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Anomalous quasiparticle dynamics in the hidden order phase of URu_2Si_2 from time-resolved ARPES

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Below the coherence temperature of 60 K, and within the existing hybridization gap, several new quasiparticle features appear as a function of temperature in the heavy fermion system URu_2Si_2. First, a gap-like feature at 25 - 30K is observed in ultrafast reflectivity and optical conductivity and is interpreted by some as secondary hybridization gap or pseudogap. The pseudogap language, borrowed from the field of high temperature superconductivity, is used to stress the *precursor* nature of this feature with respect to what happens at even lower temperature of 17.5K. At this temperature the *hidden order* gap opens, corresponding to a massive removal of entropy and is linked to an unknown order parameter. The nature of the order parameter is a center of an ongoing vigorous dispute, while the massive removal of entropy at the HO transition evades explanation. Here we use time-and angle-resolved photoemission spectroscopy (tr-ARPES) to elucidate the itinerant nature of HO. We show how the Fermi surface is renormalized by shifting states away from the Fermi level at specific hot spots. By measuring the ultrafast dynamics we identify the location and lifetime of the quasiparticle states forming at the hotspots. We find that the quasiparticle lifetime increases from 42 fs to few hundred fs across the transition. The new model of the Fermi surface evolution through the HO transition is proposed.