Q 65: Poster Photonik

Zeit: Donnerstag 16:30–18:30 Raum: Poster C

Q 65.1 Do 16:30 Poster C

Comparison of time integration schemes in FDTD simulations in two dimensions — •Christian Matyssek[1], Oleksiy Kiriyenko[1], Markus Däne[1], Wolfram Hergert[1], Helmut Podhaisky[2], Rüdiger Weiner[2], and Martin Arnold[2] — [1]MLU Halle-Wittenberg, Institut für Physik, Von-Seckendorff-Platz 1, 06120 Halle — [2]MLU Halle-Wittenberg, Institut für Mathematik, Theodor-Lieser-Straße 5, 06120 Halle

The Yee formulation of the finite difference time domain (FDTD) method uses a fully explicit leapfrog time-stepping process which is second-order accurate. A limitation of the method is, that its stability is conditional, depending on time steps and spatial discretisation. Thus, during the last years uncondtionally stable algorithms to solve the time-dependent Maxwell equations, e.g. based on exponential integrators, have been studied.[1]

We construct FDTD algorithms based on a spatial Yee-grid combined with different higher-order accurate time integration schemes using Krylov subspace techniques. The performance of these integrators is compared. Areas of applications like nonlinear effects in Maxwell's equations will be discussed.

[1] J.S. Kole, M.T. Figge, H. De Raedt, Phys. Rev. E, 066705 (2003)

Q 65.2 Do 16:30 Poster C

Effective permittivity and optical properties of photonic/plasmonic structures in glass — •Oleksiy Kiriyenko, Wolfram Hergert, Stefan Wackerow, and Heinrich Graener — Martin-Luther-Universität Halle-Wittenberg, Institut für Physik, Friedemann-Bach-Platz 6, 06108 Halle

Nanocomposite glass containing metallic nanoparticles are of considerable interest as photonic structures with special optical properties. The effective dielectric properties of such nanocomposite glass has to be known first for a successful calculation of optical properties of photonic/plamonic structures in this material. The finite element method (FEM) is used to calculate the complex effective permittivity of two-phase disordered composite media consisting of silver nanoparticles which are randomly placed in a homogeneous dielectric (glass). Volume fractions know from experiments are studied. The results are compared with effective medium theories (EMT). The results are used to calculate optical properties of photonic structures generated in such material. The calculations are compared with experimental results.

Q 65.3 Do 16:30 Poster C

Simulation von Mikroresonatoren in photonischen Kristallen in Diamant — •Christine Kreuzer, Elke Neu und Christoph Becher — Universität des Saarlandes, Fachrichtung 7.3, Technische Physik, 66041 Saarbrücken

Die Verwendung von optisch aktiven Defektzentren in Diamant für Anwendungen in der Quanteninformation ist Gegenstand aktueller Forschung. Für den Einsatz in Quantennetzwerken [1] und probabilistischen Quantencomputern [2] ist die Ankopplung von einzelnen Defektzentren an eine Mode von Mikroresonatoren hoher Güte Voraussetzung. In diesem Zusammenhang betrachten wir Mikroresonatoren in zweidimensionalen photonischen Kristallen in Diamantfilmen. Die Lokalisierung der Moden wird durch Braggreflexion an der periodischen Struktur im Film und Totalreflexion an den Oberflächen des Diamantfilms erreicht. Zur Simulation und Charakterisierung der photonischen Kristalle werden zwei verschiedene Methoden verwendet, die die Vorteile der Lösung der Maxwellgleichungen im Frequenz- und Zeitraum kombinieren (FDTD). Wir diskutieren Strategien zur Maximierung des Gütefaktors Q der Defektresonatoren und die mögliche experimentelle Realisierung.

[1] L. Childress et al., Phys. Rev. Lett. **96**, 070504 (2006).
[2] Y.L. Lim et al., Phys. Rev. A **73**, 012304 (2006).

