K 6: Poster

Time: Tuesday 14:00–16:00 Location: Tent

K 6.1 Tue 14:00 Tent

Ultrafast Spectroscopy Reveals Spin-Crossover Behavior in Nanometric Thin Films — •Raluca Denisa Coltuneac[1], Maciej Lorenc[2], Nicolas Godin[2], Cristian Enachescu[1], and Laurentiu Stoleriu[1] — [1]Faculty of Physics Alexandru Ioan Cuza University of Iasi, Iasi, Romania — [2]Institute of Physics (IPR), Rennes, France

This study examines thermal and spin-crossover (SCO) dynamics in nanometric thin films under laser irradiation. Using$[Fe(HB(tz)_3)_2](tz = 1,2,4 - triazol - 1 - yl)$ complexes we combine analytical and experimental approaches to explore heat diffusion and SCO transitions.

A Fourier-based heat conduction model incorporates thermal conductivity and laser-induced heating across 2D and 3D geometries, revealing how system shape affects heat dissipation. SCO dynamics were analyzed with femtosecond transient absorption spectroscopy (fs-TAS), tracking spin-state transitions in thermally evaporated thin films on silica. The bistable spin behavior, studied under UV-visible excitation, showed strong links between thermal and light-induced transitions, with spectral control achieved through pump-probe delay adjustments.

These findings advance understanding of nanoscale SCO behavior, offering insights for thermal and optical applications in advanced materials.

K 6.2 Tue 14:00 Tent

Time-, space- and spectral-resolved characterization of the ablation plume generated with ultrafast laser radiation — •Phillip Börner, Markus Olbrich, Andy Engel, and Alexander Horn — Laserinstitut Hochschule Mittweida, 09648 Mittweida, Germany

The knowledge of the size and density of the ablation plume generated by ultrafast laser radiation represents a key parameter to understand the interaction of multi-pulsed ultrafast laser radiation with matter particularly in the case of applying bursts of ultrafast laser radiation with pulse separation times of several 100 ps up to a few ns within the burst. A complementary experimental setup combining pump-probe imaging reflectometry, interferometry, and spectroscopy is presented. This setup enables the measurement of space- and spectral-resolved changes in intensity over time, allowing the calculation of changes in the optical properties and geometrical shape of the material surface as well as of the induced ablation plume. Based on these changes, the excitation of the electron system and the generation of the ablation plume is determined by reflectometry and interferometry within the first nanoseconds after the irradiation. The emission of the ablation plume is measured by the combination of an imaging spectrograph coupled with an em-ICCD camera for later timescales. Therefore, this setup enables a detailed understanding of laser-matter-interaction, especially in describing the ablation plume.

K 6.3 Tue 14:00 Tent

Ping-Pong with microparticles — •Krishna Kant Singh[1,2], Ajitesh Singh[2], Deepak Kumar[2], and Debabrata Goswami[2,3] — [1]Department of Physics, University of Kassel, Germany — [2]Department of Chemistry, Indian Institute of Technology Kanpur, India — [3]Centre for Lasers and Photonics, Indian Institute of Technology Kanpur, India

Optical tweezers [1] have become a versatile and potent instrument in the realms of experimental physics, biology, and nanotechnology, allowing for the manipulation of particles ranging from micrometres to nanometres. While the use of high-repetition-rate ultrafast lasers has garnered significant attention, particularly in nanoparticle manipulation, low-repetition-rate lasers have not received comparable recognition due to challenges in achieving stable trapping. Seeking further insights, we employed an amplified kHz laser source in an optical tweezers setup for the first time, yielding intriguing findings. Our results demonstrated distinct particle behaviours compared to conventional optical tweezers, showcasing a ping-pong motion within an optically confined zone. Moreover, we achieved the successful dragging and trapping of particles from considerable distances by synergizing an amplified kHz beam with a MHz beam, a phenomenon not observed in traditional optical tweezers setups.

References [1]A. Ashkin, J. M. Dziedzic, J. E. Bjorkholm, and S. Chu, "Observation of a single-beam gradient force optical trap for dielectric particles," Opt. lett., vol. 11, no. 5, pp. 288-290, 1986.

K 6.4 Tue 14:00 Tent

A passive laser gyroscope for Earth rotation monitoring — •Tessa Koch, Jannik Zenner, and Simon Stellmer — Physikalisches Institut, Rheinische Friedrich-Wilhelms-Universität, Bonn, Germany

Active ring lasers have been the leading variant in detecting subtle earth rotation variations influenced by diverse geophysical processes across a wide spectrum of frequencies. On the other hand, passive laser gyroscopes are still a far less advanced concept. By placing the gain medium outside of the optical resonator, the passive variant removes many of the systematic limitations of active gyroscopes, and holds the potential to increase sensitivity. We will report on the current status of a unique setup that can be operated both actively and passively, with the goal of characterizing both operation concepts.

