# VPIphotonics
### DESIGN AUTOMATION

## Mode Designer

# Design of Integrated Photonic Waveguides & Optical Fibers

*VPImodeDesigner™* is a versatile simulation framework for the analysis and optimization of integrated photonic waveguides and optical fibers.

This powerful design tool offers a set of full-vectorial finite-difference mode solvers with support of widely customizable non-uniform meshing and perfectly matched layer absorbing boundaries, allowing the accurate and efficient calculation of guided and leaky modes and their properties.

*VPImodeDesigner* provides a user-friendly object-oriented python interface, which enables you to easily extend the general functionality. Full access to SciPy, NumPy and other Python packages for science, engineering, and data analysis is provided.

Waveguide cross-section definitions can be translated into model parameters of passive and active devices, enabling the seamless integration of *VPImodeDesigner* with *VPIcomponentMaker™ Photonic Circuits*.
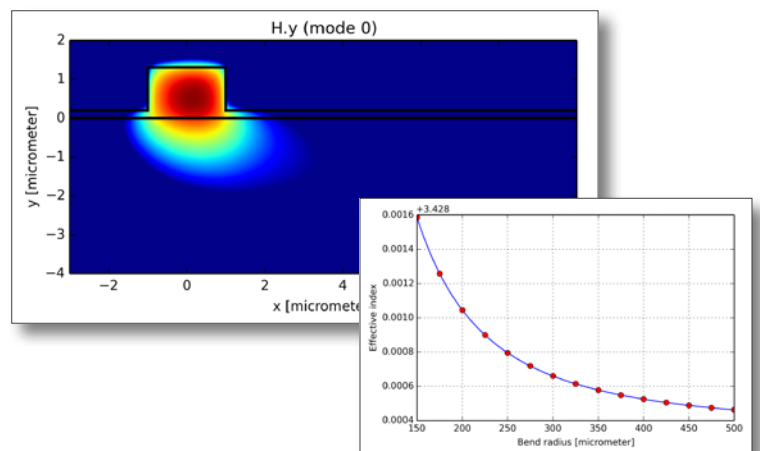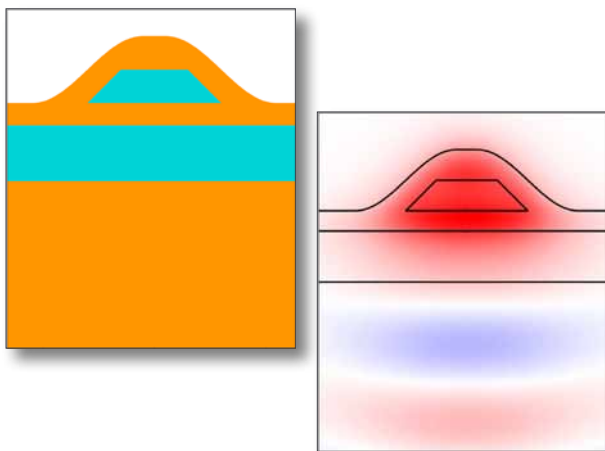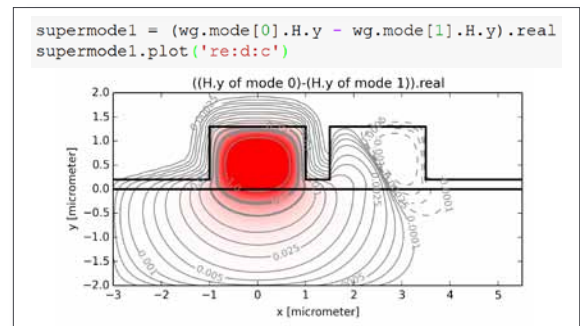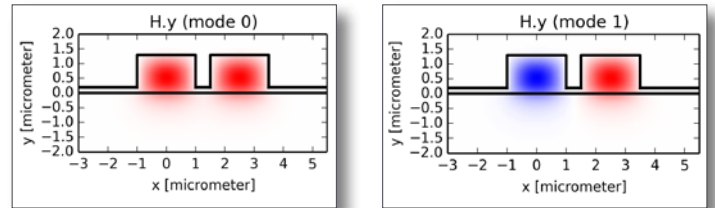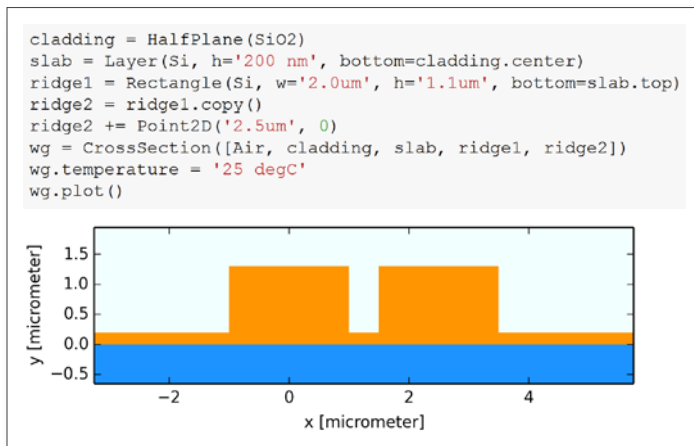


## Features

- ✓ Full-vectorial finite-difference mode solvers
- ✓ Almost arbitrarily complex cross-section layouts
- ✓ Customizable non-uniform meshing
- ✓ Support of different types of boundary conditions (PML, PEC, PMC)
- ✓ Advanced operations with guided mode fields
- ✓ Easy setup of sweeps for wavelength, temperature, and layout parameters
- ✓ Translation of waveguide cross-section into model parameters of passive and active devices

## Benefits

- ✓ Facilitate advanced layout definitions and optimization tasks via powerful Python interface
- ✓ Model straight waveguides made of dispersive anisotropic materials
- ✓ Model bent waveguides made of dispersive isotropic and lossy materials
- ✓ Verify cross-sections and analyze results using advanced visualization capabilities
- ✓ Integrate with circuit-level simulator *VPIcomponentMaker™ Photonic Circuits*

## Example: Directional Coupler

You can define almost arbitrary waveguide cross-sections with frequency- and temperature-dependent material properties. A rich set of object-oriented operations with fields of the calculated guided modes are supported.

```
cladding = HalfPlane(SiO2)
slab = Layer(Si, h='200 nm', bottom=cladding.center)
ridge1 = Rectangle(Si, w='2.0um', h='1.1um', bottom=slab.top)
ridge2 = ridge1.copy()
ridge2 += Point2D('2.5um', 0)
wg = CrossSection([Air, cladding, slab, ridge1, ridge2])
wg.temperature = '25 degC'
wg.plot()
```





```
supermode1 = (wg.mode[0].H.y - wg.mode[1].H.y).real
supermode1.plot('re:d:c')
```



The upper figures show the two original fields while the lower figure depicts their combination into a super-mode.

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## Example: Multicore Fibers

With *VPImodeDesigner* you can perform an arbitrarily complex analysis of the properties of designed waveguides and fibers. Built-in utilities allow to easily calculate effective mode area, mode confinement factor, effective and group mode indices, attenuation, and other characteristics.