Q 54 Anwendung ultrakurzer Lichtimpulse II

Zeit: Dienstag 17:30–18:30 Raum: HU 1070

Q 54.1 Di 17:30 HU 1070

Interferenz ultrakurzer Elektronenwellenpakete: Visualisierung und Anwendung — •Marc Winter, Matthias Wollenhaupt und Thomas Baumert — Universität Kassel, Institut für Physik und CINSaT, Heinrich-Plett-Str. 40, D-34132 Kassel, Germany

In diesem Beitrag wird die Analogie von im Vakuum propagierenden Materiewellenpaketen zur Propagation elektromagnetischer Wellenpakete in einem dispersiven Medium mittels der Wignerverteilung der Wellenpakete illustriert. Die Wignerverteilung erlaubt die gleichzeitige Darstellung im Orts- und Impulsraum (bzw. Zeit- und Frequenzraum). In einem Experiment zur Interferenz freier Elektronen haben wir den Kohärenztransfer von ultrakurzen Laserpulsen auf freie Elektronenwellenpakete demonstriert [1]. Wir diskutieren wie aus den Photoelektronenspektren dieses Pump-Probe Experiments am Atomstrahl die Pulsparameter der verwendeten Femtosekunden Laserpulse extrahiert werden können. Diese Pulscharakterisierungstechnik lässt sich auch, bei geeigneter Wahl der Targetatome, auf Laserwellenlängen im UV-/XUV-Bereich anwenden.

[1] M. Wollenhaupt et al., Phys. Rev. Lett 89, 173001 (2002).

Q 54.2 Di 17:45 HU 1070

Optimal control theory of time-dependent targets — •Jan Werschnik, Ioana Serban, and E.K.U. Gross — Freie Universitaet Berlin, Arnimallee 14, 14195 Berlin, Germany

The control of quantum mechanical systems by laser interaction has witnessed tremendous progress in the last 15 years. On the experimental side this progress was due to the development of pulse shaping techniques and on the theoretical side, the prediction of laser pulses has been pushed forward by the introduction of rapidly, monotonically convergent algorithms. So far, theory and experiment have concentrated on the control of time-independent targets, e.g., a specified final state should be maximally populated at the end of the laser pulse. In this talk we demonstrate the feasibility of computational quantum control for time-dependent targets. In particular, we show that the the time-dependent density can be driven along a given trajectory in real space and we control the time-dependent occupation numbers of a two-level system and a 1D model for hydrogen. The employed algorithm converges monotonically and is computationally not more expensive than algorithms for the optimization of time-independent targets.

Q 54.3 Di 18:00 HU 1070

Gated heterodyne coherent anti-Stokes Raman scattering for chemical imaging — •Marco Greve[1], Bernd Bodermann[1], Harald R. Telle[1], Peter Baum[2], and Eberhard Riedle[2] — [1]Physikalisch-Technische Bundesanstalt, Braunschweig — [2]LS für Biomolekulare Optik, Ludwig-Maximilians-Universität München

The use of molecular vibrations as contrast mechanism makes coherent anti-Stokes Raman scattering (CARS) microscopy a powerful method for molecule-specific imaging [1]. As coherent four-wave mixing process CARS provides a fixed phase relationship between the four light fields and allows the heterodyne detection of the CARS signal if a tunable phase-coherent local oscillator pulse is available. With proper pulse timing such a detection scheme - gated heterodyne CARS - is capable of significantly improving the signal-to-background ratio, i.e. the image contrast.

We demonstrate this novel method with three femtosecond noncollinear optical parametric amplifiers (NOPAs) seeded by a common white-light. Two NOPAs have previously been shown to emit phase coherent light [2]. A contrast improvement of more than two orders of magnitude compared to conventional CARS was achieved with deuterated benzene as sample and heavy water as a possible solvent.

Further applications include the thermometry of combustion processes.

[1] M. D. Duncan et al., Opt. Lett. 7, 350 (1982)
[2] P. Baum et al. , Opt. Lett. 28, 185 (2003)

Q 54.4 Di 18:15 HU 1070

Dynamics of femtosecond laser-induced breakdown in water — •Cristian Sarpe-Tudoran, Andreas Assion, Matthias Wollenhaupt, Marc Winter, and Thomas Baumert — Universität Kassel, Institut für Physik und CINSaT, Heinrich-Plett-Str. 40, D-34132 Kassel, Germany

Femtosecond laser induced optical breakdown in water has been intensively investigated in the last decade due to its applications in precise ablation of biological tissues, therapeutic laser medicine and laser analytic. Even if it is generally accepted that the primary process in the laser induced optical breakdown is the generation of high-density free electrons by multiphoton and impact ionisation, the free electrons plasma evolution in the early times of formation is not yet completely understood. We used a combination of imaging techniques, transient reflection spectroscopy and frequency-domain interferometry in order to monitor the early time breakdown plasma dynamics and to study its dependence on the laser intensity. We observed that the optical properties of the breakdown plasma created by femtosecond lasers on a water surface are quite similar to that of a Fabry-Perot interferometer. Therefore the dynamics of the plasma thickness in the nm-range and the temporal evolution of the free electrons density can be deduced.