SYRT 1 Radiation transport in random media I

Zeit: Freitag 11:00–13:00 Raum: HVI

Hauptvortrag SYRT 1.1 Fr 11:00 HVI

The Collective Atomic Recoil Laser (CARL): what atoms and fireflies have in common — •Claus Zimmermann — Physikalisches Institut der Universität Tübingen, D-72076 Tübingen, Germany

Cold atoms can be trapped in the optical modes of a high finesse ring resonator. If the cavity is pumped through one of the input ports only, the atoms will scatter light from the forward into the reverse direction leading to a standing wave light field which in turn influences the atomic density distribution. This self organisation process has strong similarities to the free electron laser and can be regarded as a first experimental realisation of the long time proposed Collective Atomic Recoil Laser (CARL). There are also strong similarities to superradiant Rayleigh scattering and Bragg Spectroscopy of Bose-Einstein condensates. By adding friction with a superimposed optical molasses, one obtains a very clean experimental realization of the so called Kuramoto model which describes a large class of fundamental self organisation processes. By means of optical Bragg diffraction we can directly observe the periodic atomic density distribution. A heterodyne technique allows determining both amplitude and phase of the diffracted light and it was possible to observe the phase of resonant Rayleigh scattering for the first time. The here presented method may also be useful for diagnostics of quantum gases in optical lattices.

Hauptvortrag SYRT 1.2 Fr 11:30 HVI

Coherent backscattering of light in nonlinear media — •Thomas Wellens — Laboratoire Kastler Brossel, Université Pierre et Marie Curie, F-75231 Paris, France

The diffusive propagation of waves in disordered media may be significantly affected by interference effects such as coherent backscattering, weak and strong localization. Whereas these effects are relatively well understood in the case of linear media, the influence of nonlinearities on the interferential properties of multiple scattering has only started to be explored. In this talk, I report on our recent work [1] on coherent backscattering of light by cold atoms which, at higher intensities, become nonlinear due to the onset of saturation. Using a perturbative approach, valid for weakly nonlinear scatterers, I show that the nonlinearity has a fundamental impact on the phenomenon of coherent backscattering. In particular, nonlinear interference effects may lead to an enhancement of the backscattered intensity by more than a factor two.

[1] T. Wellens, B. Grémaud, D. Delande, and C. Miniatura, PRA 73 (2006, in press).

Hauptvortrag SYRT 1.3 Fr 12:00 HVI

Experiments on the critical regime near Anderson localization of light — •Georg Maret, Martin Störzer, Peter Gross, and Christof M. Aegerter — Fachbereich Physik, Universität Konstanz, D-78457 Konstanz, Germany

As predicted first by P.W. Anderson diffusive transport of multiply scattered waves in disordered media may break down due to interference. This transition to localization of waves should occur for any classical or quantum wave in any media when the wavelength becomes comparable to the transport mean free path l*. Unequivocal experimental proof of the existence of wave localization in disordered bulk (3D) materials is still lacking, basically since the signatures of localization and absorption may be rather similar. Here we present measurements of time resolved non-classical diffusion of visible light in strongly scattering samples of colloidal TiO_2, which cannot be explained by absorption, sample geometry or reduced transport velocity. Deviations from classical diffusion increase strongly with decreasing l* as expected for a phase transition. This constitutes an experimental realization of the critical regime in the approach to Anderson localization of light.

Hauptvortrag SYRT 1.4 Fr 12:30 HVI

Propagation of light in disordered fiber bundles — •Ulf Peschel[1], Thomas Pertsch[2], Falk Lederer[3], Jens Kobelke[4], Kay Schuster[4], Hartmut Bartelt[4], Stefan Nolte[2], and Andreas Tünnermann[2] — [1]Institut für Optik, Information und Photonik, Universität Erlangen, D-91058 Erlangen, Germany — [2]Institut für Festkörpertheorie und Theoretische Optik, Friedrich-Schiller-Universität Jena, D-07743 Jena, Germany — [3]Institut für angewandte Physik, Friedrich-Schiller-Universität Jena, D-07743 Jena, Germany — [4]Institut für Physikalische Hochtechnologie e.V, D-07745 Jena, Germany

We experimentally study the propagation of light in a distorted bundle of coupled optical fibers. Monitoring the field evolution in the fibers we find coherent interaction to turn over into diffusive spreading due to the presence of disorder. Parts of the propagating field even remain trapped in certain areas of the array. Increasing the power we cause the nonlinearity to successfully compete with the action of disorder. The diffusive propagation of linear fields is nonlinearly modified resulting in power controlled localization. In contrast, fields which remain trapped in the low power case, start to propagate and spread due to the action of the nonlinearity. Experimental results are compared with numerical simulations and good agreement is obtained.