Hastatic Order in URu_2Si_2

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The hidden order developing below 17.5K in the heavy fermion material URu_2Si_2 has eluded identification for over twenty five years. Recently, a number of new experiments have shed new light on the nature of this phase. Most intriguingly, de Haas-van Alphen has observed nearly perfectly Ising quasiparticles deep in the hidden order phase. In this talk, I will show how these Ising quasiparticles suggest a novel two-component order parameter capturing the hybridization between $S = 1/2$ Kramers conduction electrons and the non-Kramers Ising $5f^2$ local moments. This "hastatic order" differs from conventional magnetism as it is a spinor order that breaks both single and double time-reversal symmetry by mixing states of different Kramers parity. The broken time-reversal symmetry simply explains both the pseudo-Goldstone model between the hidden order and antiferromagnetic phases and the nematic order seen in torque magnetometry. The spinorial nature of the hybridization also explains how the Kondo effect can lead to a phase transition, with the hybridization gap turning on at the hidden order transition as seen in STM. Hastatic order also has a number of new predictions: a basal-plane magnetic moment of order $.01\mu_B$, a gap to longitudinal spin fluctuations that vanishes continuously at the first order antiferromagnetic transition and a narrow resonant nematic feature in the scanning tunneling spectra.

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