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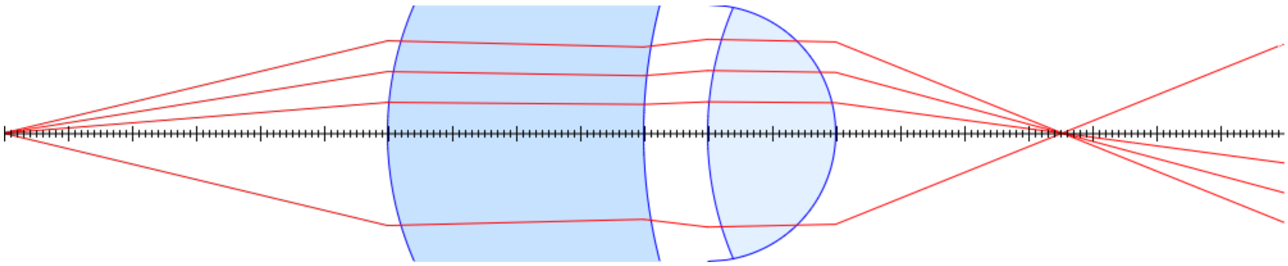
Ray tracing with the transfer matrix method

This app draws rays of light (the red lines) as they pass from left to right through a number of optical components. The light rays refract when they reach an interface between two materials with different indices of refraction. If the rays only make small angles with the optical axis, the transfer matrix method can be used to efficiently calculate the propagation of light through the system. This app allows you to place up to 10 optical elements along an optical axis and calculate how light rays propagate.



Redraw optical system

Refraction at a flat interface | Refraction at a convex interface | Refraction at a concave interface
Biconvex lens | Biconcave lens | Compound lens | Condensor lens | Immersion lens
Eye glasses - eye | Microscope | Keplerian telescope | Galilean telescope

Optical elements

Element 1	Propagation a distance d	$d =$ 0.06 [m]
Element 2	Refraction from curved surface	$n =$ 2.0 $R =$ 0.05 [m]
Element 3	Propagation a distance d	$d =$ 0.04 [m]
Element 4	Refraction from curved surface	$n =$ 1 $R =$ 0.08 [m]
Element 5	Propagation a distance d	$d =$ 0.01 [m]
Element 6	Refraction from curved surface	$n =$ 1.52 $R =$ 0.05 [m]
Element 7	Propagation a distance d	$d =$ 0.02 [m]
Element 8	Refraction from curved surface	$n =$ 1 $R =$ -0.02 [m]
Element 9		
Element 10		

Rays

Ray 1	$y_0 =$ 0.0 [m]	$\theta_0 =$ 0.08 [rad]	clear
Ray 2	$y_0 =$ 0.00 [m]	$\theta_0 =$ 0.16 [rad]	clear
Ray 3	$y_0 =$ 0.00 [m]	$\theta_0 =$ 0.24 [rad]	clear
Ray 4	$y_0 =$ 0 [m]	$\theta_0 =$ -0.24 [rad]	clear
Ray 5	$y_0 =$ [m]	$\theta_0 =$ [rad]	clear
Ray 6	$y_0 =$ [m]	$\theta_0 =$ [rad]	clear
Ray 7	$y_0 =$ [m]	$\theta_0 =$ [rad]	clear
Ray 8	$y_0 =$ [m]	$\theta_0 =$ [rad]	clear
Ray 9	$y_0 =$ [m]	$\theta_0 =$ [rad]	clear
Ray 10	$y_0 =$ [m]	$\theta_0 =$ [rad]	clear

Propagation a distance d: Propagation in a medium with a constant index of refraction. The distance is measured along the optical axis.

Thin lens: A thin lens with a focal length f. A lens is thin if the focal length is much greater than the thickness of the lens. The focal length is positive for a converging lens and negative for a diverging lens.

Refraction at a flat interface: The index of refraction is n to the right of the interface.

Refraction at a curved interface: The index of refraction is n to the right of the interface. The center of curvature is to the right of the interface for $R > 0$ and to the left of the interface for $R < 0$.