Ultrafast study of out-of-equilibrium quantum materials

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The study of quantum materials in out-of-equilibrium conditions following excitation with ultrafast lasers represents one of the novel research frontiers in condensed matter research. With femtosecond optical pulses, electronic and lattice degrees of freedom can be transiently decoupled, giving the opportunity of stabilizing new states inaccessible by quasi-adiabatic pathways.

This becomes particularly interesting for the study of strongly correlated materials, since their rich phase diagram often translates into an equally rich out-of-equilibrium behavior; as well as for the study of topological matter, where the unique features of Dirac fermions turn into peculiar photoconductivity properties after ultrafast excitation. Selected studies of prototype out-of-equilibrium Mott compounds (V_2O_3) [1] and topological insulators (Bi_2Te_3, Bi_2Se_3) [2,3] will be discussed in more detail, mainly employing time-resolved ARPES which is a particularly well adapted method for the study of 2D materials.

References:

[1] G. Lantz et al., Nat. Commun. 8, 13917 (2017).
[2] L. Khalil et al., Phys. Rev. B 85 085118 (2017)
[3] M. Hajlaoui et al., Nat. Commun. 5, 3003 (2014)