Q 65.4 Do 16:30 Poster C

Fabrication and Strain Tuning of Glass Fiber-Based Whispering-Gallery-Mode Bottle Resonators — •Michael Pöllinger[1,2], Florian Warken[1], Wolfgang Alt[1], Dieter Meschede[1], and Arno Rauschenbeutel[1,2] — [1]Institut für Angewandte Physik, Universität Bonn, Wegelerstr. 8, 53115 Bonn — [2]Institut für Physik, Universität Mainz, 55099 Mainz

We present our recent results on the fabrication and characterization of a novel type of highly prolate shaped whispering-gallery-mode resonators with an advantageous mode geometry and spectrum [1]. We realize the "bottle resonator" structures starting from glass fibers. The fibers are flame heated and elongated to produce a 15-μm diameter waist and then microstructured by focused CO_2 laser heating. The resulting small radius modulations are then measured using a diffraction technique that allows us to determine the resonator profile with a sub-micron precision. The resonators are spectrally characterized in a setup where light is coupled in and out by means of micron sized coupling fibers. Furthermore this setup allows us to apply strain to the resonator, thereby tuning its resonance frequency. Tuning over more than one free spectral range has been achieved. Quality factors in the $Q = 10^5$ range have been observed. Our current efforts aim at enhancing Q by working with custom made glass fibers made of high quality glass. Ideally, values in the $Q = 10^8$–10^9 range should be achievable.

We acknowledge financial support by the DFG research unit 557.

[1] Y. Louyer, D. Meschede, and A. Rauschenbeutel, Phys. Rev. A **72**, 031801(R) (2005).

Q 65.5 Do 16:30 Poster C

Selective excitation of electric and magnetic resonances in nanoscopic structures with radially and azimuthally polarized light — •Peter Banzer, Susanne Quabis, Ulf Peschel, and Gerd Leuchs — Max Planck Researchgroup, Institute of Optics, Information and Photonics, Guenther-Scharowsky-Straße 1, 91058 Erlangen, Germany

A couple of years ago the research in the domain of so-called metamaterials started. Metamaterials are a form of effective media of which the properties do not depend on the intrinsic material parameters but their macroscopic periodic structure. They can show a rather contra intuitive behaviour. In this context the electric and magnetic resonances of the nanoscopic unit cells of the material play an important role.

We investigate the selective excitation of magnetic and electric resonances in single nano-structures. For this purpose we use radially and azimuthally polarized light which provides a non-homogeneous polarisation distribution at a sub-wavelength scale. The polarized light is focussed by a high numerical aperture microscope objective (NA 0.9). The existence of longitudinal and transversal electric and magnetic fields which are formed in the focal plane of the beam allow us to choose the direction of the induced electric and/or magnetic dipole and therefore its plane of radiation. In order to check for resonances we measure angular spectrum of the scattered light sensitive to polarisation with a tuneable light source.

The measurements are performed using single sub-wavelength gold spheres as well as so-called split-ring-resonators.

Q 65.6 Do 16:30 Poster C

Talbot effect at two-dimensional microscopic periodic structures — •Ralf Ameling, Manuel Gonçalves, André Siegel, and Othmar Marti — Universität Ulm, Institut für Experimentelle Physik, D-89069 Ulm

The Talbot effect is a self-imaging phenomenon observable at periodic objects illuminated with coherent light. The intensity distribution at the grating is reproduced at distances that are mutiples of the Talbot distance. This lenght is dependent on the array symmetry, the lattice constant and the wavelength of the incident light.

We investigated self-imaging at two-dimensional hexagonal colloidal crystals consisting of polysterene spheres and their inverse egg-box-like structures. The observed diffraction patterns (especially at the Talbot-length) have been compared with computer simulations based on different theoretical models like the Rayleigh-Sommerfeld-theory and the Hertz-vector diffraction theory. In addition, several computer programs for the simulation of the propagation of electromagnetic waves and the optical near-field have been used to verify the results. They are based on the finite-difference time-domain (FDTD) algorithm and the finite element method .

Q 65.7 Do 16:30 Poster C

Thermo-acoustic optical path length stabilization in a single mode optical fiber. — •Wojciech Lewoczko-Adamczyk[1], Max Schiemangk[1], Holger Müller[2], and Achim Peters[1] — [1]Humboldt Universität zu Berlin, Institut für Physik, Quantenoptik und Metrologie, Hausvogteiplatz 5-7, 10117 Berlin — [2]Physics Department, Stanford University, Stanford, CA 94305

We present a simple technique to actively stabilize the optical path length in an optical fiber. A part of the fiber is coated with a thin electrically conductive layer, which acts as a heater. The optical path length is thus modified by temperature dependent changes in the refractive index and in the mechanical length of the fiber. The dynamic response of the latter is dominated by the speed of sound in glas rather than by slow thermal diffusion. Making use of this fact we succeeded in actively stabilizing the optical path length with a closed-loop bandwidth greater than 1 kHz.