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Pseudogap signatures measured in the Fermi surface of underdoped YBCO by quantum oscillations

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Solving the riddle of the pseudogap state in underdoped high temperature superconductors is critical to the understanding of the origin of high temperature superconductivity. Quantum oscillations performed on single crystals of the family of underdoped YBCO cuprates reveal small Fermi surface pockets in the normal state accessed at low temperatures and high magnetic fields. It has been widely thought, however, that high magnetic fields cause this state to be significantly different from the mysterious pseudogap state measured at high temperatures and low magnetic fields. In this talk I will present a quantum oscillation study of underdoped $YBa_2Cu_3O_{6+x}$ up to magnetic fields of 100 T that reveals a dimensional collapse of the Fermi surface due to a drastic reduction in c-axis hopping, identical to the pseudogap signature measured in the low magnetic field regime. We therefore conclude that the fundamental properties of the pseudogap are encoded in the Fermi surface, an understanding of which is critical to uncovering the origin of the pseudogap in high temperature superconductors. Possible mechanisms are discussed to explain the origin of the Fermi surface in underdoped $YBa_2Cu_3O_{6+x}$. This work was performed in collaboration with G. Lonzarich (University of Cambridge), N. Harrison, M. Altarawneh, F. Balakirev (Los Alamos National Laboratory), and R. Liang, W. Hardy, D. Bonn (University of British Columbia)