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Quantum Criticality and Magnetism in $Ln_2Fe_{12}P_7$ Compounds [1]

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Recent investigations of a class of noncentrosymmetric, pnictogen-based systems with chemical formula $Ln_2Fe_{12}P_7$ (Ln = Lanthanide or Actinide) have yielded a wealth of strongly correlated electron physics [1, 2, 3]. We have carried out magnetization, specific heat, and electrical resistivity measurements for compounds with Ln = Yb, Sm, U, and Th. Each system exhibits an enhanced electronic contribution to specific heat and Ln = Yb, Sm, and Th have a magnetically ordered ground state in zero applied magnetic field [1, 2, 3]. The Ln = Sm compound exhibits multiple magnetic transitions and a meta-magnetic transition, which might suggest this system's close proximity to a quantum critical point (QCP) [3]. The Ln = Yb system exhibits a crossover from a magnetically ordered non-Fermi-liquid (NFL) phase to a second NFL phase under applied magnetic field H [1]. The crossover occurs near the value of H where the transition temperature T_M of the ordered phase was no longer observable, but *not* where a possible QCP would be found if T_M is extrapolated to zero temperature. The resulting $T - H$ phase diagram deviates strongly from the form typically taken by classical QCP phase diagrams, adding $Yb_2Fe_{12}P_7$ to a growing list of materials exhibiting unconventional NFL behavior.

Materials with strongly correlated electrons often exhibit enhanced thermoelectric power S, especially if their Fermi energy lies near a sharp peak in the electronic density of states [4]. Since such systems are potentially useful in thermoelectric applications, we measured the thermoelectric power S of the Ln = Yb compound. We observed that it exhibits an enhanced S, comparable to many other strongly correlated electron systems, but that its power factor S^2/ρ (where ρ is electrical resistivity) is an order of magnitude smaller than that of the power-factor record holder $YbAl_3$ [5].

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