

Maksim Skorobogatiy

Canada Research Chair in **photonic crystals**

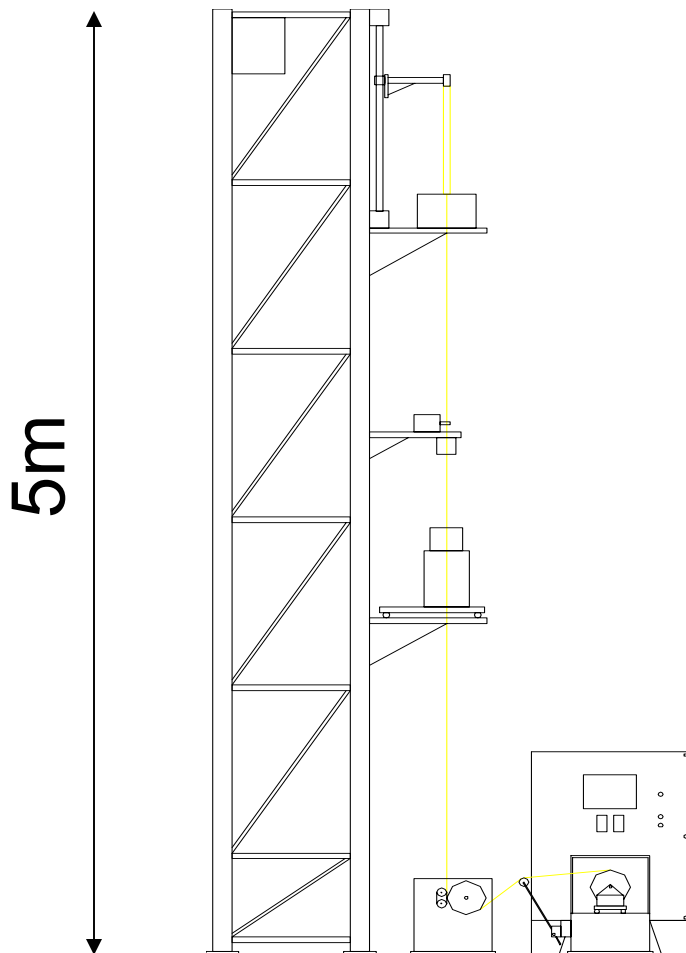
<http://www.photonics.phys.polymtl.ca>

Laboratoire de Structures et Processus Photonique
Complexes

Complex Photonic Structures and Processes Group

Our Experimental Objectives:

1. Fabrication of all-polymer multilayer preforms and bio-compatible microstructured fibers.
2. Fabrication of microstructured fiber based components

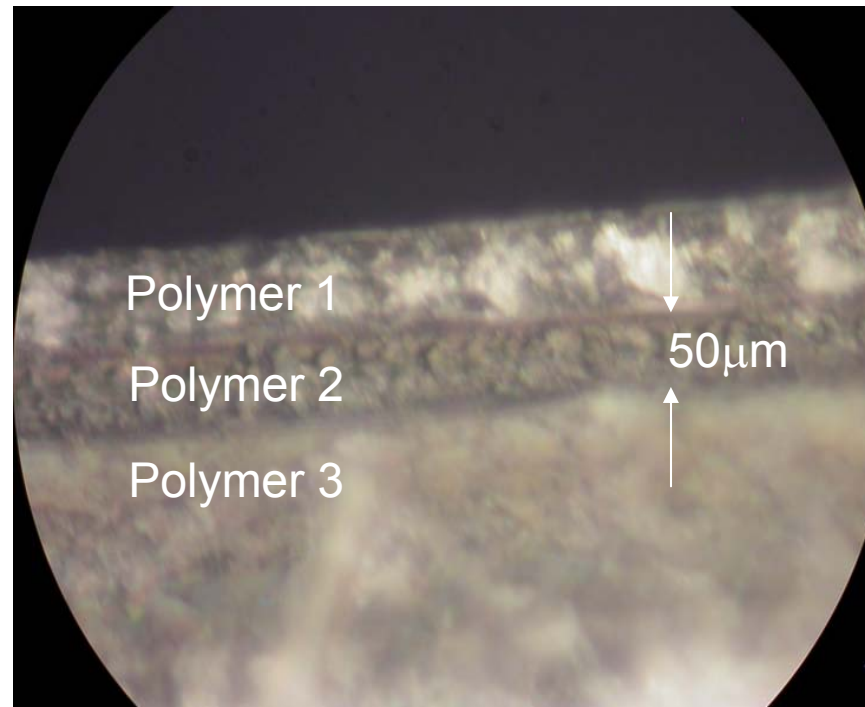


Plastic Optical Fiber Draw Tower
Automation Engineering Incorporated
(FCI)

