MAR14-2013-020007

Abstract for an Invited Paper
for the MAR14 Meeting of
the American Physical Society

Magnetic field tuned quantum criticality of heavy fermion system YbPtBi[1]

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Quantum criticality triggers an emergence of new quantum phase of matters due to the critical behavior of quantum fluctuations. Heavy fermion (HF) compounds have provided the cleanest evidence for the quantum phase transition. The face-centered cubic YbPtBi is one of the few frustrated stoichiometric Yb-based HF compounds. Measurements of magnetic field and temperature dependent resistivity, specific heat, thermal expansion, Hall effect, and thermoelectric power indicate that the antiferromagnetic (AFM) order ($T_{\mathrm{N}} \sim 0.4$ K) can be suppressed by applied magnetic field of $H_{\mathrm{c}} \sim 4$ kOe. In the H-T phase diagram of YbPtBi, three regimes of its low temperature states emerges: (I) AFM state, characterized by spin density wave (SDW) like feature, which can be suppressed to $T = 0$ by the relatively small magnetic field of $H_{\mathrm{c}} \sim 4$ kOe, (II) field induced anomalous state in which the electrical resistivity follows $\rho(T) \sim T^{1.5}$ between H_{c} and ~ 8 kOe, and (III) Fermi liquid (FL) state in which $\rho(T) \sim T^2$ for $H >$8 kOe. Regions I and II are separated at $T = 0$ by what appears to be a quantum critical point. Whereas region III appears to be a FL associated with the hybridized $4f$ states of Yb, region II may be a manifestation of a spin liquid state.

[1]Work was supported by the US Department of Energy, Office of Basic Energy Science, Division of Materials Sciences and Engineering. Ames Laboratory is operated for the US Department of Energy by Iowa State University under Contract No. DE-AC02-07CH11358.