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Field-induced magnetism and quantum criticality in superconducting $CeRhIn_5$ under pressure

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The antiferromagnet CeRhIn5 becomes superconducting under pressure, where superconducting state coexists with the helical magnetic state with Q=(0.5, 0.5, 0.293). Similarly to other heavy fermion superconductors, however, magnetism disappears when the antiferromagnetic transition temperature becomes equal to superconducting temperature, hiding a magnetic quantum critical point. Applying magnetic field reveals a low-temperature specific heat anomaly in the unconventional superconducting state, which defines a quantum phase transition from a solely superconducting state to a phase with coexisting magnetic and superconducting orders [1]. The field-pressure phase boundary at zero temperature is anticipated theoretically [2] and is strikingly similar to that in high-Tc cuprates [3], delineating a correlation between quantum criticality and unconventional superconductivity.

[1] T. Park et al., Nature 440, 65 (2006)
[2] Q. Si et al., Nature 413, 804 (2001); E. Demler et al., Phys Rev. Lett. 87 067202 (2001)
[3] B. Lake et al., Nature 415, 299 (2002); H. J. Kang et al., Nature 423, 522 (2003)