Pressure induced superconductivity in magnets

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Superconductivity and magnetism would be antagonistic because of the competitive nature between the screening by Meissner effect and the internal fields generated by magnetic orderings. It is generally accepted that antiferromagnetism with local moments could coexist with superconductivity. Recent observation of superconductivity in the ferromagnet UGe_2 has renewed our interest on the interplay of magnetism and superconductivity.

UGe_2 is a ferromagnet with a Curie temperature $T_C = 52$ K at ambient pressure. Interestingly, superconductivity appears within the ferromagnetic phase [1]. Subsequent researches have indicated that there exists a new line $T_X(P)$ separating the ferromagnetic phase, which possibly corresponds to the change between fully polarized and partially polarized states [2]. At low temperatures, the change at $T_X(P)$ in the ferromagnetic phase shows first order phase transition [3]. The transition line of $T_X(P)$ would have a critical point or a tricritical point. Since a superconducting transition temperature exhibits a maximum at around $P(T_X = 0)$ in magnetic fields, it is likely that some fluctuation related to $T_X(P)$ induces the superconductivity [4]. We will present the detailed $P - T$ phase diagram by thermal expansion and ac susceptibility measurements and discuss the correlation between the ferromagnetism and the superconductivity.

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