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UNIVERSITÄT DUISBURG ESSEN

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Relaxation dynamics in strongly correlated materials - from models to materials

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Strong correlations between spin, charge and orbital degrees of freedom play an important role in materials and a recent development of ultrafast spectroscopies enabled to disentangle these relevant degrees of freedom by their temporal evolution. Due to the complexity of non-equilibrium dynamics it has become necessary to exchange ideas between experimental and theoretical community. I will present recent development of theoretical tools based on dynamical mean field theory (DMFT) that enable us to describe the non-equilibrium dynamics in strongly correlated materials and show how the theoretical development is approaching a realistic description of solids, which is crucial to provide a proper feedback to the experimental community.

I will start with a summary of the charge carrier relaxation after the photo-excitation in Mott insulators described within DMFT and continue how this formalism can be extended to more realistic description including the role of dynamical screening and non-local fluctuations (GW+EDFMT)[1,2]. First I will describe relevant relaxation channels deep in the Mott phase and close to the metal-insulator transition within a Hubbard model. The relevance of this description will be exemplified by the relaxation dynamics of the photo-emission spectra in 1T-TaS_2[3].Then I will introduce an advanced description including the effects of dynamical screening in the charge channel and open the question how to use the laser pulse to manipulate screening in Mott insulators. As an extreme example I will present a self-trapping of the system in the negative temperature state by a proper manipulation of the screening environment, which leads to the enhanced subgap response in the charge susceptibility. This population inversion leads to the low-energy anti-screening and I will comment on its experimental relevance. In the last part I will shed a light on the role of spin fluctuations in the relaxation dynamics, which can be analysed by an extension of DMFT[4], and exemplify how optical pump probe techniques can be used to detect some basic theoretical ideas in higher dimensional doped antiferromagnets, like string states, Trugman paths and the lack of spin-charge separation. At the end I will provide an outlook how to extend these tools to an ab-initio description of strongly correlated materials out of equilibrium.

References

[1] D. Golež, M. Eckstein, and P. Werner. Phys. Rev. B, 92:195123, Nov (2015).

[2] D. Golež, L. Boehnke, H. U. R. Strand, M. Eckstein, and P. Werner. Phys. Rev. Lett., 118:246402 (2017).

[3] M. Ligges, I. Avigo, D. Golež, H. Strand, L. Stojchevska, M. Kalläne, P. Zhou, K. Rossnagel, M. Eckstein, P. Werner, and U. Bovensiepen. ArXiv e-prints:1702.05300(2017).

[4] N. Bittner, D. Golež, M. Eckstein, P. Werner, in preparation.

Für diese Zeit steht eine Kinderbetreuung nach vorheriger Anmeldung zur Verfügung.

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