

Timing of photoemission and the dielectric response of metallic surfaces

Luca Castiglioni

Department of Physics, University of Zurich, Switzerland

Progress in attosecond science in the past decade has enabled the study of ultrafast electronic processes with unprecedented temporal resolution [1]. We extended an interferometric two-photon technique named RABBITT [2] based on attosecond XUV pump pulses and a phase-matched IR probe field from gas phase to solid surfaces to study the dynamics of the photoelectric effect [3].

Experiments on the noble metal surfaces Ag(111) and Au(111) revealed a strong energy dependence of the delays for photoemission from the d -valence band [3]. The origin of photoemission delays in solid surfaces has been the subject of numerous theoretical investigations and initial vs. final state effects have been discussed heavily. Our experiments were sensitive for final state effects only and will be discussed in terms of final state band structure and electron propagation.

Interpretation of the observed delays requires a precise model of the probe field distribution at the surface. The RABBITT technique was used in a similar experiment to sample the IR field distribution on a Cu(111) surface [4]. Finally, I will show how such techniques can be used to study the effective field of low-frequency THz pulses at metal surfaces and nanostructures [5].

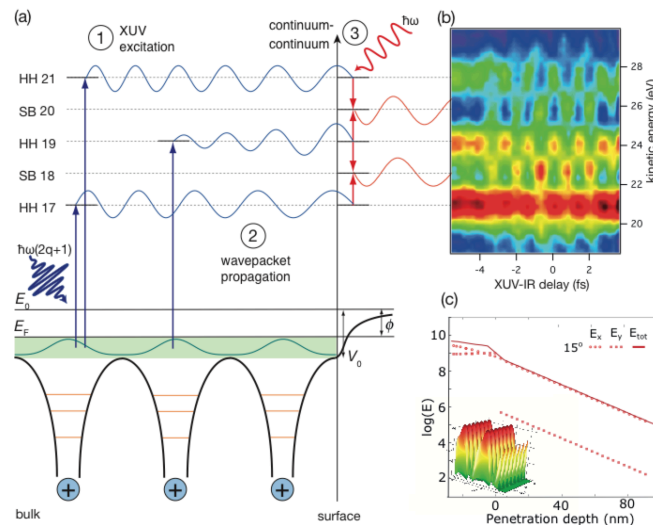


Fig. 1. (a) Schematic of the RABBITT process in a solid surface: (1) initial excitation by a XUV photon, (2) wavepacket propagation to the surface and (3) continuum-continuum interaction with the IR probe field. (b) Experimental RABBITT trace from Ag(111). (c) IR-probe field at the metal-vacuum interface.

REFERENCES

- [1] A. L. Cavalieri *et al.* *Nature* **449**, 1029 (2007).
- [2] P. M. Paul *et al.* *Science*, **292**, 1689 (2001).
- [3] R. Locher *et al.* *Optica* **2**, 405 (2015).
- [4] M. Lucchini *et al.* *Phys. Rev. Lett.* **115**, 137401 (2015).
- [5] K. Waltar *et al.* *Optics Express*, **26**, 8364 (2018)