92 T Tilted Magnetic Field Study of the Fermi Surface of the Underdoped High T_c Superconductor $YBa_2Cu_4O_8$

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Despite several years having passed since the discovery of magnetic quantum oscillations in the underdoped high T_c cuprates $YBa_2Cu_3O_{6+x}$ [1] and $YBa_2Cu_4O_8$ [2,3], it remains unknown whether the magnetic quantum oscillations in these two compounds have a common origin. The stoichiometric material $YBa_2Cu_4O_8$ is located close to the optimal doping location of the superconducting dome compared to the more underdoped $YBa_2Cu_3O_{6+x}$, and contains two pairs of chains per unit cell rather than one as is the case for $YBa_2Cu_3O_{6+x}$. It is unclear, therefore as to whether the quantum oscillation frequency observed in $YBa_2Cu_4O_8$ of the order of 20% larger than in $YBa_2Cu_3O_{6+x}$ has a different origin.

To pursue a better understanding of the relationship between the quantum oscillations in these two superconductors, we measured the evolution of the quantum oscillation waveform in $YBa_2Cu_3O_8$ in tilted magnetic fields. The larger resistive transition of $YBa_2Cu_3O_8$ compared to $YBa_2Cu_3O_{6+x}$ implies that larger magnetic fields are required to access a comparable angular range in the former. With 92 T, we were able to detect magnetic quantum oscillations for tilt angles (θ) between the applied magnetic field and the *c* axis as large as 55°. A preliminary analysis of the quantum oscillations suggests that the waveforms, with regards to spin damping and the field-dependent beat pattern, exhibit many similarities in the two compounds.

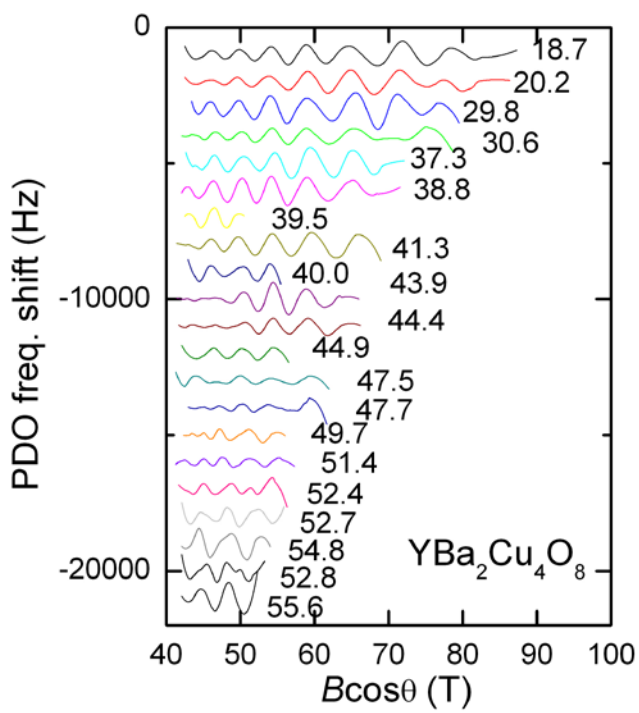

Figure 1. Magnetic quantum oscillations measured using the contactless conductivity technique in $YBa_2Cu_4O_8$ in tilted magnetic fields, with the tilt angles indicated.

References

[1] Doiron-Leyraud, N. *et al.*, Nature **447**, 565 (2007).
[2] Yelland, E.A., *et al.*, Phys. Rev. Lett , **100**, 046004 (2008).
[3] Bangura, A.F., *et al.*, Phys. Rev. Lett , **100**, 046004 (2008).