K 4: Pulsed Power - Laser-Beam Matter Interaction

Time: Wednesday 14:00–15:45 Location: MB HS

Invited Talk K 4.1 Wed 14:00 MB HS

Experimental Results from the Development of a Triggered Vacuum Switch (TVS) at the Pohang Accelerator Laboratory (PAL) — •Klaus Frank[1], Wung Hoa Park[2], Suk Ho An[2], and Byung Joon Lee[2] — [1]Physics Department University of Erlangen Nuremberg, Erlangen,Germany — [2]Pohang Accelerator Laboratory, Pohang, South Korea

The TVS is an extremely robust devices that can survive over-voltage, overcurrent, and reverse-current faults. At the Pohang Accelerator Laboratory in 2015 started the development of a non-sealed-off TVS prototype. The experimental set-up consists of the 6 * rod prototype TVS switch, a charging circuit with a capacitor bank with C = 16.63 μF, which has at 20 kV charging voltage a total stored charge of 0.3 C or a total energy of 3.3 kJ. The peak current Ip is 88 kA. Introductorily a short review of the history of TVS development is given. For better understanding of triggering and breakdown the basic model of TVS breakdown is briefly described. Usually the trigger unit is at an elevated position with regard to the cathode surface. Therefore it is inevitably exposed to metal vapor deposition from the main discharge plasma. At PAL a second position of the trigger unit was studied. The trigger unit is positioned in a recess of the cathode. Lifetime comparisons of both trigger positions are presented. In parallel, the metallic layer deposition on the ceramic disc of the trigger is investigated by several methods of thickness analysis. Finally an outlook for future experiments is given.

K 4.2 Wed 14:30 MB HS

Semiconductor Lasers Optically Pumped in the Tunnel Excitation Regime — •Richard Hollinger[1,2], Valentina Shumakova[3], Pavel Malevich[3], Skirmantas Ališauskas[3], Lukas Trefflich[4], Robert Röder[4], Audrius Pugžlys[3], Andrius Baltuška[3], Carsten Ronning[4], Christian Spielmann[1,2], and Daniil Kartashov[1] — [1]Institute of Optics and Quantum Electronics, Abbe Center of Photonics, University Jena, 07743 Jena, Germany — [2]Helmholtz-Institut Jena, Helmholtzweg 4, 07743 Jena, Germany — [3]Institute for Photonics, TU Vienna, Gußhausstrasse. 25-29, 1040 Vienna, Austria — [4]Institute for Solid State Physics, University Jena, Max-Wien-Platz 1, 07743 Jena, Germany

Since the famous work of Albert Einstein at the beginning of the last century, we describe light matter interaction in the photon picture, i.e.the absorption of light depends only on the frequency of the photon and not on the intensity of the light wave. With the advent of intense lasers, multiphoton excitation has been realized, i.e. two or more low energy photons have to be absorbed simultaneously to excite an atom. There, excitation depends not only on the photon energy but also on the intensity of the incident light wave. Here, we show that further lowering the pump photon energy brings us into the regime of tunneling excitation. Now the excitation of atoms becomes (nearly) independent of the frequency but solely depends on the incident intensity of the light wave. Experimentally we confirm the wavelength and intensity scaling in the tunneling excitation regime by studying the visible emission of semiconductor nanolasers under mid-infrared pumping.

K 4.3 Wed 14:45 MB HS

Influence of the system lengthscale in the Strong Field Photoelectron Energy Spectra — •Abraham Camacho Garibay[1], Zhou Wang[1], Hyunwook Park[1], Ulf Saalmann[2], Jan-Michael Rost[2], and Louis DiMauro[1] — [1]The Ohio State University, Columbus, OH, USA — [2]MPI-PKS, Dresden

Electrons emitted from atoms in the presence of a strong (IR) lasers are successfully explained by the Three-Step Model, which considers the parent atom to have no volume. This model describes the features of photoelectron spectra in terms of direct electrons driven by the field, or backscattered ones from binary collisions, with cutoff energies of 2 and 10 U_p respectively. In previous experiments with rare gas clusters, the resemblance to the atomic case was not clear and a thermalization process was considered to be dominant. With current laser capabilities with tunnable wavelength, along with variable cluster sizes, we show (experimentally and numerically) that energetic electrons are produced by field driven backscattered electrons. More importantly, we have found that this cutoff energy is universally determined by the dimensionless scaled cluster radius R_{cl}/r_w, naturally extending our understanding of the atomic case.

K 4.4 Wed 15:00 MB HS

Modellierung der Erwärmung von CFK durch cw-Laserstrahlung unter Berücksichtigung der thermischen Strahlung zwischen den einzelnen Faserschichten — •Rüdiger Schmitt — Deutsch-französisches Forschungsinstitut Saint-Louis, Postfach 1260, D-79547 Weil am Rhein

Aufgrund Ihres inhomogenen Aufbaus finden bei der Beaufschlagung von Verbundwerkstoffe mit leistungsstarker Laserstrahlung vielfältige Prozesse statt, die eine Modellierung im Gegensatz zu beispielsweise Metallen erschweren.

