

LP Fiber Mode Calculator

Abstract



The Fiber Mode Calculator can be used to calculate linearly polarized (LP) modes propagating in a cylindrically symmetric fiber, either step-index with a single core or graded-index with an infinite parabolic profile. The corresponding polynomials to describe these modes are Bessel for step-index fibers and Laguerre for gradedindex fibers. This use case shows how to use the calculator and the configuration of the sampling parameters of the mode fields.

Configuring the Fiber Structure: Step-Index Fiber

	1: Fiber Mode Calculator
	Mode Type Linearly Polarized Bessel V Index
	Wavelength 650 nm
	Core Diameter 10 µm
	Core Material
	Name Silicon_Dioxide-SiO2-ThinFilm
+	Catalog Material 🗸 🖉
	State of Matter Solid \checkmark 1
	Cladding Material
	Name Fused_Silica
	Catalog Material V
\sim	State of Matter Solid 1
	Maximum Azimuthal Index
n _{cladding}	
	Output of Additional Data Arrays
	Create Mode Fields Show Mode Subclure
+	Validity: 1
$ ho_0$	
$2\rho_0$ is core diameter.	

The *Fiber Mode Calculator* allows for the definition of Linearly Polarized Bessel modes and Linearly Polarized Laguerre modes.

In step-index fibers the propagating modes are of Bessel type. For this configuration, the material for core and cladding needs to be defined and the number of propagating modes must be specified (all other modes are truncated).

Configuring the Fiber Structure: Graded-Index (GRIN) Fiber



1: Fiber Mode Calculator		
Mode Type	Linearly Polarized Laguerre 🗸 🗸	Inc
Wavelength	650 nm	
Core Diameter	10 µm	
Core Material		
Name Silicon_Dioxide-Si	iO2-ThinFilm	
Catalog Material	× 🧪 📔	
State of Matter	Solid \vee	
Gradient Constant	0.0025	
Maximum Azimuthal Index	7 🜩	
Maximum Radial Index	4	
Output of Additional Data	a Arrays	
Create Mode Fields	Show Mode Structure	<
Validity: 🕑		

Note: The applied GRIN model of this *Fiber Mode Calculator* (Mode Type *Linearly Polarized Laguerre*) neglects a constant refractive index of the cladding.

The *Fiber Mode Calculator* allows for the definition of Linearly Polarized Bessel modes and Linearly Polarized Laguerre modes.

For GRIN Fibers, a *Gradient Constant* is defined. The refractive index is then calculated by

$$n(\rho) = n_{\rm core}(\lambda) \sqrt{1 - 2\Delta \left(\frac{\rho}{\rho_0}\right)^2}$$

As in the previous case, the number of desired propagating modes needs to be defined.

Calculation of Propagation Constants

1: Fiber Mode Calculator					[- 0 X	Ìr	
								Propagation constant β for
Mode Type	Linearly Polarized Bessel V	Index	Azimuthal Order L	Radial Order M	Propagation Const	Effectiv		p ropagation constant p rom
Wavelength	650 nm	2	0	2	1.4242E+07 m ⁻¹	1.4704		each mode is calculated
		3	0	3	1.4162E+07 m ⁻¹	1.4651		on the flu
Core Diameter	10 µm	4	0	4	1.4094E+07 m ⁻¹	1.458		on-the-fly.
Core Material		5	1	1	1.4232E+07 m ⁻¹	1.4723	ן ו	
		6	1	2	1.4192E+07 m ⁻¹	1.4681		
Name Silicon_Dioxide-Si	iO2-ThinFilm	7	1	3	1.4131E+07 m ⁻¹	1.4618		
Catalog Material	 / 	0 0	2		1.4218E+07 m ⁻¹	1,4709	Ι,	
		10	2	3	1.4097E+07 m ⁻¹	1,4584	IJ	Effective refractive index
State of Matter	Solid 🗸	11	3	1	1.4201E+07 m ⁻¹	1,4691		
Cladding Material		12	3	2	1.4139E+07 m ⁻¹	1.4627		m is $m = -\frac{\beta}{2}$ with k
Cladding Material		13	4	1	1.4182E+07 m ⁻¹	1.4671		$n_{\rm eff}$ is $n_{\rm eff} - \frac{1}{k_{\rm e}}$, with k_0
Name Fused_Silica	Q	14	4	2	1.4109E+07 m ⁻¹	1.4596		<i>i</i>
		15	5	1	1.4159E+07 m ⁻¹	1.4648		the vacuum wave number.
Catalog Material	× 🖉	10			1.4134E+07 m ⁻¹	1,4622	·	
State of Matter	Solid \checkmark	17	,	1	1.410/E+0/ m	1,4595		
Maximum Azimuthal Index	7 😴							
Maximum Radial Index	4							
Output of Additional Data	a Arrays							
Create Mode Fields	Show Mode Structure							
Validity: 🚹 🚺					Close	Help		

Plot Order Indices, Propagation Constants and n_{eff}



Calculation and Display of Propagating Modes



title	Fiber Mode Calculator
document code	FCP.0005
document version	1.1
software edition	VirtualLab Fusion Basic
software version	2021.1 (Build 1.180)
category	Feature Use Case
further reading	