Abstract for an Invited Paper
for the MAR09 Meeting of
The American Physical Society

New developments in our understanding of superconductivity in the 115 materials[1]

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Is a quantum critical point (QCP) pertinent to unconventional superconductivity? There are several heavy-fermion compounds in which unconventional superconductivity emerges in proximity to a spin-density-type quantum-critical point (1). The absence of superconductivity in prime candidates for a local or Kondo-breakdown quantum criticality, however, raises the question of whether this type of criticality could benefit superconductivity (2). Using the heavy-fermion antiferromagnet $CeRhIn_5$ as an example (3), we present the first evidence that critical modes associated with the Kondo-breakdown criticality can provide a new route to unconventional superconductivity. At a local QCP, accessed by applied pressure, magnetic and charge fluctuations coexist and produce electronic scattering that is maximal at the optimal pressure for unconventional superconductivity. References: (1) Mathur et al., Nature 394, 39 (1998); Monthoux et al., Nature 450, 1177 (2007). (2) Gegenwart et al., Nat. Phys. 4, 186 (2008). (3) T. Park et al., Nature 440, 65 (2006); T. Park et al. Proc. Nat. Acad. Sci. 105, 6825 (2008).

[1]Work at Los Alamos National Laboratory was performed under the auspices of the US Department of Energy, Office of Science.