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Photoemission from solid surfaces and nanoparticles with attosecond-nanometer spatiotemporal resolution.[1]

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Attosecond time-resolved spectroscopy applies ultrashort attosecond XUV pulses (or pulse trains) to emit electrons into the field of delayed IR laser pulses. Over the past two decades this technique has matured to a powerful method for investigating the electronic dynamics in atoms [1] and is now being transferred to the scrutiny of electronic excitations, electron propagation, and collective electronic effects in solids [1-4] and plasmonic nanoparticles [1,5-7]. 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 [1-4], (ii) elastic and inelastic scattering of released photoelectrons inside the solid [2-6], (iii) surface and bulk collective electronic excitations [5-7], (iv) the 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 [1], and (vi) the effect of spatially inhomogeneous plasmonic fields on the photoemission process [3,5-7]. I will address 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 [3,6-7] and IR-XUV two-photon interference (RABBITT) [2,4] photoemission spectra. [1] U. T. et al., in: Handbook of Photonics, Vol. 1, (Wiley 2015). [2] C. Chen et al., Proc. Natl. Acad. Sci. 114, E5300 (2017). L. Kasmi et al., Optica 4, 1492 (2017). [3] Q. Liao, and U. T., Phys. Rev. A 89, 033849 (2014); ibid. 92, 031401(R) (2015). [4] M. J. Ambrosio and U. T., Phys. Rev. A 96, 051403 (2017); ibid. 97, 043431 (2018). [5] J. Li, E. Saydanzad, and U. T., Phys. Rev. A 94, 051401(R) (2016); ibid. 95, 043423 (2017). L. Seifert et al., Nat. Phys. 13, 766 (2017). [6] E. Saydanzad, J. Li, and U. T., Phys. Rev. A 95, 053406 (2017); 98, 063422 (2018). [7] J. Li, E. Saydanzad, and U. T., Phys. Rev. Lett. A 120, 223903 (2018).

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