European XFEL

THEORY GROUP MEETING

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12:45

AER 19 Seminar Room 4.14

Final states effects in stationary and non-stationary photoemission

by

Eugene Krasovskii

**University of the Basque Country,
Donostia International Physics Center, and
IKERBASQUE, Basque Foundation for Science,
San Sebastian, Spain**

This talk discusses elastic and inelastic scattering of photoelectrons at kinetic energies of the order of 100 eV. By way of introduction, stationary angle-resolved photoemission will be considered. There the scattering by the crystal lattice (band structure effects) manifests itself in strong variation of spectral lineshapes with photon energy, and inelastic scattering lifts the momentum conservation and gives rise to the band gap emission. It will be shown that the interplay of these effects can be described ab initio within the one-step theory of photoemission [1].

Then the basic principles of the attosecond time-resolved photoelectron spectroscopy in application to solids will be introduced [2-4]: In the laser-assisted photoemission (laser streaking technique), an ultra-short pulse of extreme UV radiation creates a photoelectron wave packet with a temporal spread within a fraction of the oscillation period of the laser light. The energy shift of the photoelectron spectrum due to the acceleration by the laser field provides information about the temporal structure of the excitation process [2-4].

Here, we focus on the role of the band structure in the dynamics of the laser-streaked photoelectron [4]. In the vicinity of band gaps, the strong interaction with the crystal is shown to lead to a distortion and a temporal shift of the streaking spectrogram. Further, the implications of inelastic scattering for the streaking phase shift and the optical potential approach to it are discussed. The streaking experiments on W(110) and Mg(0001) [2-4] are analyzed in terms of the transport properties of the photoelectron final states.

[1] E.E. Krasovskii et al., Phys. Rev. Lett. 98, 217604 (2007).

[2] A.L. Cavalieri et al., Nature (London) 449, 1029 (2007).

[3] S. Neppl et al., Phys. Rev. Lett. 109, 087401 (2012).

[4] S. Neppl et al., Nature 517, 342 (2015).