A 21: Interaction with Strong or Short Laser Pulses II

Zeit: Mittwoch 16:30–18:00 Raum: VMP 6 HS-C

Fachvortrag A 21.1 Mi 16:30 VMP 6 HS-C

Spin effects in purely laser-induced pair creation — •Matthias Ruf, Carsten Müller, Karen Z. Hatsagortsyan, Guido R. Mocken, and Christoph H. Keitel — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, D-69117 Heidelberg

Electron-positron pair creation is investigated in an oscillating electric field, which can be formed by two counter-propagating laser fields. A numerical ansatz is employed to propagate the corresponding Dirac equation on a 2+1 dimensional space-time grid. This enables us to obtain the momentum distribution of the created particles in a single computation. It is found that for linear laser polarization the spin state of the electron is not relevant for the process, whereas for circular polarization a strong asymmetry occurs between the two spin orientations. This effect can be explained in the context of a quasi-classical approach by an additional spin term of the classical Hamiltonian. The process is in principle of interest for experimental studies in upcoming intense x-ray laser facilities.

A 21.2 Mi 17:00 VMP 6 HS-C

Study of multiple ionization of Xe induced by intense XUV femtosecond laser pulse — •Roland Guichard, Ulf Saalmann, and Jan-Michael Rost — Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Straße 38, 01187 Dresden, Germany

Recently, an experiment performed at the FLASH source of Hamburg showed that xenon atoms irradiated with intense XUV femtosecond laser pulses can be ionized up to Xe^{21+} [1]. Contrary to an experiment performed with a conventional IR laser [2] where multiple ionization is understood within tunneling and rescattering framework, the previous can neither be interpreted within the perturbative nor the non-perturbative theories of laser-atom interaction. Furthermore, the XUV frequency is in the range of the well-known giant resonance of the Xe $4d$ shell [3,4] which renders the dynamics of the very first ionization steps unclear. To shed more light onto these processes, we develop a multielectronic treatment based on time-dependent density functional theory. First results and computational issues will be presented in the talk.

[1] A.A. Sorokin, S.V. Bobashev, T. Fiegl, K. Tiedtke, H. Wabnitz, and M. Richter. *Phys. Rev. Lett.*, **99** (2007)

[2] K. Yamakawa, Y.Akahane, Y. Fukuda, M. Aoyama, N. Inoue, H. Ueda, and T. Utsumi. *Phys. Rev. Lett.*, **92** (2004)

[3] R. Haensel, G. Keitel, P. Schreiber, and C. Kunz. *Phys. Rev.*, **188** (1969)

[4] A. Zangwill and P. Soven. *Phys. Rev. A*, **21** (1980)

A 21.3 Mi 17:15 VMP 6 HS-C

Bestimmung der H2 bzw. He - Clustergrössenverteilung für Experimente in straken Laserfeldern — •Rui Alexandre Costa Fraga und Robert Grisenti — Institut für Kernphysik Goethe Universität, Frankfurt am Main, Deutschland

Mit Hilfe der Rayleigh-Gans-Theorie für Lichtstreuung an sphärischen Partikel wird die Clustergrössenverteilung unserer Clusterquelle bestimmt. Diese Clusterquelle wird dann verwendet um H2 und He-Cluster zu erzeugen, die dann mit einem starken Laserfeld (1e16 W/cm^2) wechselwirken sollen. Die daraus entstehenden Ionen werden mit einem MCP-Detektor untersucht.

A 21.4 Mi 17:30 VMP 6 HS-C

Electronic Wavepackets in Lithium — •Michael Schuricke, Jochen Steinmann, Ganjun Zhu, Manuel Kremer, Bettina Fischer, Robert Moshammer, Alexander Dorn, and Joachim Ullrich — Max Planck Institut für Kernphysik, Heidelberg, Germany

Whenever an excitation process coherently transfers population from an initial state to several final states a wavepacket is created. Its dynamics will be determined by the number of excited states, their energy differences and their spatial wavefunctions. The creation of a wavepacket can be achieved with a single photon or as in this case with several photons, as long as the final states lie within the coherence bandwidth of the laser pulse.

In our experiment a superposition of 4p and 4f states was excited by three-photon absorption from a Ti:Sa laser pulse with 800 nm wavelength and 20 fs duration. The peak intensity of the pulses was kept moderate and therefore the ionization rate for a single pulse was negligible. The evolution of the wave packet was probed by a variable delayed probe pulse ionizing the atoms and determining the momenta of the ejected electrons. As result, dramatic changes in the momentum distribution as a function of delay time were observed.

By shaping the spectral profile of the laser, it was also possible to excite superpositions of the 9p,f and 10p,f states via three photon excitation. The measurements allow to deduce the multiphoton excitation amplitudes and their relative phases with respect to the different intermediate states.

A 21.5 Mi 17:45 VMP 6 HS-C

High-quality laser-accelerated ion beams for medical applications — •Zoltan Harman[1], Yousef I. Salamin[1,2], and Christoph H. Keitel[1] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg — [2]American University of Sharjah, POB 26666, Sharjah, United Arab Emirates

Cancer radiation therapy requires accelerated ion beams of high energy sharpness and a narrow spatial profile. As shown recently [1], linearly and radially polarized, tightly focused and thus extremely strong laser beams should permit the direct acceleration of light atomic nuclei up to energies that may offer the potentiality for medical applications. Radially polarized beams have better emittance than their linearly polarized counterparts. We put forward the direct laser acceleration of ions, once the refocusing of ion beams by external fields is solved or radially polarized laser pulses of sufficient power can be generated.

[1] Y. I. Salamin, Z. Harman, C. H. Keitel, Phys. Rev. Lett. 100, 155004 (2008)