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SEMINAR

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CFEL-bldg. 99, seminar room IV

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Steady-state and relaxation dynamics of doped two-dimensional antiferromagnetic Mott insulators

Out-of-equilibrium dynamics of doped two-dimensional antiferromagnetic Mott insulators driven by a constant or a time-dependent external force represents an exciting and widely unexplored field of both theoretical as well as experimental research. We study by means of numerical calculations how charge carriers (holes) doped into 2D antiferromagnets [1,2,3] behave under highly nonequilibrium conditions. In particular, we are interested how the energy of the excited electronic system is transferred to spin and phonon degrees of freedom on a femtosecond time scale.

I will first address the steady state properties of a hole within the t-J-Holstein model, driven by a time-independent external electric field. In this case the energy gained by the propagation of a hole along the field can flow to both spin and phonon degrees of freedom [2]. Such an investigation of a multi-component system under nonequilibrium conditions is motivated by recent developments of pump-probe experiments, and addresses a highly nontrivial question about the main relaxation mechanism of two-dimensional strongly correlated materials coupled to phonons. Our results indicate that for values of model parameters as relevant for materials like cuprates, the energy in the steady state flows predominantly to the spin subsystem. In the second part I will discuss relaxation dynamics of doped systems after a short laser irradiation, relevant for comparison to ultrafast experiments. I will present a fully quantum-mechanical study of relaxation dynamics of a Holstein polaron far from equilibrium [4], and comment on the subject of relaxation of doped carriers in 2D antiferromagnets.

[1] M. Mierzejewski, L. Vidmar, J. Bonča and P. Prelovšek, Phys. Rev. Lett. 106, 196401 (2011)
[2] L. Vidmar, J. Bonča, T. Tohyama and S. Maekawa, Phys. Rev. Lett. 107, 246404 (2011)
[3] J. Bonča, M. Mierzejewski and L. Vidmar, Phys. Rev. Lett. 109, 156404 (2012)
[4] D. Golež, J. Bonča, L. Vidmar and S. A. Trugman, Phys. Rev. Lett. 109, 236402 (2012).

Host: Martin Eckstein - MPSD