Imaging Heavy Fermion Hybridization in URu_2Si_2

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Within a Kondo lattice, the strong hybridization between electrons localized in real space (**r**-space) and those delocalized in momentum space (**k**-space) generates exotic electronic states called 'heavy fermions'. Here we use the unique capabilities of the spectroscopic imaging scanning tunneling microscope to image the electronic structure of the heavy fermion material URu_2Si_2 simultaneously in **r**-space and in **k**-space. Utilizing quasiparticle interference imaging, we observe in **k**-space a light band at high temperatures that on cooling rapidly splits into two new heavy bands with a structure consistent with Kondo lattice hybridization. Simultaneously, in **r**-space, we image the local atomic scale structure of a 'Kondo-hole' generated by substituting a spinless Thorium atom for a magnetic Uranium atom. The high degree of internal consistency between the **r**-space and **k**-space analysis and the excellent agreement with theory provides confidence in the atomic-scale understanding of the Kondo lattice.

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