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Local Kondo screening and spatial coherence in $YbRh_2Si_2$[1]

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Heavy fermion metals are often characterized by a variety of relevant energy scales and competing interactions which may result in such fascinating phenomena as quantum criticality and unconventional superconductivity. Therefore, these materials have advanced to suitable model systems by means of which electronic interactions can be studied in detail. This will be discussed for the interplay of localized and itinerant electronic states in Kondo lattice systems in which heavy charge carriers are generated. We investigate the generic Kondo lattice system $YbRh_2Si_2$, one of the heaviest heavy fermion metals, by utilizing atomically resolved Scanning Tunneling Spectroscopy (STS) [1]. An analysis of the topography allows for a determination of the terminating surface as well as a comparison to results from chemical analysis. Importantly, the crystal field excitations are unambiguously reflected by our STS measurements, clearly relating STS to bulk properties. The hybridization of conduction and $4f$ electrons results in a gap-like feature in the tunneling conductance. In addition, a strongly temperature dependent peak in the tunneling conductance is attributed to a resonance resulting from the Kondo lattice. The experimental data are discussed in relation to results obtained within the non-crossing approximation (NCA) and renormalized band structure calculation. In a brief outlook we discuss further investigations by STS, e.g. with respect to the quantum critical phenomena observed in $YbRh_2Si_2$ [2], to substitutions-induced changes of the relevant energy scales [3], or on heavy fermion superconductors.

[1] S. Ernst *et al.*, Nature **474** (2011) 362.
[2] S. Friedemann *et al.*, Proc. Natl. Acad. Sci. USA **107** (2010) 14547.
[3] S. Friedemann *et al.*, Nature Phys. **5** (2009) 465.

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