Draw tower will be functional in the
spring of 2005

Laboratory of Polymer Preform Fabrication (FQRNT)

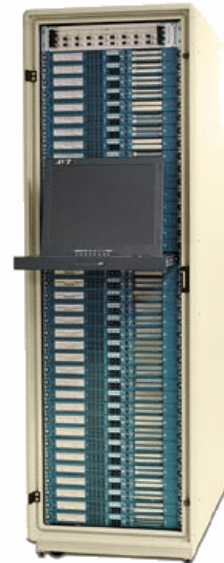
Collaboration with Département de Génie Chimique and applied polymer research center CRASP, Poly



Our Theoretical Objectives:

1. Design of new photonic crystal components
2. Simulation of optical device performance
3. Modeling of microstructured fiber fabrication process

Dedicated parallel computer cluster, Microway Xeon

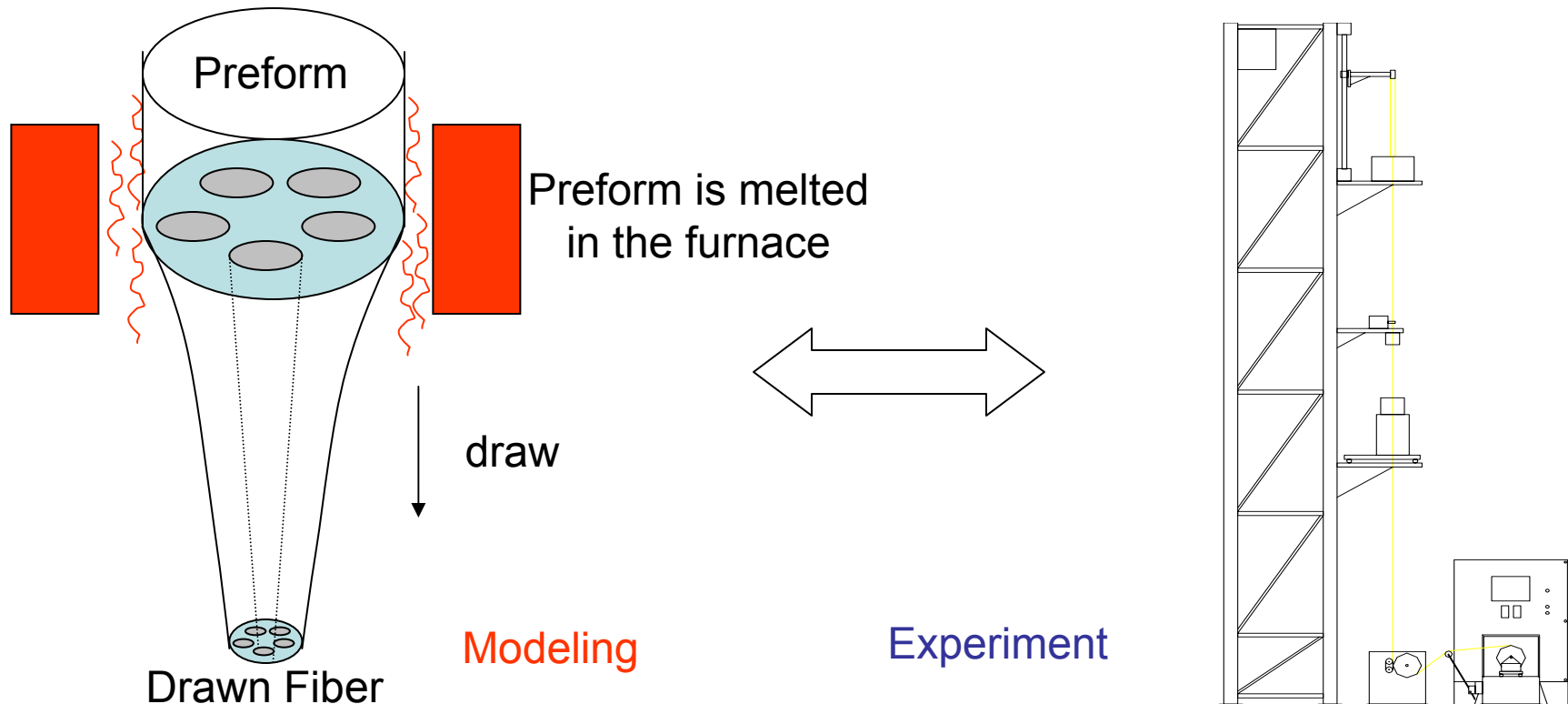


Fondation d'École Polytechnique,
FQRNT