K 6.5 Tue 14:00 Tent

Ultrafast Detection of Quantum Emitters at High Repetition Rates — •Amr Farrag[1], Assegid Mengistu Flatae[1], Amir Ashjari[2], Doris Möncke[2], and Mario Agio[1,3] — [1]Laboratory of Nano-Optics and Cμ, University of Siegen, 57072 Siegen, Germany — [2]Inamori School of Engineering at the New York State College of Ceramics, Alfred University, Alfred, New York 14802, USA — [3]National Institute of Optics (INO), National Research Council (CNR), 50125 Florence, Italy

Single-photon sources have become essential for quantum science and for quantum-based technologies. Detection of ultrafast quantum emitters is currently limited by the temporal resolution of time-correlated single-photon counting (TCSPC) down to a few ps. Nonlinear sampling techniques such as optical Kerr gate (OKG) can offer sub-ps temporal resolution. Here, we present OKG experiment with Bismuth Borate Silicon Dioxide (BBS) glass and Graphene as a Kerr media, using a gate laser beam at 1 GHz repetition rate, thereby allowing addressing ultrafast single-photon emitters.

K 6.6 Tue 14:00 Tent

Interferometric Visualization of High-Power Standing Ultrasound Fields — •Regina Schuster[1], Murat-Jakub Ilhan[1], Marius Foith[1], Jan Helge Dörsam[2], Christoph Haugwitz[2], Class Hartmann[2], Sören Soennecken[2], Yannick Schrödel[3,4], Christoph M. Heyl[3,4], Mario Kupnik[2], and Anne Harth[1] — [1]ZOT, AASAP, Aalen University, Aalen, Germany — [2]TU Darmstadt, Darmstadt, Germany — [3]DESY, Hamburg, Germany — [4]Helmholtz Institute, Jena, Germany

The contactless and diffraction-based deflection of laser beams in air [1] requires the use of high-power standing ultrasound fields [2]. Consequently, a non-invasive and detailed characterisation of these intense sound fields is imperative.

In this work, we present a two-dimensional imaging technique for the interferometric visualisation of standing ultrasound fields. The modulation of air pressure induced by sound waves changes the refractive index of air, which can be quantitatively measured using an interferometer. This method enables the two-dimensional acquisition of complex sound field distributions generated by high-power ultrasound transducers in a single measurement.

[1] Y. Schrödel, *et. al., Nature Photonics,* vol. 18, no. 1, pp. 54-59, 2024

[2] A. Jäger, *et. al., 2017 IEEE International Ultrasonics Symposium,* pp. 1-4, 2017

K 6.7 Tue 14:00 Tent

Terahertz-Induced Nonlinear Response in ZnTe — •Felix Selz[1,2,3], Johanna Kölbel[2], Felix Paries[1], Georg von Freymann[1,3], Daniel Molter[1], and Daniel M. Mittleman[2] — [1]Fraunhofer Institute for Industrial Mathematics ITWM, Department Materials Characterization and Testing, 67663 Kaiserslautern, Germany — [2]School of Engineering, Brown University, Providence, Rhode Island 02912, USA — [3]Department of Physics and Research Center OPTIMAS, RPTU Kaiserslautern-Landau, 67663 Kaiserslautern, Ger-

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Measuring terahertz waveforms in terahertz spectroscopy often relies on electro optic sampling employing a ZnTe crystal. Although the nonlinearities in such zincblende semiconductors induced by intense terahertz pulses have been studied at optical frequencies, the manifestation of nonlinearity in the terahertz regime has not been reported. In this work, we investigate the nonlinear response of ZnTe in the terahertz frequency region utilizing time-resolved terahertz-pump terahertz-probe spectroscopy. We find that the interaction of two copropagating terahertz pulses in ZnTe leads to a nonlinear polarization change which modifies the electro-optic response of the medium. We present a model for this polarization that showcases the second-order nonlinear behavior. We also determine the magnitude of the third-order susceptibility in ZnTe at terahertz frequencies, $\chi^{(3)}(\omega_{\mathrm{THz}})$. These results clarify the interactions in ZnTe at terahertz frequencies, with implications for measurements of intense terahertz fields using electro-optic sampling.

