Q 7 Photonik in komplexen und periodischen Strukturen I

Zeit: Montag 11:10–12:40 Raum: H14

Q 7.1 Mo 11:10 H14

Anisotropic Light Diffusion in Suspensions of Birefringent Colloids — •T. Gisler, K. Sandomirski, G. Maret, and H. Stark — Universität Konstanz, Fachbereich Physik, Fach M621, 78457 Konstanz

We study multiple scattering of light in suspensions of birefringent, spherical colloids with a large, positive birefringence $n_e - n_o \approx 0.2$. Due to the anisotropy in the diamagnetic susceptibility, these particles are oriented by a magnetic field **B** which suppresses the orientation fluctuations.

In the diffusive regime of light transport, the diffuse transmission T_d *decreases* with increasing magnetic field B when the incident wave vector $\mathbf{k}_i$ is parallel to **B**. On the other hand, T_d measured for $\mathbf{k}_i \perp \mathbf{B}$ *increases* with B. Furthermore, the particle orientation by the magnetic field leads to a pronounced anisotropy in the transmission profiles when $\mathbf{k}_i \perp \mathbf{B}$: the photon diffusion coefficient $\mathcal{D}_\perp$ perpendicular to the magnetic field is larger than $\mathcal{D}_\parallel$, the photon diffusion coefficient parallel to **B**, with a maximal value of the anisotropy $\mathcal{D}_\perp/\mathcal{D}_\parallel \approx 1.6$ at a magnetic field strength $B = 7\,\mathrm{T}$. Even at high particle densities and with samples thick enough that ballistic light is virtually absent, we find that the diffusely transmitted light is partially polarized, with a degree of polarization that increases with B and reaches a value 0.14 at $B = 7\,\mathrm{T}$. This indicates that the orientation of the particles by the magnetic field induces a macroscopic uniaxial symmetry into the random medium guiding the diffusive light propagation.

Q 7.2 Mo 11:25 H14

Talbot effect observed on microstructured surfaces — •Manuel Gonçalves, André Siegel, and Othmar Marti — University of Ulm, Dept. of Experimental Physics, Albert-Einstein-Allee 11, D-89069 Ulm, Germany

The Talbot effect, known in optics since the middle of the 19th century acquired, recently, also strong interest in atom optics. In both classical and atom optics the theoretical analysis of this effect relies on the paraxial and parabolic approximations of the Fresnel diffraction.

We show that, in some cases, this approach is inadequate. We have observed experimentally the self-imaging on two-dimensional arrays of microspheres adsorbed on flat surfaces, and on microstructured surfaces using colloidal crystals as templates. These structures can focus an incoming plane wave sharply generating very narrow light sources. We show that if the size of light sources is of the order of the wavelength, or even smaller, the conventional paraxial approximation to calculate the Talbot length, z_T, fails.

In order to explain the evolution of the light intensity with the distance to the array, we have developed an theoretical model based on the Rayleigh-Sommerfeld diffraction theory, without using the paraxial approximation. The results obtained are in good agreement with the experimental measurements. On the other hand, the diffraction patterns predicted by the classical Fresnel formalism were not observed experimentally.

Q 7.3 Mo 11:40 H14

Optische Nichtlinearitäten in photonischen Bandlückenfasern mit hohlem Kern — •Erik Benkler, Axel Springhoff und Harald R. Telle — Physikalisch-Technische Bundesanstalt, Bundesallee 100, 38116 Braunschweig

Photonische Bandlückenfasern mit Hohlkern sind neuartige Wellenleiter zur einmodigen Übertragung hoher optischer Leistungen und zur Kompression ultrakurzer Lichtimpulse. Das Feld wird hier weitgehend im Hohlkern geführt, woraus eine geringe Wechselwirkung mit Phononen im Mantelmaterial und eine kleine effektive Nichtlinearität dritter Ordnung resultiert. Bei sehr hohen Spitzenintensitäten werden trotzdem nichtlineare Effekte beobachtet, die teilweise im Fasermantel und teilweise im Kern (z.B. Luft) stattfinden. Wir haben ein hochempfindliches Femtosekunden-Vierwellenmischverfahren mit Heterodyn-Detektion entwickelt, mit dem derartig kleine Nichtlinearitäten bereits bei niedrigen Impulsenergien quantitativ und wellenlängenabhängig gemessen werden können. Es verwendet kleine Frequenzabstände, so dass eventuelle Phononenbeiträge wirkungsvoll unterdrückt werden. Über Anwendungen dieses Systems auf verschiedene Wellenleiter, insbesondere auf Hohlkernfasern, wird berichtet.

