Quantum Oscillations in the Underdoped Cuprate YBa$_2$Cu$_4$O$_8$\textsuperscript{1}

EDWARD YELLAND, University of St Andrews, UK, JOHN SINGLETON, CHUCK MIELKE, NEIL HARRISON, FEDOR BALAKIREV, LANL, BOGDAN DABROWSKI, Northern Illinois University, MARCIN MATUSIAK, JOHN COOPER, University of Cambridge — The quantum oscillations (QOs) seen in the underdoped cuprate superconductor YBa$_2$Cu$_4$O$_8$ (Y124) in magnetic fields up to $B=85$T [1] are strong evidence for a well-defined Fermi surface (FS) in Y124 at low temperature $T$ and high $B$. The QO frequency $F=660\pm15$T, implies a FS pocket with 2.4\% of the full Brillouin zone (BZ) area. Taken with earlier work [2], our data suggest FS pockets are generic to underdoped CuO$_2$ planes and give the first hint of doping dependence of the FS. We discuss the carrier concentration implied by the QOs within various models. Comparison of the $T$-linear specific heat $\gamma$ (from QO quasiparticle mass $m^*$) to $\gamma$ estimated from zero-field specific heat measurements constrains the number of FS pockets present in the BZ and supports a reduced BZ due e.g. to a charge/spin density wave or ordered orbital currents. [1] E. A. Yelland et al, arXiv:0707.0057. [2] N. Doiron-Leyraud et al, Nature 446, 565 (2007)

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