K 6.8 Tue 14:00 Tent

Exploring Intensity Correlations in Strong-Field Frequency Conversion — •Carlo Kleine, Mohamed Attia, Hannah Schlenker, Christian Ott, and Thomas Pfeifer — Max-Planck-Institut für Kernphysik, Heidelberg, Deutschland

The interaction of light with matter using short, intense laser pulses is a key focus in many areas of research. These pulses enable the investigation of electronic and nuclear dynamics in atoms and molecules, as well as the active control of small quantum systems. Typically, these interactions have been successfully described using a classical electromagnetic field. However, recent experimental findings highlight the necessity of a quantum mechanical description of the field, particularly in extreme nonlinear processes such as high-order harmonic generation (Tsatrafyllis et al, Nat. Commun. 8(1) 2017). This has been demonstrated by investigating the anticorrelation between the transmitted intensity of the driving near-infrared (IR) and the generated extreme ultraviolet (XUV) light. These studies emphasize the importance of exploring intensity correlations in strong-field frequency conversion processes. In this poster, the intensity correlation between perturbative harmonics in the visible and near IR is investigated and analyzed, focusing on both correlation and anticorrelation.

K 6.9 Tue 14:00 Tent

A Dual-driven Hard X-ray Source as Benchmark for High Brilliance Lab-based X-ray Generation — •Lion Günster, Luka Petersen, Jose Mapa, Greta Paruschke, Philip Mosel, Sven Fröhlich, Andrea Trabattoni, Uwe Morgner, and Milutin Kovacev — Leibniz Universität Hannover - Institut für Quantenoptik, Hannover, Deutschland

Conventional X-ray sources have been stagnating in terms of brightness. Melting of target or anode material caused by the electron beam limits conventional sources to a brilliance of $< 10^{10}$ Photon/s mrad^2 mm^2. However, it has been proposed that secondary sources could be the key to advance lab based hard x-ray sources and with the rapid improvements of high energy short pulsed lasers promising results have been achieved.

In my poster I will demonstrate the construction of an apparatus that employs a Galinstan liquid metal jet as target material and allows the switching between an electron beam and a laser produced plasma (LPP) to drive the generation of x-rays without modifying any other experimental parameters. In that way, the apparatus allows a direct comparison between conventional and secondary x-ray sources, which has not been conducted yet.

K 6.10 Tue 14:00 Tent

Laser-Driven X-ray Sources — •Luka Petersen, Lion Günster, Jose Mapa, Greta Paruschke, Philip Mosel, Sven Fröhlich, David Schmitt, Uwe Morgner, Andrea Trabattoni, and Milutin Kovacev — Leibniz University Hannover, Institute of Quantum Optics, Germany

The field of X-ray imaging has gained increasing attention in recent years due to its applications in the medical and industrial sectors. Advancements in this field have enabled to resolve increasingly smaller structures within shorter time frames. However, high-intensity and especially pulsed X-ray sources are usually only available in large-scale facilities.[1]

Here we present our current development of a table-top laser-based high-repetitive X-ray source. The setup is based on the concept of laser-produced plasma (LPP) driven by a high-power laser system that is focused on a liquid metal jet target. The produced plasma consequently emits a strong X-ray burst. The aim is to enhance brilliance and coherence compared to conventional X-ray sources, such as X-ray tubes. This is possible as lasers can achieve much smaller focal spots than electron beams. In first benchmark experiments we will compare different target geometries in terms of photon numbers, X-ray source sizes, debris and handling.

[1] Robert Schoenlein et al., Recent advances in ultrafast X-ray sources 2019, http://doi.org/10.1098/rsta.2018.0384

K 6.11 Tue 14:00 Tent

Debris Detection and Mitigation for Laser-Produced Plasma X-ray Sources — •Greta Paruschke, Lion Günster, Luka Petersen, Jose Mapa, Philip Mosel, Sven Fröhlich, Andrea Trabattoni, Uwe Morgner, and Milutin Kovacev — Leibniz Universität Hannover, Hannover, Germany

Laser produced plasmas (LPP) can produce large amounts of X-rays. X-ray sources from metal based LPPs have several advantages e.g. a high flux and small source point. However, in Laser-based X-ray sources debris production leads to limitations of the performance by degrading components in the proximity of the interaction area. This is unavoidable making efficient debris shielding necessary.

Debris particles come in the form of vapor, ions, dust, and high-speed particles as unwanted byproducts of the plasma that degrade the surface of optics, resulting in lower reflectivity and potential damages on the optic. Mitigation techniques differ depending on the debris composition and source geometry, making each source unique. To fully use the benefits of LPP sources, choosing the appropriate shielding is essential to minimize the degradation of the focusing optics and maintain a high photon flux.

Here we investigate methods to evaluate the composition of debris from our LPP source regarding its particle size and speed distribution. Furthermore, approaches for debris mitigation are presented and evaluated.