Perpendicular Magnetic Field Effect on FFLO State in λ-$(BETS)_2FeCl_4$

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A magnetic organic conductor λ-$(BETS)_2FeCl_4$ is known to show superconductivity only under high magnetic fields from 17 T to 42 T, parallel to the conducting *ac* layers [1]. This field induced superconductivity (FISC) has been qualitatively understood by Jaccarino-Peter effect, where the internal field created by the localized Fe 3d moments plays an essential role. In the FISC phase, an inhomogeneous superconducting state with spatially modulated order parameter, so-called a Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) state is theoretically predicted [2]. When the field is applied exactly parallel to the layers, successive dip features in the interlayer resistance are observed. The dips are interpreted as the commensurability effect between the Josephson vortex (JV) lattice penetrating the insulating layers and the wavelength of the FFLO superconducting order parameter (OP) oscillation: the JVs are collectively pinned by the periodic nodal planes of the OP.

As the field is tilted to the perpendicular direction, the critical field B_{c2} (onset of the transition) steeply increases and the dips are smeared out. In the field angle range for $\theta>2^o$, no dips are appreciable. In perpendicular field, the 2D FFLO state undergoes Landau quantization characterized by the index n The index n, which gives the highest B_{c2}, depends on temperature and the orbital effect[2]. As the field is tilted to the perpendicular direction (as the orbital effect is enhanced), successive transitions to different n states take place, which should cause kink features in the angular dependence of B_{c2}. The B_{c2} *vs.* θ plot in Fig. 1 suggests that the FFLO state is destroyed at about $\theta=2^o$ and the phase transition from the n=1 to n=0 state takes place simultaneously. The behavior may be consistent with the theory [2]. The results will be discussed in detail.

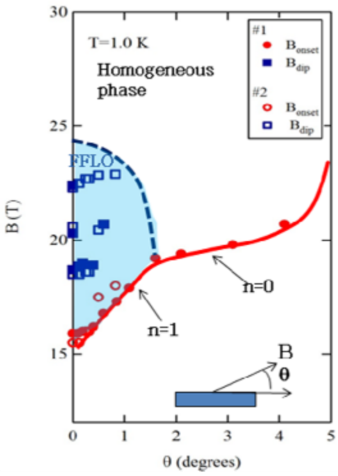

Fig. 1 B_{c2} vs. θ plot.

[1] S. Uji et al., Nature (London) **410** (2001) 908, Phys. Rev. Lett. **97** (2006) 157001
[2] M. Houzet et al., Phys. Rev. Lett. **88** (2002) 227001