

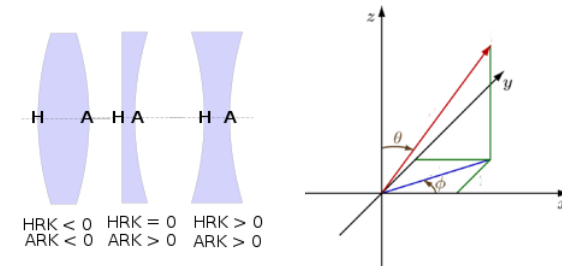
Key	Input Order and defaults	Action on beams <i>(Increase of strayness for R on HR, T on HR, R on AR, T on AR)</i>	Remarks
bo	$X, Y, Z = 0$ <i>(origin of bench)</i>		This will shift all the coordinates of the following optics and beams (until the next <b>bo</b> line) by the amounts given here (blank <b>bo</b> line to return to general system).
bm	$Wx = 1.\text{mm}, Wy = 1.\text{mm}$ <i>(waist sizes),</i> $WDistx = 0., WDisty = 0.$ <i>(waist positions from beam origin),</i> $Wl = 1064.\text{nm}, P = 1.W, X = 0., Y = 0., Z = 0.$ <i>(position of origin in space),</i> $\Theta = \pi/2., \Phi = 0.$ <i>(orientation),</i> $\Alpha = 0.$ <i>(rotation of eigenbase for orthogonal beams),</i> $Ref = None$		$\Alpha = 0.$ $\leftrightarrow$ eigen X is $\perp$ to beam direction and has maximum Z component. If direction is $\pm e_Z$ then eigen X is $\pm e_X$
mr	$X = 0., Y = 0., Z = 0.$ <i>(position of center of HR chord),</i> $\Theta = \pi/2., \Phi = 0.$ <i>(orientation of HR Norm, pointing out),</i> $Wedge = 0., \Alpha = 0.$ <i>(wedge and wedge rotation),</i> $HRK = 0.01, ARK = 0.$ <i>(curvatures),</i> $Diameter = 10.\text{cm}$ <i>(of the construction cylinder),</i> $Thickness = 2.\text{cm}, N = 1.4585, HRr = .99, HRt = .01,$ $ARr = .1, ARt = .9$ <i>(power reflectances and transmittances),</i> $KeepI = False, Ref = None$	0, +1, +1, 0	Wedges are counted positive if you <i>add</i> material when you increase the wedge.
bs	$X = 0., Y = 0., Z = 0.$ <i>(position of center of HR chord),</i> $\Theta = \pi/2., \Phi = 0.$ <i>(orientation of HR Norm, pointing out),</i> $Wedge = 0., \Alpha = 0.$ <i>(wedge and wedge rotation),</i> $HRK = 0., ARK = 0.$ <i>(curvatures),</i> $Diameter = 10.\text{cm}$ <i>(of the construction cylinder),</i> $Thickness = 2.\text{cm}, N = 1.4585, HRr = .5, HRt = .5,$ $ARr = .1, ARt = .9$ <i>(power reflectances and transmittances),</i> $KeepI = False, Ref = None$	0, 0, 0, 0	This is very similar to mirror <b>bm</b> , but has diferent default values and never increases the strayness of beams.
th	$X = 0., Y = 0., Z = 0.$ <i>(position of center of lens),</i> $\Theta = \pi/2., \Phi = 0.$ <i>(orientation of HR Norm, pointing out),</i> $Focal = 10.\text{cm}, Diameter = 5.\text{cm}, R = .1, T = .9$ <i>(power reflectance and transmittance, per surface),</i> $KeepI = False, Ref = False$	+1, 0, 0, +1	All parameters which are not present here are internally adjusted in order to fit the input <b>Focal</b> , <b>Diameter</b> and a $N = 1.4584$ value for the optical index
tk	$X = 0., Y = 0., Z = 0.$ <i>(position of apex of HR face of lens),</i> $\Theta = \pi/2., \Phi = 0.$ <i>(orientation of HR Norm, pointing out),</i> $K1 = .01, K2 = .001$ <i>(curvatures),</i> $Diameter = 5.\text{cm}, Thickness = 2.\text{cm},$ $N = 1.4585, R = .1, T = .9$ <i>(power reflectance and transmittance),</i> $KeepI = False, Ref = None$	+1, 0, 0, +1	<b>Thickness:</b> on optical axis (from apex to apex). Note that in this case the provided HR center corresponds to the position of the <i>apex of the HR surface, on the contrary of mirrors.</i>
sp	$RonHR = 0, TonHR = 0, RonAR = 0, TonAR = 0$ <i>(actions on beams),</i> $X = 0., Y = 0., Z = 0.$ <i>(position of center of HR chord),</i> $\Theta = \pi/2., \Phi = 0.$ <i>(orientation of HR Norm, pointing out),</i> $Wedge = 0.,$ $\Alpha = 0.$ <i>(wedge and wedge rotation),</i> $HRK = 0.01, ARK = 0.$ <i>(curvatures),</i> $Diameter = 10.\text{cm},$ $Thickness = 2.\text{cm}, N = 1.4585, HRr = .99, HRt = .01, ARr = .1, ARt = .9$ <i>(power reflectances and transmittances),</i> $KeepI = False, Ref = None$	User defined by <b>RonHR, TonHR, RonAR, TonAR</b>	This is the object which allows you to specify exactly the action of each surface on reflected and transmitted beams.
bd	$X = 0., Y = 0., Z = 0.$ <i>(position of center of HR),</i> $\Theta = \pi/2., \Phi = 0.$ <i>(orientation of HR Norm, pointing out),</i> $Diameter = 5.\text{cm}, Thickness = 2.\text{cm}, Ref = None$	Stops all beams	
gh	$X = 0., Y = 0., Z = 0.$ <i>(position of center of HR),</i> $\Theta = \pi/2., \Phi = 0.$ <i>(orientation of HR Norm, pointing out),</i> $Diameter = 5.\text{cm}, Ref = None$	Transmits beams without modification, no reflected beam	This component does not affect the beams, but just allows to have a new entry in the output file for the beam emerging from the ghost surface. It does not have a 3D rendering object associated.

**Keys.** **bo** (new coordinate origin), **bm** (input beam), **mr** (mirror), **bs** (beam splitter), **th** (thin lens), **tk** (thick lens), **sp** (special surface), **bd** (beam dump), **gh** (ghost surface)

**Functions.** sin, cos, tan, arcsin, arccos, arctan, sqrt, exp

**Notes.**

- **Theta, Phi** are spherical coordinates around  $e_Z$  and  $\Phi = 0.$   $\leftrightarrow +e_X$
- All constructors can be called without arguments, all parameters have default values.



**Units.** (km, m = 1., cm, mm, um, nm), (kW, W = 1., mW, uW, nW), (THz, GHz, MHz, kHz, Hz = 1., mHz, uHz), (ppm = 1.e-6, rad = 1., deg), pi