Modeling of microstructured fiber fabrication process

Theoretically and experimentally: Numerically, we study fluid dynamics of microstructured fiber draw process of multi-material composition. Our aim is to understand how compatible should be the properties of constituent materials to result in a successful draw.

**Collaboration with le Lab. de Fibres Optiques, and
Dép. Génie Mécanique, Poly**

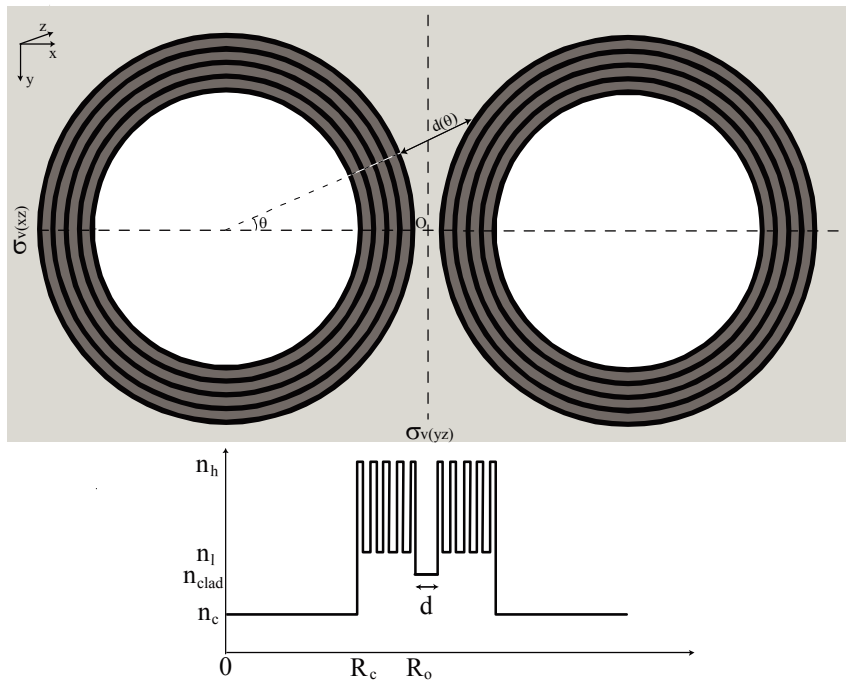


Design of new photonic crystal components

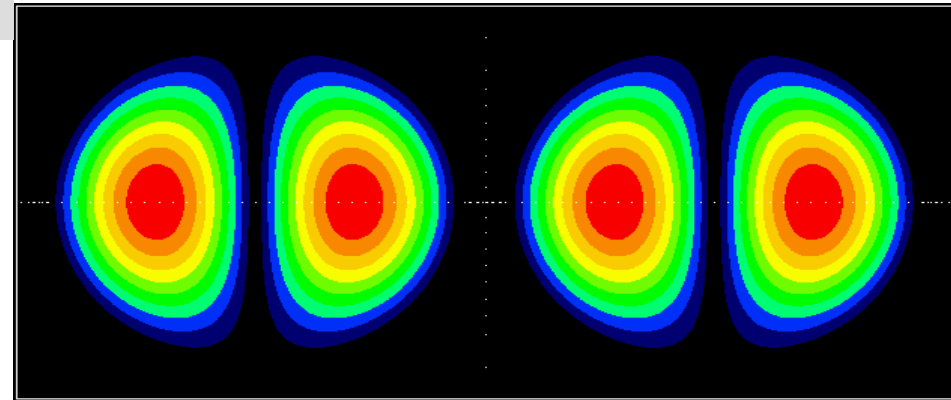
Collaboration with University of Hokkaido

