Time-Resolved Photoemission from Surfaces and Nanoparticles

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Attosecond time-resolved spectroscopy is a powerful method for investigating the electronic dynamics in atoms [1], and this technique is now being transferred to the scrutiny of electronic excitations, electron propagation, and collective electronic (plasmonic) effects in solid surfaces [1–4] and nanoparticles [1,5,6]. Compared with photoemission from isolated gaseous atoms, numerical simulations of such experiments on complex targets require, in addition, the adequate modeling of (i) the target’s electronic band structure [2,3], (ii) elastic and inelastic scattering of released photoelectrons inside the solid [2–6], (iii) surface and bulk collective electronic excitations [1,5,6], (iv) the dielectric screening and reflection of the assisting IR-laser field at the solid surface [4], (v) the influence of equilibrating residual charge distributions on emitted photoelectrons, and (vi) the effect of spatially inhomogeneous plasmonic fields on the photoemission process [2,3,5].

This talk will review the extent to which photoelectron propagation in matter and the plasmonic response of nanostructures can be (a) represented in classical [1,6] and quantum mechanical [1–5] simulations and (b) retrieved in IR-streaked XUV [1–3,5,6] and IR-XUV two-photon interference (RABBITT) [4] photoemission spectra. As examples, I will discuss our recent numerical results for photoemission from (adsorbate-covered) metal surfaces [2–4] (in comparison with experimental data) and from plasmonic 10 to 200 nm diameter spherical nanoparticles that show how spatio-temporal information of the sub-infrared-cycle plasmonic and electronic dynamics is embedded in time-resolved spectra [5,6].

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References