High-Pressure Fermiology Studies of YBCO

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Introduction

We continued our study of the Fermiology of YBCO across the superconducting dome, focusing on the 45 kbar pressure where a non-linear region was observed in the Hc2, frequency of the quantum oscillations (QO) and effective mass, which we attributed to the effect of pressure on the charge density wave (CDW). We also repeated our QO measurements on the overdoped side to check the 680T frequency reported last year.

Experimental

QO were measured using a Tunnel Diode Oscillator (TDO) setup coupled with metallic Diamond Anvil Cell to probe pressures up to 25GPa in the 45T Hybrid at the NHMFL-Tallahassee.

Results and Discussion

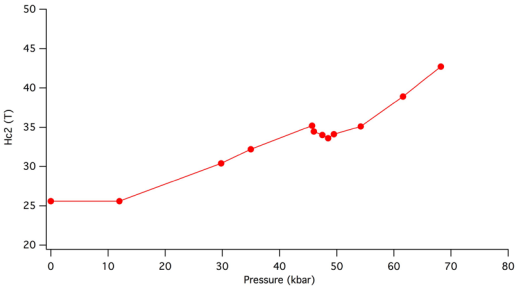

Figure 1

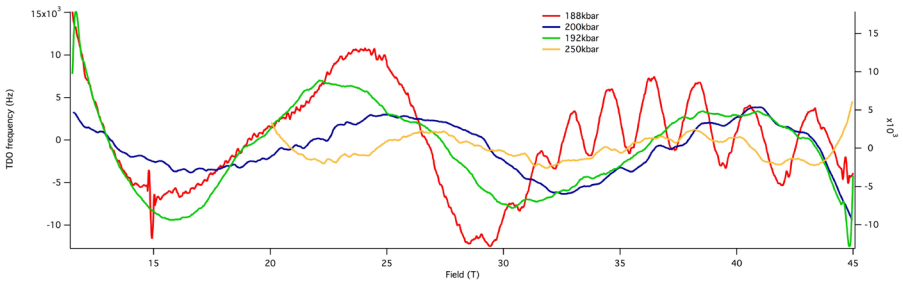

Figure 2

Fig. 1 Critical field Hc measured at 450mK. We confirm the non-linearity previously reported, and thus the effect of the pressure on the CDW. **Fig. 2** Background subtracted TDO frequency as a function of the magnetic field, for 4 pressures (with a Δp~20kbar in that pressure range). The frequency obtained is of the order of 680T as observed last year. Additional measurement in our in-house PPMS on those high pressure cells have not shown any signature for a critical temperature down to 2K, which would indicate that the samples at those pressure are in the normal state, or that the non-hydrostatic conditions (which are unavoidable at those high pressures) would broaden a Tc signal in the TDO and preclude its observation.

Conclusions

We confirmed the effect of pressure on the CDW in underdoped YBCO, and have successfully repeated our measurement of the Fermi surface of YBCO on the overdoped side. We confirm that we do not observe the 18kT orbit, which causes us to question the existence of a Fermi surface reconstruction under pressure. Another possibility would be that either the CDW observed on the underdoped side would survive through the superconducting dome and still exist on the overdoped side, or that a new one would develop there under pressure. This seems to have been ruled out by recent high pressure X-ray studies [3, 4].

Acknowledgements

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References

[1] Ramshaw, B. J. et al. Science **348** 317-320 (2015)
[2] Vignolle, B. et al., Nature Letters **455** (2008)
[3] S.M. Souliou et al., Physical Review B 97, 020503(R) (2018)
[4] H. Huang et al, Phys. Rev. B 97, 174508