A 19: Collisions, scattering and correlation phenomena

Time: Tuesday 16:30–19:00 Location: Empore Lichthof

A 19.1 Tue 16:30 Empore Lichthof

Floquet-DMFT and its application to the time-periodically driven Hubbard model — •Tao Qin and Walter Hofstetter — Institut für Theoretische Physik, Goethe Universität Frankfurt/Main 60438, Germany

A time-periodically driven system is a well-controlled versatile quantum simulator. The Hofstadter- and Haldane Hamiltonians, which are under intense studies because of their interesting topological properties, have been realized with time-periodically driven cold atoms in the optical lattice. Using the effective Hamiltonian approach, previous studies mainly focused on the non-interacting situation. It is very interesting to introduce 2-particle interactions and study their effect on topological properties. Floquet-DMFT is one possible tool for studying the interacting case. In our work, we study the time-periodically driven Hubbard Hamiltonian with Floquet-DMFT. In the calculation, we use the Bethe lattice and the infinite-dimensional simple cubic lattice. We identify the Mott metal-insulator transition with the increase of the Hubbard U. Comparing with the static Hubbard model, we study the role of the driving. We further calculate the optical conductivity and discuss its potential for indentifying effects of the interaction on topological properties.

A 19.2 Tue 16:30 Empore Lichthof

Proton-impact ionization cross sections of tetrahydrofuran measured from 0.3 to 3.0 MeV by electron spectroscopy — •Mingjie Wang, Benedikt Rudek, Daniel Bennett, Marion Bug, Ticia Buhr, and Hans Rabus — Physikalisch-Technische Bundesanstalt, Bundesallee 100, 38116 Braunschweig, Germany

Within the framework of the EMRP Project "BioQuaRT", the track structure simulation codes GEANT4-DNA [1] and PTra [2] have been extended with experimental DNA interaction cross sections to simulate ionizing radiation interactions with biological matter on cellular (micrometric) and subcellular (nanometric) scales.

For this purpose, double differential cross sections (DDCS) for ionization of tetrahydrofuran by protons with energies from 0.3 to 3.0 MeV were measured at the PTB ion accelerator facility. The electrons emitted at angles between 15° and 150° in 15° steps relative to the proton beam direction were detected with an electrostatic hemispherical electron spectrometer. The experimental DDCS are compared to the semi-empirical Hansen-Kocbach-Stolterfoht model [3] as well as to the recently reported calculation based on the dielectric response function formalism [4]. This comparison shows a good agreement in a broad range of emission angles and energies of secondary electrons.

[1] S. Incerti et al., Med. Phys. 37, 4692 (2010).
[2] M. U. Bug et al., Radiat. Phys. Chem. 81, 1804 (2012).
[3] M. A. Bernal et al., Nucl. Instrum. Methods Phys. Res., Sect. B 251, 171 (2006).
[4] P. de Vera et al., Phys. Rev. Lett. 114, 018101 (2015).

A 19.3 Tue 16:30 Empore Lichthof

Manipulating electron vortex beams with crossing laser beams — •Armen Hayrapetyan[1], Marco Ornigotti[2], Karen Grigoryan[3], Alexander Szameit[2], and Jörg Götte[4] — [1]Max-Planck-Institut für Physik komplexer Systeme, Dresden, Germany — [2]Institute of Applied Physics, Friedrich-Schiller Universität Jena, Germany — [3]Yerevan State University, Armenia — [4]School of Physics and Astronomy, University of Glasgow, Glasgow G12 8QQ, U.K.

Recent advances in technology have made it possible to generate electron vortex beams with subnanometer spot size and quantized orbital angular momentum along their axes of propagation. In this present work, we explore the interaction of such electron vortices with plane wave laser fields propagating perpendicularly to each other. In such a crossed-beam scenario, we develop a relativistic scalar theory for laser-driven electron vortices and find Bessel-type solutions to the Klein-Gordon equation. By constructing distributions of the probability density and the transverse current, we examine two distinct cases when the electron is incident on either of the maximum or minimum of the laser field. On each of these cases we derive different coupling constants and demonstrate the possibility of controlling and manipulating the electron vortices via lasers.

A 19.4 Tue 16:30 Empore Lichthof

A powerful new electron gun for electron-ion crossed-beams experiments — •Benjamin Ebinger[1,2], Alexander Borovik Jr.[1,2], Stefan Schippers[1,2], and Alfred Müller[2] — [1]I. Physikalisches Institut, Justus-Liebig-Universität Gießen — [2]Institut für Atom- und Molekülphysik, Justus-Liebig-Universität Gießen

In an electron-ion crossed-beams experiment, the experimental sensitivity is mainly determined by the densities of both beams in the interaction region. Aiming at the extension of the available range of accessible electron energies and densities, a new high-power electron gun has been developed and fabricated. It delivers a ribbon-shaped beam with high currents at all energies variable between 10 and 3500 eV [1,2]. We report on recent progress in the development and the performance of this electron gun. First experiments have demonstrated the expected high electron currents in the interaction region and very good beam transmission. Meanwhile, the tests have entered the final phase as the electron gun has been integrated into the experimental crossed-beams setup in Gießen. Employing the *animated crossed-beams* technique [3], first ionization signals were measured. Several challenging issues connected with space-charge effects in the high-density electron beam were revealed and are currently being investigated.

[1] Shi et al., Nucl. Instr. Meth. Phys. Res. B 205 (2003) 201-206
[2] Borovik et al., J. Phys.: Conf. Ser. 488 (2014) 142007
[3] Müller et al., J. Phys. B. 18 (1985) 2993-3009

A 19.5 Tue 16:30 Empore Lichthof

Measuring and modeling of anisotropic and polarized x-ray emission following resonant recombination into highly charged ions — •Chintan Shah[1,2], Pedro Amaro[1], Holger Jörg[1], René Steinbrügge[2], Sven Bernitt[2], Christian Beilmann[1,2], Stephan Fritzsche[3,4], Andrey Surzhykov[3], José Ramón Crespo López-Urrutia[2], and Stanislav Tashenov[1] — [1]Physikalisches Institute, Heidelberg, Germany — [2]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [3]Helmholtz-Institut Jena, Jena, Germany — [4]Theoretisch-Physikalisches Institut, Jena, Germany

The angular distribution and polarization of x rays emitted due to resonant recombination into highly charged ions were studied experimentally using an electron beam ion trap. In the first experiment, the linear polarization of x rays produced by dielectronic recombination into highly charged krypton ions was measured using the Compton polarimetry technique. In the second experiment, the electron-ion collision energy was scanned over the K-shell dielectronic, trielectronic and quadruelectronic recombination resonances in highly charged iron and krypton ions. The angular distribution of x rays following resonant recombination was measured by two detectors mounted along and perpendicular to the beam axis. The measured polarization and emission asymmetries comprehensively benchmarked full-order atomic calculations, confirming their suitability for the polarization diagnostics of hot plasmas under the premise of inclusion of higher order processes that were neglected in earlier work.