

## Reference Sheet for “Opticstrain.m”

The Matlab program `opticstrain.m` plots the width of a Gaussian beam as a function of propagation distance. The location and type of optics encountered are listed in a control file with four columns: Optic location ( $z$ ), Type of optic, Optic parameters, Program control commands. The locations  $z$  of all optics are specified with respect to the same origin. All lengths should be specified in the same units as the beam parameter (complex curvature)  $q$ . For example, if  $q$  is specified in millimeters, so must  $z$ , and all other length parameters ( $\lambda, d, f, R, t, L, dL, R_{input}, R_{end}, L_{input}, L_{end}$ )

### Optics

Optic	Parameters	Comments
$q$	$\text{Re}(q) \quad \text{Im}(q)$	No “ $i$ ” should be added to the imaginary part
mode	$l \ m$	Laguerre-Gaussian mode numbers
lambda	$\lambda$	In same units of length as $q$
index	$n$	index of refraction of propagation medium (usually air)
opticdiam	$d$	default edge-to-edge diameter of optics in chain
lens	$f$	Focal length
mirror	$R$	Radius of curvature of mirror
window	$n \ t$	Index of window material, physical thickness of window
beamstop		Just a ref point (doesn't actually stop beam).
cavityR, cavityT, cavityI	$L$  $dL$  $R_{input} \ R_{end}$ $r_{input} \ r_{end}$ $l_{input} \ l_{end}$ $n_{cav} \ n_{input} \ n_{end}$ $L_{input} \ L_{end}$	Cavity length (will be rounded to nearest wavelength multiple), Length offset (usually required for resonance to compensate for Gouy phase of beam), Mirror radii of curvature, Mirror <i>amplitude</i> reflectivities, Mirror optical losses, indexes of cavity medium, Input mirror and end mirror substrate (physical) thicknesses. <i>Note: If no parameters are provided, the code uses the results from the last cavity calculation (or returns an error if no cavity has yet been used in the optics train). (This can be useful in order to use the transmitted and reflected beams in a branch without re-doing the cavity calculations.)</i>

### Program Control Commands

Command	Comments
push	Save the current beam parameters (position, $q$ , amplitude) onto the heap
pop	Retrieve the last beam parameters pushed onto the heap
down	Move the beam train down. Can be issued multiple times per line.
up	Move the beam train up. Can be issued multiple times per line.
pref	Set this location as the “reference location.”
profile	Display the beam profile immediately after the current optic. (Use the <code>beamstop</code> optic to obtain profiles at arbitrary locations.)