Abstract:
A century of research on magnetic phenomena had led to the view that the normal state of itinerant-electron ferromagnets such as Fe, Ni and Co could be described in terms of the standard model of the metallic state or its extension known as the nearly ferromagnetic Fermi liquid theory. In recent years, however, a large body of observations has accumulated from various complex intermetallic systems that raises the possibility that this assumption might be wrong. Here we examine this issue by means of high-precision measurements of the electrical transport and magnetic properties of pure ferromagnets—in particular, MnSi—in which the Curie temperature is tuned towards absolute zero by the application of hydrostatic pressure. With this method, it is possible for us to study the normal state over an extraordinarily large range of temperature of up to five orders of magnitude above the Curie temperature. Our results using MnSi reveal a particularly striking combination of properties—most notably a $T^{3/2}$ power law for the resistivity—showing clearly that the normal state of this itinerant-electron ferromagnet cannot be described in terms of the standard model of metals.