Q 7.4 Mo 11:55 H14

Quantum-optical and classical spectroscopy with radiatively coupled multi quantum-wells — •Marco Werchner, Martin Schäfer, Walter Hoyer, Mackillo Kira, and Stephan W. Koch — Department of Physics and Material Sciences Center, Philipps University, Marburg, Germany

The optical properties of multiple-quantum-well systems are in many respects different from single quantum-well results. Radiative-coupling effects have been observed for classical spectroscopy after coherent excitation [1] as well as for steady-state photoluminescence spectra in the incoherent regime [2].

Here, an extended microscopic theory compared to [2] is presented which allows one to study *quantum* excitation, i.e. the full dynamics after excitation with an incoherent light pulse. This theory is applied to analyze reflection and transmission spectra for such a quantum excitation. In particular, the influence of the quantum-well spacing is investigated. Key differences between quantum and classical excitation are shown to result from different dephasing characteristics of coherent and incoherent excitons.

[1] T. Stroucken, A. Knorr, P. Thomas, and S. W. Koch, Phys. Rev. B **53**, 2026 (1996)
[2] M. Kira, F. Jahnke, W. Hoyer, and S. W. Koch, Prog. Quantum Electron. **23**, 189 (1999)

Q 7.5 Mo 12:10 H14

Symmetry Properties of Light-Matter Interaction in Chiral and Achiral Metamaterials — •Tineke Stroucken[1], Walter Hoyer[1], Torsten Meier[1], Stephan W. Koch[1], Matthias Reichelt[2], Jerry V. Moloney[2], and Ewan M. Wright[3] — [1]Department of Physics and Material Sciences Center, Philipps-University, Renthof 5, D-35032 Germany — [2]Arizona Center for Mathematical Sciences, University of Arizona, Tucson, AZ 85721, USA — [3]College of Optical Sciences, University of Arizona, Tucson, AZ 85271, USA

Recently, optical properties of metamaterials, i.e., regular arrays of artificial sub-wavelength structures, have received considerable attention. The possibility to achieve a magnetic response at optical frequencies allows for a variety of new optical phenomena, such as negative refraction. In general, the response of a metamaterial is modeled with the aid of an effective electric and magnetic susceptibility. Although effectively homogeneous, the interaction of electromagnetic waves with metamaterials may depend on the polarization state of the exciting light field, indicating an anisotropic response. In particular, nonreciprocal response and optical activity for circularly polarized light interacting with planar chiral metamaterials could be observed[1,2].

Here, we investigate the general symmetry properties of the light-matter interaction in metamaterials and discuss their constraints on the effective optical response[3].

[1] A. Papakostas et al., Phys. Rev. Lett. **90**, 107404 (2003)
[2] M. Kuwata-Gonokami et al., Phys. Rev. Lett. **95**,227401 (2005)
[3] M. Reichelt et al.,submitted to Applied Physics B

Q 7.6 Mo 12:25 H14

Two-dimensional self trapped photonic lattices in anisotropic photorefractive media — •Bernd Terhalle[1], Nina Sagemerten[1], Denis Träger[1], Cornelia Denz[1], Anton S. Desyatnikov[2], Dragomir N. Neshev[2], Wieslaw Krolikowski[2], and Yuri S. Kivshar[2] — [1]Institut für Angewandte Physik, Westfälische Wilhelms-Universität Münster — [2]Nonlinear Physics Center and Laser Physics Center, Center for Ultra-high bandwidth Devices for Optical Systems (CUDOS), Research School of Physical Sciences and Engineering, Australian National University, Canberra ACT 0200, Australia

Photonic structures provide many novel possibilities to control light propagation, because the wave band-gap spectrum and diffraction are strongly affected by the periodic refractive index modulation. Lattices of different symmetries can be induced optically in photorefractive crystals using periodic light patterns that propagate without change in their profile. Due to the anisotropy of photorefractive materials, ordinary polarised light propagates in an almost linear regime, whereas extraordinary polarised light experiences strong photorefractive nonlinearity. Therefore one can distinguish between linear, nonlinear and so called mixed lattices. In our contribution, we investigate structure, stability and waveguiding properties of such lattices in real space as well as in Fourier space.