In der Präsentation werden Ergebnisse numerischer Berechnungen vorgestellt, die die thermische Entwicklung innerhalb einer laserbeaufschlagten Laminatstruktur aus Kohlenstofffasern und einer Kunststoff-Matrix beschreiben. In der FEM-Rechnung wurde berücksichtigt, dass das Harz einen relativ niedrigen Siedepunkt hat und die Wärmeleitfähigkeit nach dem Verdampfen stark vermindert wird. Wie die Rechnungen zeigten, kann die thermische Strahlung zwischen den einzelnen Faserschichten einen großen Teil zum Wärmetransport beitragen.

Ergänzend zu den FEM-Rechnungen wurden analytische Beziehungen hergeleitet, die basierend auf der Wärmeleitungsgleichung und einem thermischen Ersatzschaltbild die Berechnung eines temperaturabhängigen, anisotropen Wärmeleitkoeffizienten ermöglicht. Gerade bei dickeren Strukturen kann hierdurch die innere Wärmeübertragung durch thermische Strahlung berücksichtigt werden, ohne jede der nur wenige mu dicken Fasern bei der Erstellung der Geometrie berücksichtigen zu müssen.

K 4.5 Wed 15:15 MB HS

Development of a highly reflective double-pulsed plasma mirror with emphasis on plasma scale length control — •Gregor Indorf[1,2], Graeme Scott[3], Malte Ennen[1], Lisa Scaife[3], Alexander Andreev[1,2], Ulrich Teubner[1,2], and David Neely[3] — [1]Institut für Laser und Optik, Hochschule Emden/Leer, D-26723 Emden — [2]Institut für Physik, Universität Oldenburg, D-26129 Oldenburg — [3]STFC Central Laser Facility OX11 0QX, United Kingdom

For the last decade, plasma optics have constantly been used in the field of high power laser related studies and applications, revealing multiple possibilities to manipulate pulses or generate high harmonics in attosecond trains. Plasma mirrors have proven to be powerful tools not only for increasing the temporal contrast of ultrashort intense laser systems by several orders of magnitude, but also for providing an ultrafast optical switch capable of working at high fluences. A record reflectivity of a double-pulse plasma mirror system has been presented by G.G. Scott et al in 2015[1] to be around 96% of an incoming laser pulse of 1 ps. We are now concentrating on achieving similar results for a 40fs pulse, paying special attention to the quality of the reflected wave-front by optimising the prepulse and the interpulse delay between pre- and mainpulse. The driving laser for these studies is a 500mJ, 10Hz Ti:sapphire system at the Rutherford Appleton Laboratory at Harwell, UK. This work has been sponsored by grant EP/K022415/1. [1] G.G. Scott et al., Optimisation of plasma mirror reflectivity and optical quality using double laser pulses. New journal of physics, 2015.

K 4.6 Wed 15:30 MB HS

Mid-infrared supercontinuum generation in germanate and tellurite photonic crystal fibers — •Rafal Sopalla[1], Heinar Hoogland[2,3], Jiapeng Huang[1], Fehim Babic[1], Roland Holzwarth[2], Xin Jiang[1], and Philip St.J. Russell[1] — [1]Max-Planck-Institute for the Science of Light, 91058 Erlangen, Germany — [2]Menlo Systems GmbH, 82152 Martinsried, Germany — [3]Universität Erlangen-Nürnberg (FAU), 91058 Erlangen, Germany

We report recent advances in the development of soft-glass photonic crystal fibers, with tailored dispersion for broadband supercontinuum extending into the mid-infrared. Two types of PCFs, made from germanate and tellurite glasses, are engineered for pumping at 2 μm. The tellurite PCF has a solid core with diameter 6.2 μm, surrounded by five-rows of hollow channels, with a relatively high air-filling-fraction of >80%. This highly nonlinear solid-core PCF has a zero dispersion wavelength of 1.8 μm, shifted from 2.2 μm in bulk material. The germanate PCF has a core ~1.9 μm in diameter held in place by three thin glass membranes and thus surrounded by three large hollow channels. Its zero dispersion wavelength is 1.5 μm. A 2.05 μm fiber laser CPA system (based on MenloSystems Red-Fiber) generating 400-fs pulses at 10 MHz and 1.2-W average power is used as pump., The generated supercontinuum spectrum in a 16 mm length of tellurite PCF starts from 0.54 μm and extends well beyond 3.5 μm. The results are verified by numerical simulations based on the commonly used generalized nonlinear Schrödinger equation for the slowly varying complex envelope of the pulses.