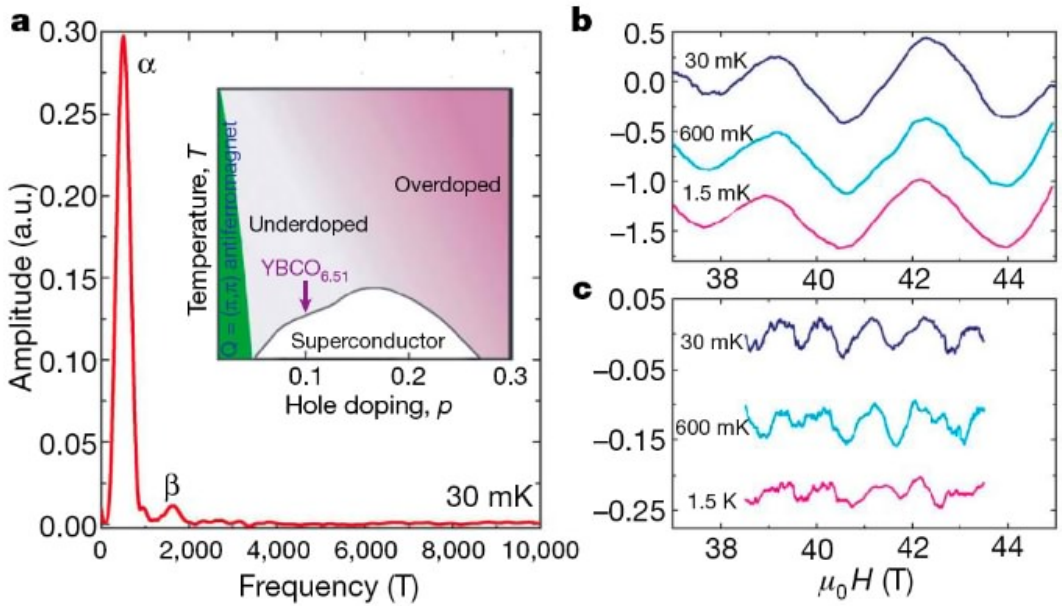
HTc Superconductor MultiComponent Fermi Surface

National High Magnetic Field Laboratory

DC Field Facility User Program, Florida State University

Quantum oscillations in the magnetism of the vortex state of a superconducting $YBa_2Cu_3O_{6.31}$ sample revealed an electronic structure with more than one carrier pocket. The second pocket, first detected in this work, has carriers with higher mass and is thermo-dynamically more important.

This observation allows detailed constraints to be placed upon the underlying order and location of the carriers and points toward a possible relationship between magnetic ordering and superconductivity in these materials.



The frequencies of the two different fermi surface pockets are shown above (a). The second frequency is not visible in the raw data (b) until the first frequency is fit and subtracted (c).

Sebastian, S.E.; Harrison, N.; Palm, E.; Murphy, T.P.; Mielke, C.H.; Liang, R.; Bonn, D.A.; Hardy, W.N. and Lonzarich, G.G., ***Nature***, **454**, 200 (2008).

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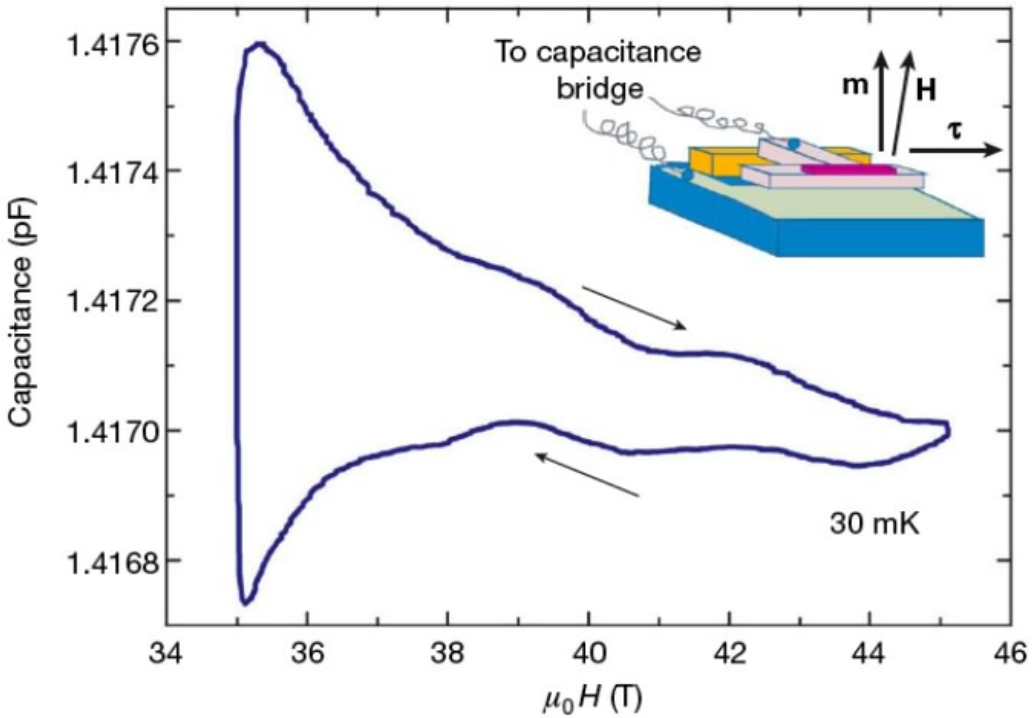

The sample was measured using a torque magnetometer in the NHMFL 45 T hybrid magnet. The hysteresis between the up and down sweeps is due to the pinning of vortices or small regions of non-superconducting electrons.

This work was a collaboration involving a diverse group of researchers from Cambridge University, UK, the NHMFL in Los Alamos and Tallahassee, and the University of British Columbia, Canada.

In addition to providing clues allowing scientists to solve the longstanding mystery of super-conductivity in the cuprates, this work yields insights that might allow researchers to engineer materials that would have enhanced superconducting properties.