Italian National Conference on Condensed Matter Physics (Including Optics, Photonics, Liquids, Soft Matter)

Palermo, September 28 - October 2, 2015

BOOK OF ABSTRACT

Editors

Flavio Seno
University of Padova

Davide Valenti
University of Palermo

ISBN 978-88-907460-8-6

Dipartimento di Fisica e Chimica

recollision by a laser field. Consequently, new reactions become feasible, where the energy absorbed by the particles is efficiently released. By investigating the laser-dressed polarization operator, we identify a new contribution describing high-energy recollisions experienced by an electron-positron pair generated by pure light when a gamma photon impinges on an intense, linearly polarized laser pulse [1]. The energy absorbed in the recollision process over the macroscopic laser wavelength corresponds to a large number of laser photons and can be exploited to prime high-energy reactions. Thus, the recollision contribution to the polarization operator differs qualitatively and quantitatively from the well-known one, describing the annihilation of an electron-positron pair within the microscopic formation region [2].

[1] S. Meuren, K. Z. Hatsagortsyan, C. H. Keitel, and A. Di Piazza, Phys. Rev. Lett. 114, 143201 (2015).
[2] A. Di Piazza, C. Müller, K. Z. Hatsagortsyan, and C. H. Keitel, Rev. Mod. Phys. 84, 1177 (2012).

#066 - Controlling photoemission from laser-driven quantum rings

Pietro Paolo Corso - Università degli Studi di Palermo - Dipartimento di Fisica e Chimica

The diffused radiation from planar and structured quantum rings driven by an intense laser field is investigated.
Adopting all the possible simplifications that do not hide the essential effects, the time dependent Schroedinger equation is numerically solved by considering a single active electron. We investigate the characterization of the emitted radiation as a function of some parameters concerning the geometry of the system and the laser polarization. The results show that manipulation of these parameters provides important handles to control the emitted spectrum indicating that the investigated systems are efficient sources of radiation.

#067 - Angular-resolved photoelectron spectroscopy of many-electron systems from a time-dependent density-functional theory perspective

Umberto De Giovannini - University of the Basque Country EHU/UPV

Photoelectron spectroscopy is a technique widely used to study the electronic properties of a large variety of physical systems ranging from atoms and molecules to solids and surfaces. Electrons ejected form these systems carry a wealth of information on the parent ions and the ionization process which is encoded in the angular distribution of their velocities. Analyzing the data to extract physical information with simple analytical tools is only possible under very specific conditions. Recent advances in the development of intense and/or ultra-short light sources offer new opportunities to study exotic and highly excited states also as a function of time [1] whose analysis require theoretical tools way beyond the simple analytical ones. Building an ab-initio approach to model these kind of process is a difficult task since it requires to deal with infinitely extended states of many-electron systems in the presence of time-dependent external fields.

Time-dependent density functional theory (TDDFT) offers a simple yet powerful framework to describe many-electron systems interacting with external electromagnetic fields. The simplicity resides in the mapping of the complicated many-body problem onto a problem of non-interacting electrons in the presence of an effective time-dependent single-particle potential. The theory is formally exact and in principle can give access to the exact time-dependent density of an interacting system.

We present a method, based on a geometrical partitioning scheme that efficiently can gives access to momentum-resolved photoelectron spectra of multi-electron systems within TDDFT [2]. We introduce the theory and illustrate the core algorithms applicable to real-space real-time formulations. We show how this techniques can be easily extended to study time-resolved pump-probe experiments in which a system response (electron emission) to a probe pulse, is measured in an excited state [3]. This simulation tool can help to interpret attosecond time-resolved spectroscopic experiments, where the electronic motion must be followed at its natural time-scale. Further, by including the ionic motion, we show how this approach can provide direct insight into molecular photochemical reactions [4] and discuss under which conditions it is possible to reconstruct the molecular orbitals from the photoelectron angular distribution [5].

[1] G. Wu, P. Hockett, and A. Stolow, Phys. Chem. Chem. Phys. 13, 18447 (2011).
[2] U. De Giovannini, D. Varsano, M. A. L. Marques, H. Appel, E. K. U. Gross, and A. Rubio, Phys. Rev. A 85, 062515 (2012).
[3] U. De Giovannini, G. Brunetto, A. Castro, J. Walkenhorst, and A. Rubio, Chemphyschem 14, 1363 (2013).
[4] A. Crawford-Uranga, U. De Giovannini, D. J. Mowbray, S. Kurth, and A. Rubio, J. Phys.