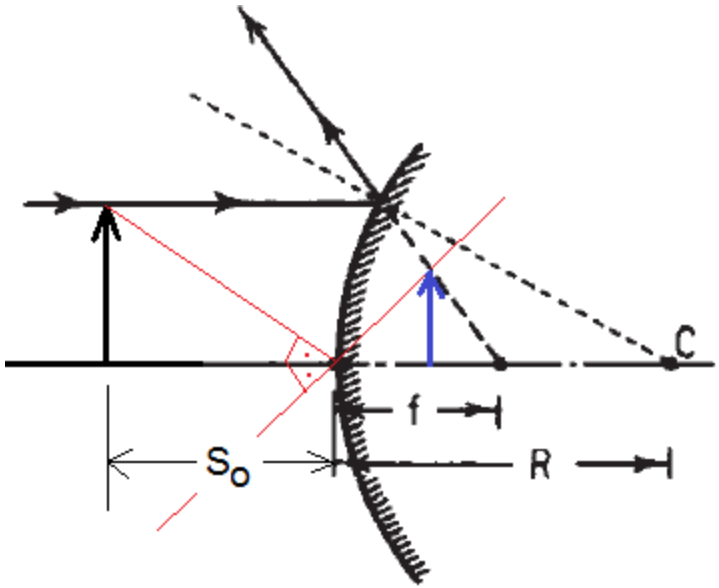
Concave/Convex Mirror

$$\frac{1}{f} = \frac{1}{s_o} + \frac{1}{s_i}$$

$$m = \frac{h_i}{h_o} = -\frac{s_i}{s_o}$$

$$f^2 = x_o x_i$$





x_o = distace between focus and object.

x_i = distance between focus and image.

Sign Conversion for Mirrors

Quantity	Positive when	Negative when
s_o	object is in front of mirror	object is in back of mirror
s_i	image is in front of mirror	image is in back of mirror
f	mirror is concave	mirror is convex
R	mirror is concave	mirror is convex
h_i	image is upright	image is inverted

Example

A spherical mirror has a focal length f = +10 cm.

Locate, describe and draw the image for the object distance

(a) 25 cm (b) 10 cm (c) 5 cm.

Ans:

(a) si = 6.67 cm, m= - 0.668, image is real and inverted.

(b) si = inf, image is formed at infinity.

(c) si = -10 cm, m= +2, image is virtual and upright.

Example

A convex mirror has a radius of curvature R = - 0.5 m.

If s_o = 3 m find image distance to the mirror and magnification.

[Ans: si = -0.23 cm, m=+0.08]

Example

A ball approaches a convex mirror at a constant speed of v = 6 cm/s.

(a) Find the speed of its image when s_o = 5cm. [Ans: (a) -2.67 m/s].

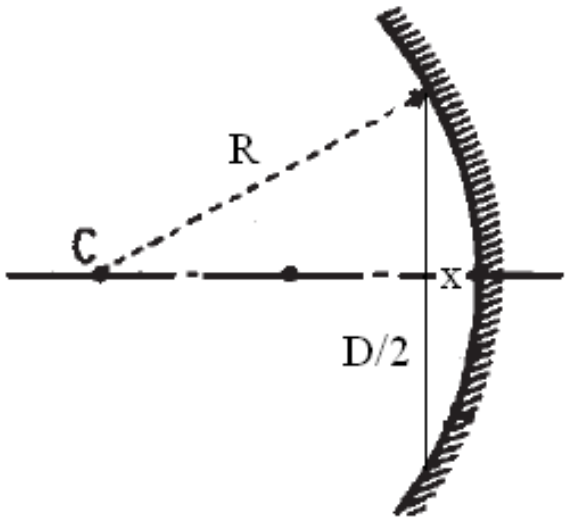
(b) Comment on the results when object is very close to the mirror.

Exercises

1. For a thin spherical concave lens find the <u>minimum</u> distance between and object and its image.

2. A ball approaches a convex mirror at a constant speed of v = 6 cm/s.
   (a) Find the speed of its image when s_o = 5 cm. [Ans: (a) −2.67 m/s].
   (b) Find the speed of its image when object is very close to the mirror.

3. Find a realtion between x, D and R in Figure below.



CONCAVE MIRROR

References

1. Serway, Beichner, **Physics for Scientists and Engineers** 6th ed, Brooks/Cole
2. W.J.Simith, Modern Optical Engineering, 3rd Ed., McGraw-Hill
3. http://en.wikipedia.org/wiki/Light
4. http://en.wikipedia.org/wiki/Electromagnetic_spectrum
5. http://www.phys.ncku.edu.tw/mirrors/physicsfaq/Relativity/SpeedOfLight/measure_c.html
6. http://www.saburchill.com/physics/chapters3/0007.html