A 21: Poster: Photoionization

Time: Tuesday 16:00–18:30 Location: Empore Lichthof

A 21.1 Tue 16:00 Empore Lichthof

Investigation of shake-up processes in Beryllium with the Multiconfigurational time-dependent Hartree-Fock method — •Christopher Hinz, David Hochstuhl, and Michael Bonitz — Institut für Theoretische Physik und Astrophysik, Christian-Albrechts-Universität zu Kiel, Leibnizstr. 15 24098 Kiel, Germany

The Multiconfigurational time-dependent Hartree-Fock (MCTDHF) method is an extension of Hartree-Fock to gradually include correlations, in addition to the contributions of the mean-field. Extending our previous work on Helium [1], we apply MCTDHF to the full four-electron system of Beryllium in an external electro-magnetic field for different amounts of correlation, while previous works [2,3] using traditional approaches—like Configuration interaction (CI)—were only capable of treating two active electrons. Of special interest are shake-up processes, in which a second electron is excited during photoionization, which can be subsequently ionized by a second photon with a higher resulting electron energy. Since the shake-up is a consequence of correlations between the shake-up electron and the first photoelectron this process is not treatable with pure Hartree-Fock methods. To resolve the time evolution of the shake-up process, we apply a pump-probe scheme to the atomic system, which is not accessible with a time-independent method.

[1] D. Hochstuhl, M. Bonitz, J. Chem. Phys. **134**, 084106 (2011)

[2] S. Laulan, H. Bachau, Physical review A **69**, 033408 (2004)

[3] F.L. Yip et al., Physical review A **81**, 063419 (2010)

A 21.2 Tue 16:00 Empore Lichthof

Photoelectrons below the low-energy structure — •Elias Diesen, Ulf Saalmann, and Jan-Michael Rost — MPI-PKS, Dresden, Germany

Only recently the LES was discovered, a pronounced structure in the low energy photoelectron spectrum resulting from the interaction with a high intensity infrared laser pulse [1]. As shown in [2,3], the LES can be understood classically as an energy bunching effect due to the Coulomb field of the parent ion in so-called soft recollisions. Motivated by new experimental results [4,5] we have investigated the dynamics very close to threshold which reveals a rich structure of the spectrum below the LES.

[1] Blaga et al, Nature Phys., 5, 335 (2009)
[2] Kästner et al, Phys. Rev. Lett. 108, 033201 (2012)
[3] Kästner et al, J. Phys. B 45, 074011 (2012)
[4] Wu et al, Phys. Rev. Lett. 109, 043001 (2012)
[5] Moshammer, private communication

A 21.3 Tue 16:00 Empore Lichthof

The time-dependent restricted active space Configuration Interaction method for the photoionization of many-electron atoms — David Hochstuhl, •Christopher Hinz, and Michael Bonitz — Institut für Theoretische Physik und Astrophysik, Christian-Albrechts-Universität zu Kiel, Leibnizstr. 15 24098 Kiel, Germany

We present the time-dependent restricted active space Configuration Interaction method, which was introduced in Ref. [1] to solve the time-dependent Schrödinger equation for many-electron atoms, and particularly apply it to the treatment of photoionization processes in atoms. We proof the applicability of the method by calculating the photoionization cross sections of Helium and Beryllium. Further, we consider the time-delay in the photoionization from the 2s and 2p shell of neon [2] and apply a correlated and explicitly time-dependent treatment for its simulation.

[1] D. Hochstuhl, M. Bonitz, Phys. Rev. A **86**, 053424 (2012)

[2] Schultze et al., Science, **328**, 1658 (2010)

A 21.4 Tue 16:00 Empore Lichthof

The influence of electron-electron interaction on localization effects in microwave-driven helium — •Felix Jörder, Markus Heinrich, Klaus Zimmermann, Alberto Rodrigues, and Andreas Buchleitner — Physikalisches Institut, Uni Freiburg, Deutschland

The driven helium atom defines a paradigmatic scenario of a fragmenting quantum system, characterized by high spectral densities and decay channels into multiple continua. The microwave-induced excitation process of helium Rydberg atoms is retarded by dynamical localization effects, leading to strongly reduced multiphoton decay rates. We present numerical simulations of this process within a collinear model, tuning the impact of the interelectronic repulsion by varying the initial energies of both electrons and the spatial configuration of electrons and nucleus.

A 21.5 Tue 16:00 Empore Lichthof

Vergleich von Rydbergionisation von Yb in Hoch- und Niederspannungsmassenseparatoren — •Fabian Schneider[1], Charlotte Andersson[2], Dag Hanstorp[2], Tobias Kron[1], Nils Odebo Länk[2], Johanna Olsson[2], Sven Richter[1], Johannes Rossnagel[1] und Klaus Wendt[1] — [1]Institut für Physik, Universität Mainz — [2]Department of Physics, University of Gothenburg

Die Resonanzionisationsspektroskopie bietet eine sehr effiziente Methode zur Erzeugung von elementreinen Ionenstrahlen. Die Entwicklung von Anregungsschemata für On-Line-Ionenquellen, die üblicherweise eine Beschleunigung der Ionen auf 30...60 kV aufweisen, wird dabei häufig an kompakten und betriebsgünstigen Apparaturen mit niedriger Beschleunigungsspannung durchgeführt. Dies beeinflusst die resonante Anregung im Allgemeinen nicht wesentlich.

Unterscheide in den Anregungsspektren der Ionisation von Ytterbium über Rydbergzustände bei Verwendung einer Ionenquelle mit Nieder- und Hochspannungsbeschleunigung wurden untersucht. Aufgrund identischer Ionisationsöfen sind diese nur durch den unterschiedlich starken Eingriff des Extraktionsfeldes in den Ofen zu erklären.

A 21.6 Tue 16:00 Empore Lichthof

Disentanglement of different excitation and decay pathways in the O 1s shape-resonance region of CO — •R. Püttner[1], D. Ceolin[2], O. Travnikova[2], J. Palaudoux[3], C. Miron[3], M. Hoshino[4], H. Kato[4], H. Tanaka[4], Y. Tamenori[5], C. C. Wang[6], K. Ueda[6], and M. N. Piancastelli[3,7] — [1]Freie Universität Berlin, Germany — [2]Synchrotron SOLEIL, Gif-sur-Yvette, France — [3]Universite Pierre et Marie Curie, Paris, France — [4]Sophia University, Tokyo, Japan — [5]Japan Synchrotron Radiation Research Institute, Hyogo, Japan — [6]Tohoku University, Sendai, Japan — [7]Uppsala University, Sweden

Auger spectra of CO subsequent to O 1s ionization with 549.85 eV-photons, i.e. on top of the shape resonance, are presented. These spectra are compared with the normal Auger spectrum recorded at a photon energy well above the shape resonance revealing distinct differences. In particular, in the energy region of the O $1s^{-1} \rightarrow b^1\Pi$ and O $1s^{-1} \rightarrow a^1\Sigma^+$ Auger transitions additional narrow lines are found in the spectra.

In a detailed fit analysis of the spectra based on the approach presented in Ref. [1] it was found that distortions caused by post-collision interaction are absent. This identifies the additional lines as caused by resonant Auger processes. In addition, the angular distribution of these lines was investigated. From the analysis the resonant Auger decays could be assigned to transitions from the doubly excited state O $1s^{-1}4\sigma^{-1}2\pi3l\sigma$ to the excited state $4\sigma^{-2}3l\sigma$ of CO^+ with l = s or p.

[1] R. Püttner et al., Chem. Phys. Lett. **445**, 6 (2007).