A 19 Wechselwirkung mit VUV and X-FEL Licht

Zeit: Donnerstag 14:00–16:00 Raum: H7

Hauptvortrag

A 19.1 Do 14:00 H7

Nonlinear Optics in Coherently Prepared Media — •Thomas Halfmann — Fachbereich Physik, Technische Universitaet Kaiserslautern, Erwin-Schroedingerstrasse, 67653 Kaiserslautern

Nonlinear optics provide a powerful tool to extend the wavelength regime of coherent radiation. In particular, short-wavelength, i.e. vacuum- (VUV) or extreme ultraviolet (XUV) radiation, is of significant interest for lithography, high-resolution microscopy or spectroscopy. Atomic gases exhibit typical nonlinear optical media to drive frequency conversion processes to the VUV or XUV. However, nonlinear optical processes in gaseous media suffer from low conversion efficiencies. Coherent preparation of the media, adiabatically driven by laser pulses with moderate intensities, serves to overcome these difficulties and permits the significant enhancement of frequency conversion processes. The talk reports on enhancement of four-wave mixing in media, prepared in maximum coherence by Stark-chirped rapid adiabatic passage (SCRAP). The efficiency of the frequency conversion processes, yielding VUV and XUV radiation, is enhanced by more than one order of magnitude with respect to the case of conventional frequency conversion. Even less efficient preparation of coherences, induced by ultra-short radiation pulses, permits the significant enhancement of frequency conversion. The generation of coherent ultra-broad spectra in molecular systems is strongly enhanced by stimulated coherences. Thus, these results demonstrate the significant potential of coherent preparations in nonlinear optical media paving the way towards enhanced sources for coherent radiation.

Hauptvortrag

A 19.2 Do 14:30 H7

Generation of Extreme Intense Coherent Femto- and Attosecond Pulses — •Ulrich Teubner and Dietrich von der Linde — Fachbereich Physik, Universität Duisburg-Essen, Lotharstr. 1, 47048 Duisburg

It is well known that today coherent radiation in the extreme ultraviolet (XUV) could be obtained via the generation of high-order harmonics (HH) in gases. However, although extraordinary results such as HH with attosecond pulse duration have been demonstrated, there are difficulties with phase matching and the maximum applicable laser intensity limits the intensity of the harmonics. On the other hand it is less well known that HH generation down to the XUV is also possible at solid density surfaces and this without the mentioned disadvantages. The generated HH are as well coherent, of femto- or even attosecond pulse duration and moreover they could be very intense. We will give an overview on this topic and discuss HH generation with femtosecond laser pulses up to relativistic intensities which results in extreme intense XUV pulses.

A 19.3 Do 15:00 H7

Wechselwirkung von intensiver VUV-FEL Strahlung mit Edelgasclustern — •H. Thomas[1], C. Bostedt[1], M. Hoener[1], E. Eremina[1], T. Möller[1], E. Plönjes[2], M. Kuhlmann[2] und H. Wabnitz[2] — [1]TU Berlin — [2]DESY Hamburg

Experimente über die Wechselwirkung von höchstintensiver ultravioletter Strahlung des TTF1-FEL bei 100 nm und 10^{13} W/cm^2 mit Edelgasclustern haben zu überraschenden Ergebnissen geführt. Es wurde eine unerwartet hohe Absorption der Strahlung in den Clustern gemessen, die zur Coulombexplosion der Cluster mit Ladungszuständen von bis zu 8+ führte. Als Erklärung für die beobachtete starke Absorption der Strahlung in den Clustern wurden aus theoretischer Sicht neue Ansätze wie atomare Korrekturen für das Potential im inversen Bremsstrahlungsprozess vorgeschlagen. Der neue DESY VUV-FEL arbeitet bei einer Wellenlänge von 32 nm und ähnlichen Intensitäten. Ein Vergleich von Ergebnissen bei 32 mit den bei 100 nm kann wichtige Information über die Rolle der Absorption durch inverese Bremsstahlung liefern.

