Max-Planck-Institut für Struktur und Dynamik der Materie

Max Planck Institute for the Structure and Dynamics of Matter

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CFEL Seminar room I (Bldg. 99)

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Cooperative valence dynamics in Anderson Lattices observed by resonant inelastic x-ray scattering

In rare earth intermetallics with weakly bound f-electrons and a Kondo energy scale much larger than magnetic exchange interactions or crystal field splittings, the screening of local moments may result in a non-magnetic Fermi liquid ground state [1]. At low temperatures, the quantum fluctuations between magnetic and non-magnetic valence configurations can then acquire a cooperative (lattice) character. On a phenomenological basis, a sound understanding of this Anderson Lattice phenomenon has been achieved. On the other hand, the microscopic description of the coherent coupling between Kondo-screened sites remains an outstanding theoretical challenge [2]. In experiment, the cooperative character of Anderson Lattices has only recently become directly accessible. Momentum-resolved spectroscopies, such as angle-resolved photoemission and inelastic neutron scattering, reveal the emergence of characteristic low-energy quasiparticle dynamics at low temperatures [3]. These methods probe single-particle excitations in the charge and magnetic channels, respectively. By contrast, high-resolution resonant inelastic x-ray scattering (RIXS) experiments couple to both charge and spin degrees of freedom in a non-trivial way and thus provide a more subtle point of view. If calculations of the underlying Kramers-Heisenberg term on a basis of strongly correlated f-electronic bands are achieved, RIXS may unlock unprecedented microscopic insights into the entanglement of local and itinerant charge and magnetic degrees of freedom. This would address a fundamental mechanism of quantum matter, with relevance far beyond lanthanides and actinides.
I will review previous spectroscopic investigations of intermediate valence materials, present our recent RIXS results on the archetypal Anderson Lattice compound CePd3, and highlight some ideas for future x-ray scattering studies at 3rd and 4th generation light sources.

[1] P. Riseborough and J. Lawrence, Rep. Prog. Phys. 79, 084501 (2016)
[2] Y.-F. Yang et al., Nature Letters 454, 611 (2008)
[3] E. Goremychkin et al., Science 359, 186 (2018)

Host: Michael Först / Andrea Cavalleri

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