Normal State and Electron Pairing Near Ferromagnetic and Ferroelectric Phase Transitions

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We compare and contrast the nature of the unusual normal and superconducting states in itinerant electron ferromagnets and carrier-doped ferroelectrics[1] on the border of ferromagnetic or ferroelectric quantum critical points. In both classes of material the normal states exhibit thermal enhancement of the magnetic or electric polarisation in an applied conjugate field, a phenomenon that may be described in terms of the concept of "order by disorder". The mechanism for this thermal enhancement has recently been identified in particular in the case of displacive quantum paraelectrics.[2] The role of quantum critical order parameter fluctuations in the formation of Cooper pairs in both quantum paraelectrics and paramagnetic systems will also be considered. A quantitative description of pairing in carrier-doped quantum paraelectrics, in particular, points to the importance of multiple hybrid polar lattice modes that can lead to extraordinarily strong pairing interactions and an "ionic" type of superconductivity.[1]

1. Superconductivity in the vicinity of a ferroelectric quantum phase transition
   S. E. Rowley, C. Enderlein, J. Ferreira de Oliveira, D. A. Tompsett, E. Baggio Saitovitch, S. S. Saxena and G. G. Lonzarich, *arxiv*:1801.08121 (2018)
2. Emergent quantum coherent state on the border of ferroelectricity
   M.J. Coak, C.R.S. Haines, C. Liu, S.E. Rowley, G.G. Lonzarich and S.S. Saxena (2018)