Overview Master Program Lab Courses

M.Sc. Physics

M.Sc. Optoelectronics&Photonics

M.Sc. Materials Science

Computersimulation von optischen Wellenleitern auf Basis von photonischen Kristallen mit "CST Studio Suite®"

Computer Simulation and Study of Photonic Crystal Based Waveguides with "CST Studio Suite®"

Program: Physics, Optoelectronics&Photonics

Scientific adviser: Prof. Dr. rer. nat. Jens Förstner

Short description:

Photonic crystals (PhC) are structures consisting of dielectric materials with a spatial periodic arrangement resulting in electromagnetic waves not being able to travel within a certain (optical) frequency range called "photonic band gap". This effect can be exploited in order to develop and fabricate different kinds of optical components and integrated optical devices used for a wide range of applications, such as PhC cavities, optical filters and optical waveguides.

Due to the availability of modern high-performance computers as well as advanced innovative numerical methods and algorithms the analysis, design and optimization of such highly complex structures by means of computer simulations can be easily and efficiently performed. One application thereof is the commercial software "CST Studio Suite®" developed by the company "CST AG" which enables the numerical calculation of electromagnetic fields within structures consisting of almost arbitrary material distributions in both time and frequency domain.

In this project, a photonic crystal based waveguide will be analyzed using the above mentioned simulation tool. For this purpose, a computer model of the considered structure must first be built and then the response of the waveguide depending on various design parameters such as refractive index contrast and lattice constant has to be examined. This project's aim is to give an introduction to the use of modern computer-based simulation tools as well as to impart theoretical knowledge and comprehension of structure and functionality of suchlike optical components.

Goals:

- the acquisition of basic knowledge in the use of numerical simulation tools
- the learning and practicing of theoretical basics about photonic crystals and optical waveguides
- the development and extension of soft skills such as the ability of methodical and independent work, team work as well as scientific documentation and presentation

Tasks:

- familiarization in the theory of photonic crystals and optical waveguides
- building of a parametrized CAD model of a PhC based optical waveguide
- examination of the dependency of the operating frequency range on geometry and material parameters by means of a parameter study
- recording of project results by means of a written report and an oral presentation