EXPLORING HIGH ATOMIC EXCITATION WITH INTENSE COHERENT SHORT-WAVELENGTH RADIATION

P. Lambropoulos

Physics Department, University of Crete & IESL-FORTH

The interaction of strong electromagnetic fields with bound electrons has until now been associated with phenomena in the long wavelength limit where the large ponderomotive energy of one electron initiates processes such as high order harmonic generation (HOHG), non-perturbative above threshold ionization (ATI), as well as the ejection of additional electrons, under the appropriate circumstances.

At the other extreme of the wavelength range, single-photon double ionization, as well as triple excitation, under appropriately short wavelength radiation, in the single-rate (weak field) limit, are well developed and understood in great detail, through a variety of techniques, both theoretically and experimentally. Many facets of correlation, a central issue beyond the two-body problem, have been and continue being elucidated. Yet, the addition of even one more photon in any of these few-body problems, ushers in many layers of new effects and questions, even in the single-rate, let alone strong driving regime. In addition to their fundamental significance, such processes are now within the reach of new sources of short wavelength, fairly intense radiation.

In the spirit of illustrating such phenomena and the underlying issues, I discuss examples of two-photon double ionization in fundamental two- and three-electron systems such as Helium and Lithium, in the weak-field, single-rate regime, as well as in the case of strongly driven transitions between triply excited states, or even Auger resonances in more complex systems. Questions pertaining to the double continuum, the correlation at various stages of these non-linear processes as it affects the strength of the transitions, as well as photoelectron energy and angular distributions are illustrated through specific case studies, as are the demands on sources for their observability, including recent experimental results.