MAR17-2016-003529

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Hybridization with a twist: Hidden (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 thirty years [1]. A number of recent experiments have shed new light on the nature of this phase. In particular, de Haas-van Alphen measurements indicate nearly perfectly Ising quasiparticles deep in the hidden order phase [2], and recent nonlinear susceptibility measurements show that this strong Ising anisotropy persists up to and above the hidden order transition itself [3,4]. Along with other features, this Ising anisotropy implies that the conduction electrons hybridize with a local Ising moment - a $5f^2$ state of the uranium atom with integer spin. As the hybridization mixes states of integer and half-integer spin, it is itself a spinor and this "hastatic" (hasta: [Latin] spear) order parameter therefore breaks both time-reversal and double time-reversal symmetries [5,6]. A microscopic theory of hastatic order naturally unites a number of disparate experimental results from the large entropy of condensation to the spin rotational symmetry breaking seen in torque magnetometry, and provides a number of experimental predictions. Moreover, this new spinorial order parameter provides a window into a number of new heavy fermion phases. [1] J. Mydosh and P. M. Oppeneer, RMP 83, 1301 (2011) [2] M. M. Altarawneh, N. Harrison, S. E. Sebastian, L. Balicas, P. H. Tobash, J. D. Thompson, F. Ronning, and E. D. Bauer, PRL 106, 146403 (2011) [3] J. Trinh, E. Bruck, T. Siegrist, R. Flint, P. Chandra, P. Coleman and A. P. Ramirez, arXiv:1608.07009 (2016) [4]R. Flint, P. Chandra and P. Coleman PRB 86, 155155 (2012) [5] P. Chandra, P. Coleman and R. Flint, Nature 493, 611 (2013) [6] P. Chandra, P. Coleman and R. Flint, PRB 91, 205103 (2015)