UNIVERSITY OF ROCHESTER, DEPARTMENT OF CHEMISTRY
PHYSICAL SEMINAR ~ MONDAY, FEBRUARY 22, 2016, 4:00 PM, HUTCHISON HALL 473

"Electronic and Structural Dynamics in Solids: from electron-phonon coupling to spin- and pseudospin-polarized excited states"

Guest Speaker: Ralph Ernstorfer

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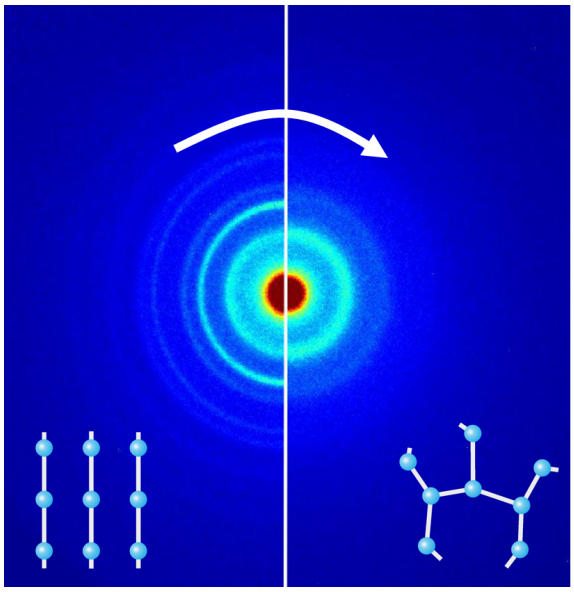
The coupling and mutual dependence of electronic and vibrational degrees of freedom is at the heart of microscopic as well as macroscopic phenomena in condensed matter. Ultrafast pump-probe techniques provide experimental access to these coupling and correlation effects through the microscopic response to specific excitation of the material. We employ femtosecond electron diffraction (FED) [1] and imaging [2], time- and angle-resolved photoelectron spectroscopy (trARPES) and optical spectroscopy for probing the dynamics of phonons, electrons and the dielectric function subsequent to optical excitation of the electrons.



I will discuss electron-lattice interaction and electron dynamics in three classes of materials. First, the electron-phonon coupling in the free-electron metal aluminium is quantitatively investigated with FED and first-principle calculations. Our results challenge the validity of the two-temperature approximation and we propose a refined non-thermal lattice model [3]. Second, we investigate the photo-induced structural dynamics in $Ge_2Sb_2Te_5$ (GST), a popular phase change material exhibiting two metastable crystalline states which can be switched by light or current pulses. We observe distinct differences between the dynamics of optical properties and lattice, which we explain in terms of the resonant bonding present in these phase change materials [4]. Third, I will discuss recent results on the preparation and observation of spin- and pseudospin-polarized excited states in the semiconducting transition metal dichalcogenide WSe_2.

[1] L. Waldecker et al., J. Appl. Phys. 117, 044903 (2015).
[2] M. Müller et al., Nature Communications 5, 5292 (2014). M. Müller et al., arXiv:1512.07037.
[3] L. Waldecker et al., arXiv:1507.03743.
[4] L. Waldecker et al., Nature Materials 14, 991 (2015); https://www.youtube.com/watch?v=-J81ooptNFA