M. Skorobogatiy, "Hollow Bragg fiber bundles: when coupling helps and when it hurts," *Optics Letters* **29**, 1479 (2004)

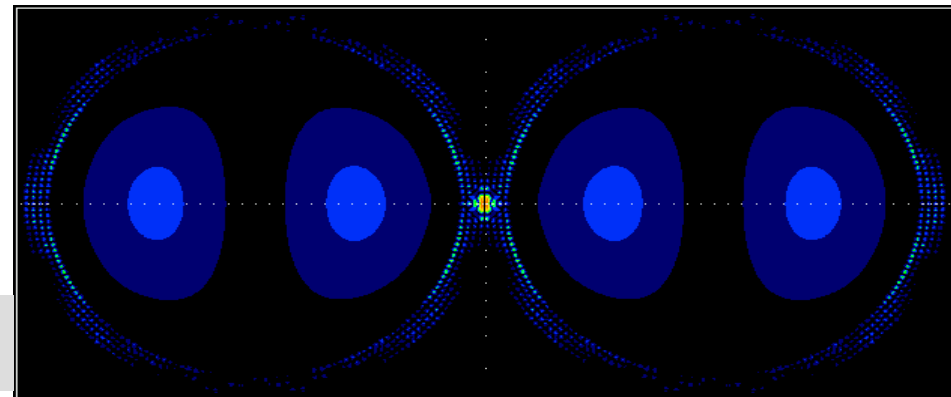
Directional coupling of hollow Bragg fibers



Optical modes of Bragg fiber coupler (telecom)



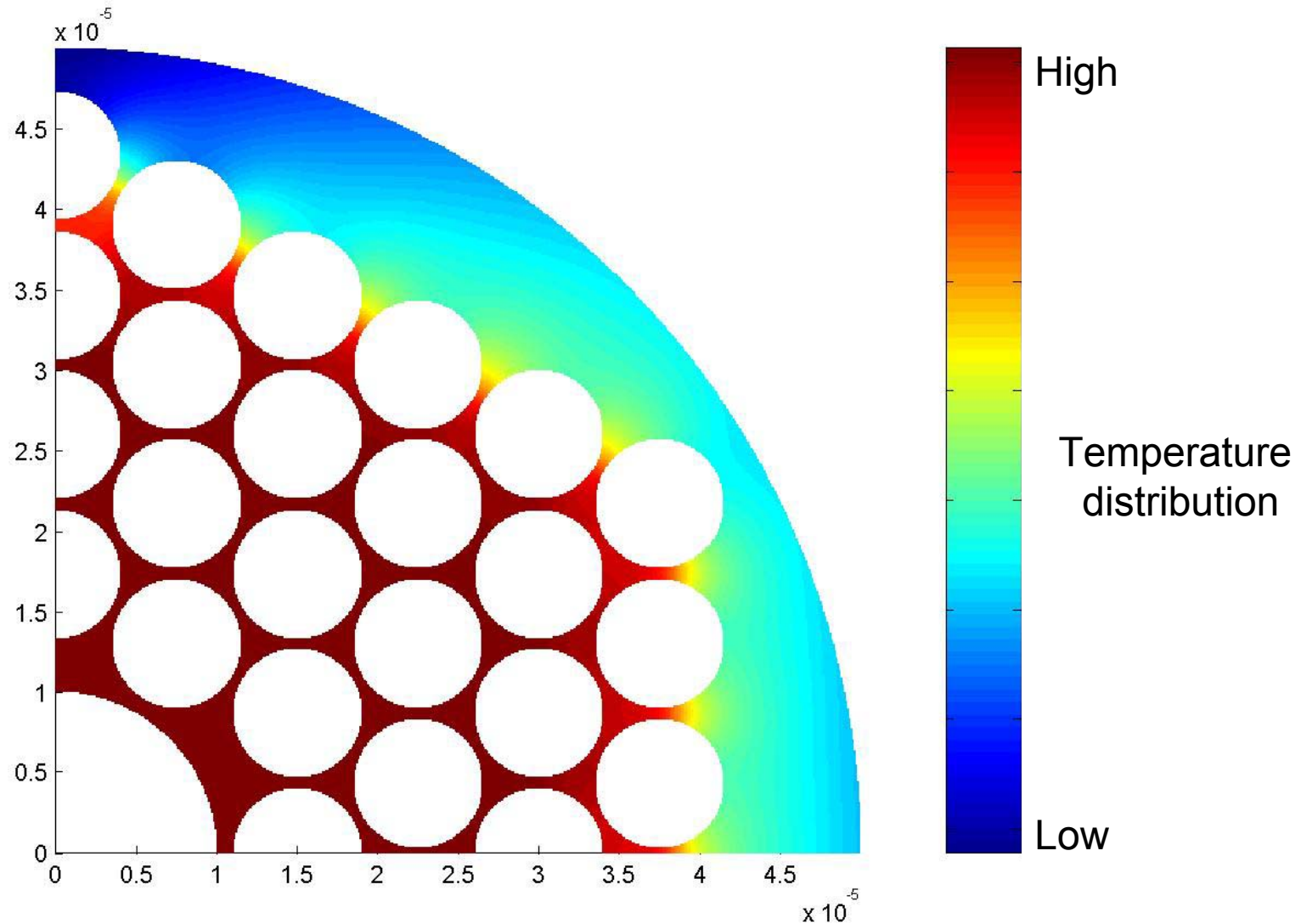
Surface modes of a Bragg coupler (chemical/biological sensing)



