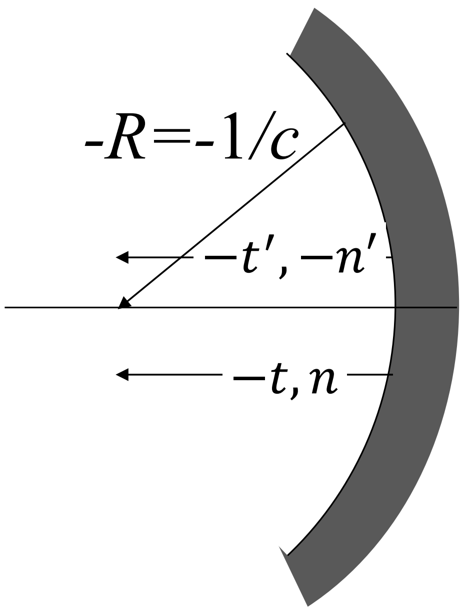
Module 4: Power of Curved Mirrors

Course 1 of *Optical Engineering*: First Order Optical System Design

with **Dr. Robert R. McLeod and Dr. Amy C. Sullivan**

Mirrors: The "lens maker's equation" for mirrors



Place object at center of curvature. Since ray strikes surface normally, it must return to the same point.

Sign convention

1. t' is negative since it is to the left of the mirror vertex
2. We use a negative index n'=-n upon reflection in any lens equation
3. All quantities (as always) labeled are +

$$\frac{n'}{t'} - \frac{n}{t} = \frac{-n}{R} - \frac{n}{R} = \frac{1}{f}$$

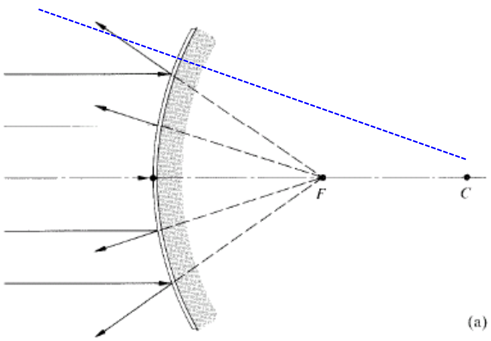
Thus

$$\boxed{\frac{1}{f} = \phi = -\frac{2n}{R} = -2nc}$$

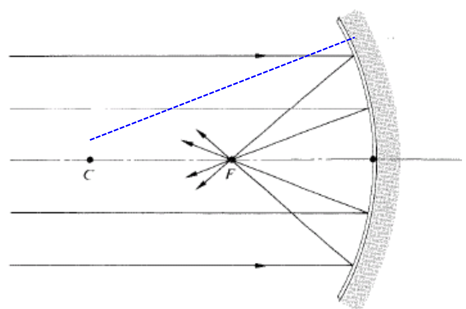
Remember that by our sign convention, R<0 in the geometry shown, yielding a lens power which is positive.

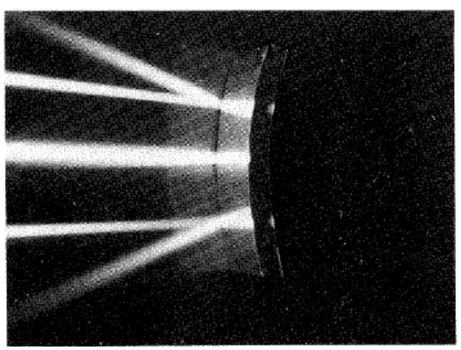
Positive and negative mirrors

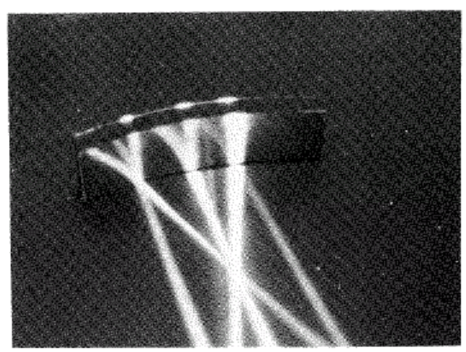
$f < 0$



$f > 0$





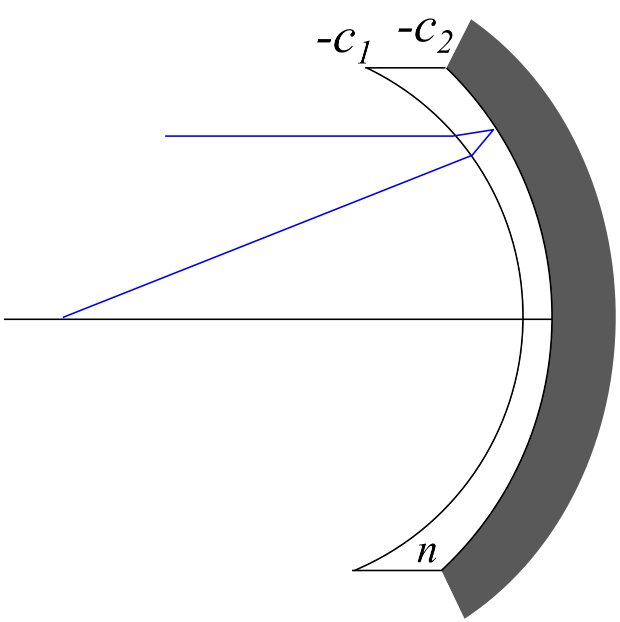


In vacuum

$$f = -\frac{R}{2}$$

Lenses and mirrors in contact: The Mangin mirror

Negative meniscus with reflective outer surface.
Cancels spherical aberration.



$$\Phi \approx \Phi_1 + \Phi_2 + \Phi_3$$

Three surfaces in contact

$$= c_1(n-1) - 2nc_2 + c_1(-1+n)$$

Lens equation, $c_1 < 0$ as drawn

Derived on previous page, $c_2 < 0$ as drawn

Lens equation but using negative indices per sign convention when light travels R → L

$$= 2c_1(n-1) - 2nc_2$$

= a symmetric concave lens with curvatures c_1 + a convex mirror of curvature c_2