Abstract for an Invited Paper
for the MAR09 Meeting of
The American Physical Society

Quantum Criticality and Superconductivity in β-$YbAlB_4$

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Heavy fermion systems have provided a number of prototypical compounds to study unconventional superconductivity and non-Fermi-liquid (NFL) states. A long standing issue in the research of heavy fermion superconductivity in $4f$ intermetallics is the dramatically different behavior between the electron like Ce ($4f^1$) and hole like Yb ($4f^{13}$) compounds. While superconductivity has been found in a number of Ce based heavy fermion compounds, no superconductivity has been reported for the corresponding Yb systems. In this talk, I present our recent finding of the superconductivity in the new heavy fermion system β-$YbAlB_4$ [1-3]. The superconducting transition temperature is 80 mK, and above it, the system exhibits pronounced NFL behavior in the transport and thermodynamic properties [2,3]. Furthermore, the magnetic field dependence of the NFL behavior indicates that the system is a rare example of a pure metal that displays quantum criticality at ambient pressure and under zero magnetic field. Using our latest results, we discuss the detailed properties of superconductivity and quantum criticality. This is the work performed in collaboration with K. Kuga, Y. Matsumoto, T. Tomita, Y. Machida, T. Tayama, T. Sakakibara, Y. Karaki, H. Ishimoto, S. Yonezawa, Y. Maeno, E. Pearson, G. G. Lonzarich, L.Balicas, H. Lee, and Z. Fisk.

[1] Robin T. Macaluso, Satoru Nakatsuji, Kentaro Kuga, Evan Lyle Thomas, Yo Machida, Yoshiteru Maeno, Zachary Fisk, and Julia Y. Chan, Chem. Mater.**19** 1918 (2007).
[2] S. Nakatsuji, K.Kuga, Y. Machida, T. Tayama, T. Sakakibara, Y. Karaki, H. Ishimoto, S. Yonezawa, Y. Maeno, E. Pearson, G. G. Lonzarich, L.Balicas, H. Lee, and Z. Fisk, Nature Phys **4**, 603-607 (2008).
[3] K. Kuga, Y. Karaki, Y. Matsumoto, Y. Machida, and S. Nakatsuji, Phys. Rev. Lett. **101**, 137004 (2008).