A 19.4 Do 15:15 H7

Photoionisation of rare gas atoms by VUV-FEL radiation — •Michael Wellhöfer[1], Jon Tobias Hoeft[1], Michael Martins[1], Wilfried Wurth[1], Markus Braune[2], and Jens Viefhaus[2] — [1]Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg, Germany — [2]Fritz-Haber-Insitut, Faradayweg 4-6, 14195 Berlin, Germany

The Vacuum Ultra Violet - Free Electron Laser (VUV-FEL) at Hasylab/DESY has been set in operation in the beginning of 2005. This unique novel source yields very short laser pulses, typically 50fs and less, with very high photon flux up to 10^{13} photons per pulse. Due to the Self Amplified Spontaneous Emission (SASE) process of the VUV-FEL each pulse differs from the previous in intensity and wavelength. This demands a complete new data acquisition system to correlate the measurements with the individual pulse properties. Furthermore the VUV-FEL does not only generate laser pulses with one distinct wavelength, but also higher harmonics. Thus, to perform experiments with a well defined photon energy, e.g. for high resolution spectroscopy, a monochromator beamline has been designed and set in operation for user experiments mid 2005. The high intensity of the VUV-FEL allows not only experiments on diluted targets such as single atoms or free clusters within a single shot, but also experiments probing the non linearity of photon absorption. Thus, the full spectral information of a single shot is required. This can be accomplished by using zero order and first order beam simultaneously. In my talk I will present first results of photoionisation experiments on rare gas atoms.

A 19.5 Do 15:30 H7

Messungen mit einer Multi-TOF-Apparatur am Freie-Elektronen-Laser — •Markus Braune, Axel Reinköster, Jens Viefhaus und Uwe Becker — Fritz-Haber-Institut der MPG, Faradayweg 4-6, 14195 Berlin

In ersten Messungen am VUV-FEL bei DESY in Hamburg kamen Elektronen-Flugzeitspektrometer und Ionen-Massenspektrometer mit MCP-Detektoren zum Einsatz. Die MCP-Signale wurden mithilfe eines Digitizer-Systems bzw. eines digitalen Speicher-Oszilloskops im Transienten-Modus nachgewiesen. Mit dem unfokussierten FEL-Strahl der nullten Ordnung am Monochromator-Strahlrohr wurden winkelaufgelöste Elektronenflugzeitspektren von Edelgasen und Ionen-Flugzeitspektren von C60 aufgenommen. Auch in den Einzelschußspektren war das Signal-Rausch-Verhältnis gut genug, um beispielsweise die Photonenenergie der FEL-Strahlung von Puls zu Puls zu charakterisieren. Die erfolgreiche Durchführung zeigt, daß ein solches Meßdatenerfassungssystem unter FEL-Bedingungen für die in Kürze geplanten Messungen der 2-Photonen-Ionisation an Helium und 2-Photonen-Fragmentation an C60 gut geeignet ist.

A 19.6 Do 15:45 H7

Nuclear quantum optics with x-ray laser pulses — •Thomas Bürvenich[1], Jörg Evers[2], and Christoph Keitel[2] — [1]Frankfurt Institute for Advanced Studies, Johann Wolfgang Goethe University, Max-von-Laue-Str. 1, 60438 Frankfurt am Main, Germany — [2]Max–Planck–Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany

We discuss direct interactions of nuclei with super-intense laser fields and demonstrate that present and upcoming high-frequency laser facilities, especially together with a moderate acceleration of the target nuclei, do allow for resonant laser-nucleus interaction. These direct interactions may be utilized for the optical measurement of nuclear properties such as the transition frequency and the dipole moment, thus opening the field of nuclear quantum optics. As ultimate goal, one may hope that direct laser-nucleus interactions could become a versatile tool to enhance preparation, control and detection in nuclear physics. Also off-resonant laser-nucleus interactions may provide interesting insight into nuclear properties and dynamics.