Graz Advanced School of Science
PHYSICS COLLOQUIUM OF THE UNIVERSITY OF GRAZ AND THE GRAZ UNIVERSITY OF TECHNOLOGY

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Ultrafast phenomena at metal-organic interfaces: From momentum dependent carrier lifetimes in metals to exciton dynamics in organic thin films

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Excited hot electrons play a crucial role for many fundamental chemical and physical phenomena occurring at surfaces, (hybrid) interfaces, or in bulk materials. For instance, they determine the conductivity in metals and semiconductors or the efficiency of charge transfer across interfaces between different materials which are both responsible for the performance of electronic and spintronic devices. Therefore, a comprehensive understanding of the different decay mechanisms of hot carriers in functional materials is essential on the way to realize next generation nanoscale devices. Here, we focus on the fs evolution of hot carriers in two fundamentally different materials: in *noble metals* and *organic thin films*.

In metals, the high charge carrier density leads to an extremely fast energy dissipation of hot carriers within a few fs by inelastic electron-electron scattering. While these inelastic scattering phenomena are well understood today, much less is known about (quasi-) elastic scattering mechanisms in metals. To this end, we have started to investigate the momentum dependent lifetime of hot electrons in metals and at metal-organic interfaces by time-resolved 2 photon momentum microscopy (tr-2PMM, see Fig. 1). This novel approach for 2 photon photoemission with full access to momentum space allows us to disentangle inelastic and (quasi-) elastic scattering of hot carriers throughout the entire energy and momentum space. For prototypical material systems, we will show that the momentum dependent carrier lifetime does not only depend on the band dispersion of the excited state, but also crucially on the band structure of the (occupied) initial state.

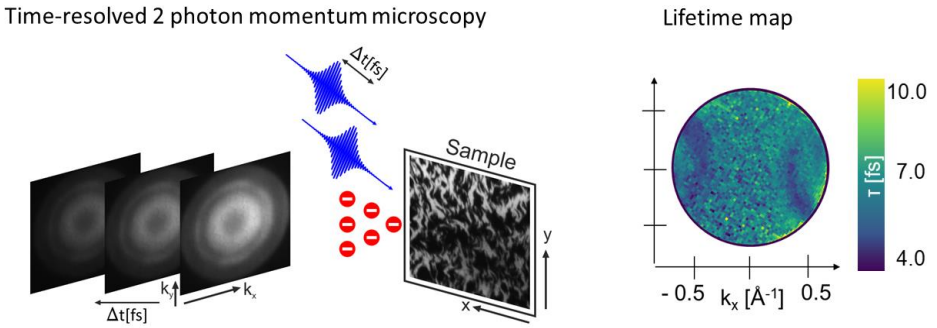

Fig. 1: Illustration of the experimental scheme of time-resolved 2 photon momentum microscopy and the resulting momentum resolved lifetime map for one constant final state energy (example for Ag(110)).

In contrast to noble metals, the properties of excited carriers in organic materials are severely influenced by the many body effects which are mediated by dielectric screening and the large polarizability of organic molecules. Both effects are responsible for the excitonic properties of organic materials as well as for the energetic position of the transport levels. Here, we investigate the many body response of thin films of the prototypical fullerene C_{60} on Ag(111) after optical excitation by time- and angle resolved photoemission using fs-XUV light. We find that optical exciton results in the formation and subsequent decay of excitons which coincides with a transient inhomogeneous linewidth broadening of all molecular orbitals. This phenomena is attributed to a collective transient polarization of the molecular film caused by excitonic *charge defects* in the organic film at local molecular sites.

Termin / Ort: Dienstag, 7.11.2017, 17.00 Uhr**,** KFU Graz, Universitätsplatz 5, Hörsaal 05.01
Meet-the-speaker ab 16.30 Uhr, Bibliothek Experimentalphysik, 1. Stock, ZiNr.: 122

Gastgeber: Ao.Univ.-Prof. Dr. Michael Ramsey – Inst. f. Physik, Surface Science