(P2-4)

Novel vortex in $PrOs_4Sb_{12}$

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A number of experiments show evidence for unconventional superconductivity in $PrOs_4Sb_{12}$, a heavy-fermion material . In particular, muon spin relaxation experiment reveals broken time reversal symmetry below Tc(∼1.8K).[1] As observed in superfluid ^{3}He, superconductivity(fluidity) with multiple order-parameter has a possibility to have various type of vortices.[2] To study the properties of vortices in $PrOs_4Sb_{12}$, we have measured the hysteresis loop of magnetization in $PrOs_4Sb_{12}$ at various temperatures. Examples of hysteresis loops are shown in Fig.1. The temperature dependence of the hysteresis(ΔM) at zero field is obtained from the hysteresis loops and shown in Fig. 2. Below 150mK, drastic decrease of ΔM is observed. According to the Bean model, ΔM is proportional to the critical current Ic or pinning force of vortices. Linear temperature dependence of Ic is expected at sufficiently low temperatures(<T/Tc∼ 0.1) according to Anderson-Kim theory[3]. However, the drastic reduction of pinning force at such low temperatures implies an apperance of a new type of vortices with non-singular core. We will also present results of lower critical field which are closely related the energy of the vortices.

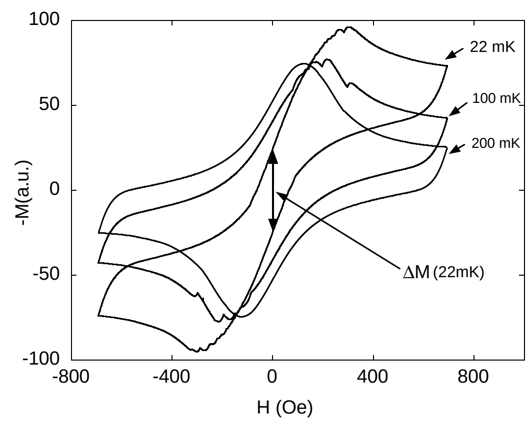

Figure 1: Hysteresis loops of magneization below 200mK. ΔM is defined as the difference in M at zero field during increasing and decreasing of field.

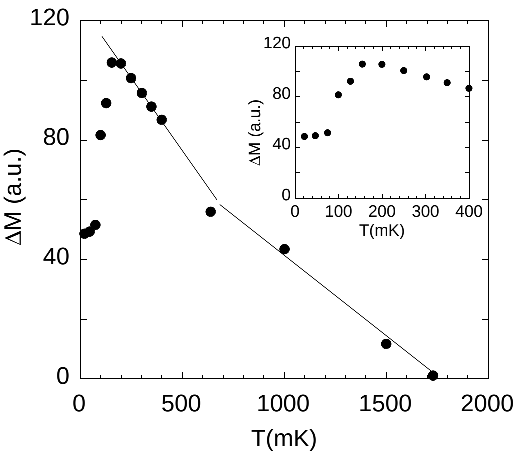

Figure 2: Temperature dependence of hysteresis(ΔM) at zero field. The inset shows low temperature part. We confirm the increase of ΔM as decrease temperature at 0.6K reported by T.Cichorek et al.[4]

[1] Y. Aoki et al., Phys. Rev. Lett. 91, 067003 (2003)
[2] O.V. Lounasmaa and E. Thuneberg, Proc. Natl. Acad. Sci. USA, 96,7760(1999)
[3] P.W.Anderson and Y.B.Kim, Rev. Mod. Phys. 36,39(1964)
[4] T.Chihorek et al., Phys. Rev. Lett. 95, 107002(2005)