K 5 Neue Verfahren / Hochdruckphysik

Zeit: Mittwoch 11:00–12:20 Raum: HU 3092

K 5.1 Mi 11:00 HU 3092

Attosecond entanglement of protons and electrons in molecular hydrogen - Experimental results and theoretical considerations
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Several experiments on liquid and solid samples containing protons show a striking shortfall in the intensity of epithermal neutrons scattered by the protons [1-3]. E.g., neutrons colliding with water for just attoseconds (as) will see a ratio of H to O of roughly 1.5 to 1, instead of 2 to 1 [1,3]. In our neutron Compton scattering (NCS) experiments, the duration of a neutron-proton scattering event is about 50-500 as. Recently this effect has been confirmed using electron-proton Compton scattering (ECS) from a solid polymer [2,3]. Electrons and neutrons interact with protons via fundamentally different forces – electromagnetic and strong. Theoretical considerations support the presence of attosecond quantum entanglement in the dynamics of the protons and the surrounding electrons. New NCS experiments on liquid hydrogen (H2, D2, and HD; T = 20 K) demonstrate that spin-entanglement between two protons play no role in this effect. Our results indicate that hitherto unknown features of attosecond dynamics of chemical bonds may become accessible to attosecond scattering techniques.

[1] C. A. Chatzidimitriou-Dreismann et al., *Phys. Rev. Lett.* **79**, 2839 (1997). [2] C. A. Chatzidimitriou-Dreismann et al. *Phys. Rev. Lett.* **91**, 057403 (2003). [3] Cf.: *Physics Today*, sect. 'Physics Update', p. 9, Sept. 2003; *Physik in unserer Zeit* **35**(4), 174 (2004).

K 5.2 Mi 11:20 HU 3092

Short lived protonic quantum entanglement and coupling to the electronic environment
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A temperature dependent decrease of the protonic total neutron scattering cross section σ_H in LiH using neutron Compton scattering (NCS) has been reported [1]. The decrease of σ_H which is found in various materials is attributed to short-lived protonic quantum entanglement [2] and the novel temperature dependence to the different decoherence due to coupling of the protons to the environment [1]. To shed more light on the latter, the NCS of two metal hydrides, i.e., LaH_2 and LaH_3, have been measured. While LaH_2 is metallic, LaH_3 is an isolator, thus involving different electronic environments the protons are coupled to. σ_H is found to be smaller for LaH_3 than for LaH_2. This result strongly indicate that the different couplings of the protons to the different electronic environments of LaH_2 and LaH_3 is responsible for these differences. Further experimental results on other materials with different electronic structures will be also presented.

[1] T. Abdul-Redah, C. A. Chatzidimitriou-Dreismann, Physica B 350 S1 (2004) E983-E986.

[2] C. A. C.-Dreismann, M. Vos, C. Kleiner, T. Abdul Redah, Phys. Rev. Lett. 91 (2003) 057403.

K 5.3 Mi 11:40 HU 3092

Echtzeitmessung der Membranenaufladung bei Säugerzellen in gepulsten elektrischen Feldern im Nanosekundenbereich
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Werden Säugerzellen sehr kurzen und hohen elektrischen Feldimpulsen (10 ns, größer 100 kV/cm) ausgesetzt, kann der programmierte Zelltod (Apoptose) ausgelöst werden. Als Ursache dafür wird derzeit die Aufladung von Membranen der Organellen im Zellinneren gesehen. Hier wurde erstmals die Membranaufladung im Nanosekundenbereich mit Hilfe eines dafür aufgebauten gepulsten Laserfluoreszenzmikroskops messtechnisch erfasst. Mittels eines 4,8 ns langen Farbstofflaserimpulses werden Zellen, deren Membranen mit einem feldsensitiven Fluoreszenzfarbstoff gefärbt sind, unter einem invertierenden Fluoreszenzmikroskop beleuchtet. Die Beleuchtung findet zu unterschiedlichen Zeitpunkten während des Feldimpulses statt. Es werden der Aufbau des Experiments und Messergebnisse der Membranaufladung von Jurkat-Zellen während eines 100 kV/cm, 60 ns Feldimpulses präsentiert.

K 5.4 Mi 12:00 HU 3092

Low jitter laser source at arbitrary low repetition rates for electro-optical sampling
— •Vadim Eisner, Holger Quast, Christian Meuer, and Dieter Bimberg — Technische Universität Berlin, Institut für Festkörperphysik, Sekretariat PN 5-2, Hardenbergstrasse 36, 10623 Berlin

For a number of time resolved optical measurement techniques such as electro-optical sampling, low jitter ultra-short optical pulses at low repetition rates are precondition. The generation of such pulses from a gain-switched semiconductor laser diode (LD) is desirable. Unfortunately, when the repetition rate of the optical pulse is less than the frequency of the relaxation oscillation of LD, typically several GHz, timing jitter appears conspicuously. In this talk, a new set-up to generate low jitter single mode laser pulses at arbitrary repetition rates using a pulsed distributed feedback (DFB) laser diode for external injection seeding will be presented. Based on simple gain-switching technique, picosecond pulses are generated. However, femtosecond pulses are needed to characterise high-performance devices in the 100 GHz range and beyond with an electro-optical measurement system. Therefore a compression scheme has been developed. It consists of a linear pulse compression based on the compensation of the red chirp and a non-linear pulse compression based on soliton compression. We presently obtained pulses of less than 300 fs FWHM at a repetition rate of 400 MHz.