M. Skorobogatiy, K. Saitoh and M. Koshiba, "Resonant directional coupling of hollow Bragg fibers," *Optics Letters* **29**, 2112 (2004)

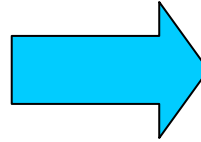
Simulation of optical device performance

Power capacity of microstructured fibers for high power transmission

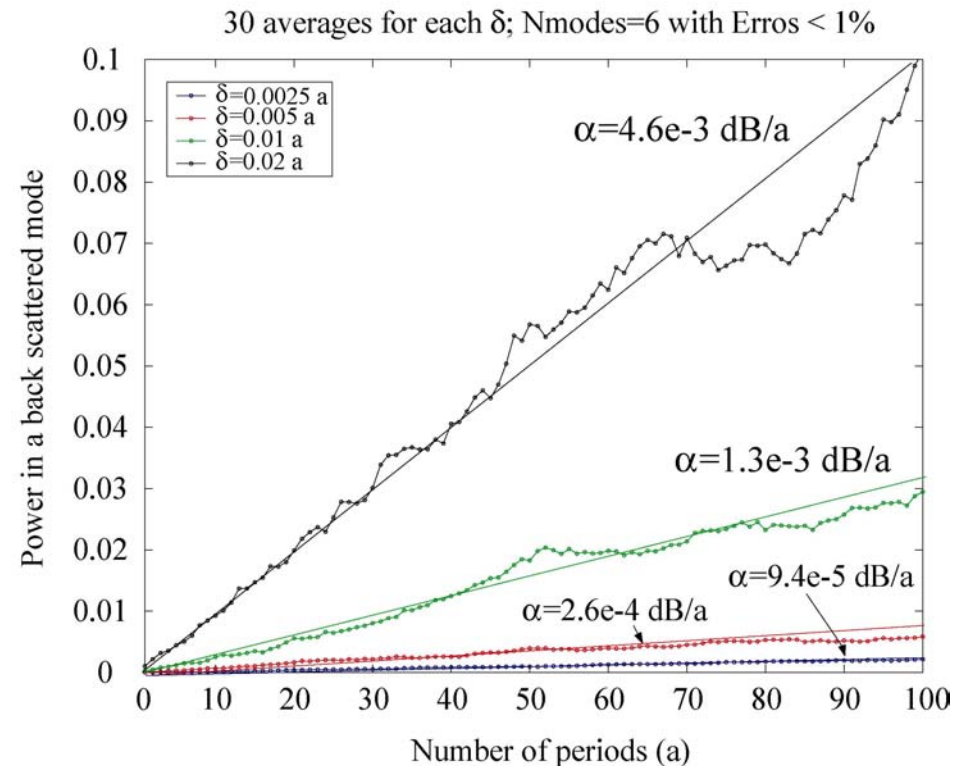
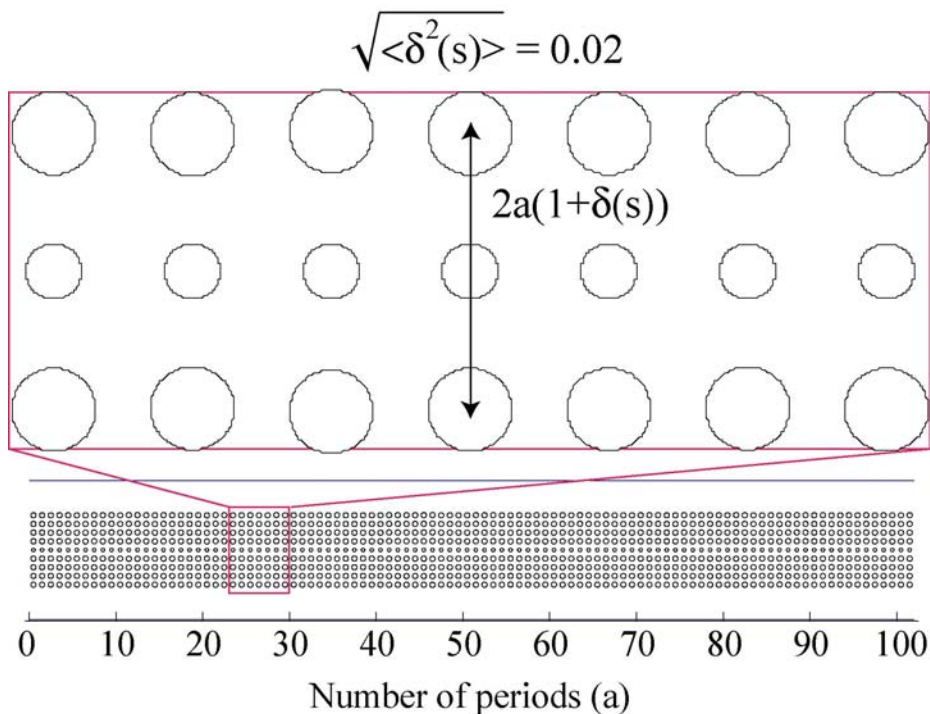


Simulation of optical device performance

Small variations in a planar Photonic Crystal waveguide core size



Large scattering losses



M. Skorobogatiy, "Modeling the impact of imperfections in high-index-contrast photonic waveguides," *Phys. Rev. E* **70**, 046609 (2004)

M. Skorobogatiy, S.A. Jacobs, S.G. Johnson, and Y. Fink, "Geometric variations in high index-contrast waveguides, coupled mode theory in curvilinear coordinates," *Optics Express* **10**, 1227 (2002)

Courses offered:

ES PHS6953A **Introd. to Photonic Crystals**

Description: Comprehensive introduction into Photonic Crystals (PC) including theory, computational methods, applications and fabrication. Hamiltonian formulation of Maxwell's equations, eigen modes and their symmetries in periodic structures, radiation and material losses. 1D multilayer stacks: transfer matrix method, band diagrams, defects in periodic structures, localized defect states, omni-directional reflectors. Quasi-1D Bragg fibers: transfer matrix method, leaky modes. 2D microstructured fibers: multipole method, endlessly single mode regime. Hollow PC fibers for telecom and high power laser guidance applications. Plane-wave method. Planar 2D PC's: TE and TM modes, point and linear defects, components for ultra dense optical integration – ultra-tight waveguide bends, intersecting waveguides, T junctions and directional couplers. Quasi-2D PC slabs: molding photon density of states for lasing applications. 3D PC's, current advances.

ES PHS6953B **Numerical Methods in Engineering Physics**

Description: Numerical methods in 1D and 2D, finite differencing, integration on general grids, shooting method, matrix method, Newton method. Introduction to subspace Krylov methods, Galerkin method, hamiltonian problems and coupled mode equations, introduction to molecular dynamics and Monte-Carlo. Introduction to the numerical methods of nuclear engineering.

Are you ambitious enough to join us?