Quantum criticality, superconductivity and Fermi surface dimensionality - comparison of $CeIn_3$, $CeRhIn_5$, and $CePt_2In_7$

Y. Krupko[1], S. Ota[2], Y. Hirose[2], R. Settai[2], A. Demuer[1], K. Götze[3], J. Klotz[3], T. Föster[3], J.A.N. Bruin[4], A. McCollam[4], H. Harima[5], M. Raba[1,6], E. Ressouche[7], N. Qureshi[8], C.V. Colin[6], V. Nassif[6], P. Rodière[6], I. Sheikin[1]

[1] *LNCMI, CNRS, UGA, Grenoble, France*

[2] *Department of Physics, Niigata University, Niigata, Japan*

[3] *HLD, HZDR, Dresden, Germany*

[4] *HFML, Radboud University, 6525 ED Nijmegen, The Netherlands*

[5] *Graduate School of Science, Kobe University, Kobe 657-8501, Japan*

[6] *Institut Néel, CNRS, UGA, Grenoble, France*

[7] *INAC, CEA, UGA, Grenoble, France*

[8] *ILL, Grenoble, France*

$CePt_2In_7$ is a recently discovered heavy fermion antiferromagnet with a Néel temperature $T_N = 5.5$ K. It belongs to the same family of CeT_nIn_{2n+3} (T: transition metal) systems as the well-studied $CeIn_3$ and $CeRhIn_5$. The crystal structure of these materials consists of a sequence of $CeIn_3$ layers intercalated by n TIn_2 layers along the c axis. All three compounds, antiferromagnets under normal conditions, can be tuned to a quantum critical point by either pressure or magnetic field. Although their Néel temperatures differ considerably, the critical values of the tuning parameters are similar, $P_c \sim 2.5 - 3.5$ GPa and $H_c \sim 50 - 60$ T. Furthermore, an unconventional superconductivity emerges in the vicinity of a pressure-induced quantum critical point in all three materials.

In heavy-fermion compounds, the Fermi surface dimensionality is expected to influence both the superconducting critical temperature and the type of quantum criticality, although this issue is still somewhat controversial. While the Fermi surface is almost spherical in the anisotropic $CeIn_3$, that of $CePt_2In_7$ is almost ideally two-dimensional, with $CeRhIn_5$ located somewhat in between. I will compare the Fermi surfaces in all three materials and discuss their superconducting properties and Fermi surface reconstructions associated with quantum criticalities from this perspective.