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Coexistence and interplay of superconductivity and ferromagnetism in URhGe

As ferromagnetism and superconductivity are usually considered to be antagonistic, the discovery of their coexistence in UGe₂, URhGe, UIr and UCoGe has attracted a lot of interest. The mechanism to explain such a state has, however, not yet been fully elucidated. In these compounds superconductivity may be unconventional: Cooper pairs could be formed by electrons with parallel spins and magnetic fluctuations might be involved in the pairing mechanism. URhGe becomes ferromagnetic below a Curie temperature of 9.5 K, with a spontaneous moment aligned to the c-axis. For temperatures below 260 mK and fields lower than 2 Tesla, superconductivity was first observed in 2001. Recently, we discovered of a second pocket of superconductivity. This new pocket of superconductivity appears at higher fields applied close to the b-axis, enveloping a sudden magnetic moment rotation transition at $H_R=12$ Tesla.

Detailed studies of the field induced metamagnetic transition and superconductivity will be presented. The role of the magnetic fluctuations emerging from a quantum critical point to the pairing mechanism giving superconductivity will be discussed.



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