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Tricritical point and wing structure in the phase diagram of UGe_2

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Among the numerous reports on quantum criticality, studies on ferromagnets are less common than studies on antiferromagnetic compounds. This is surprising since the paramagnetic to ferromagnetic transition is a textbook example of second order transition and there are several examples where the ferromagnetic transition can be tuned to zero temperature by applied pressure, chemical doping or magnetic field. However, it seems that the transition becomes first order at a tricritical point before being fully suppressed, changing the quantum critical point to a first order quantum phase transition. I will present the case of the superconducting ferromagnet UGe_2. In this material, we experimentally located the tricritical point in the temperature-pressure phase diagram. By applying magnetic field, the critical end point, which corresponds to the tricritical point at zero field, can be located leading to a wing-structure in the temperature-pressure-magnetic field phase diagram. The suppression of the critical end point to zero temperature leads to a new kind of quantum criticality: a quantum critical end point. The case of UGe_2 will be compared with other ferromagnets, in particular $LaCr_{1-x}V_xGe_3$. The work on UGe_2 was performed at CEA Grenoble, France with D. Aoki, G. Knebel, H. Kotegawa, L. Malone, I. Sheikin and J. Flouquet. The work on other compounds is performed at my present institution Ames Laboratory, Iowa State University, Ames, Iowa, U.S.A. with U. Kaluarachchi, X. Lin, S. K. Kim, S. L Bud'ko and P. C. Canfield supported by AFOSR-MURI grant FA9550-09-1-0603.

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