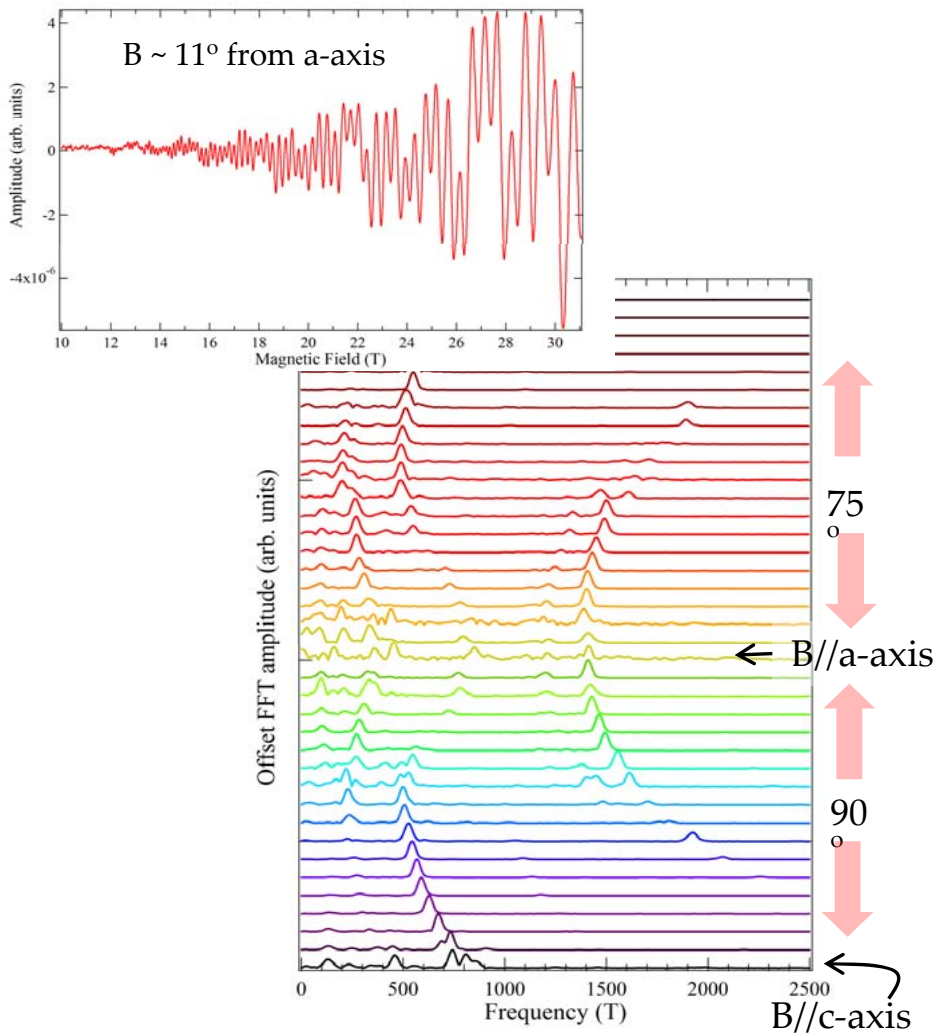
Fermi Surface of α–Uranium at Ambient Pressure

2009 NHMFL Science Highlight for NSF

DMR-Award 0654118

DC Field Facility User Program

The fermi surface of α–Uranium has been measured using de Haas van Alphen (dHvA) oscillations for the first time at ambient pressure. Extremely clean single crystals were annealed to provide the highest quality samples ever produced. The samples were mounted on a torque magnetometer and measured at fields up to 45T. These measurements provide details of the electronic structure of this important actinide. The largest effective mass was only 1.3 m_e in agreement with band structure calculations. These findings help to elucidate the fascinating physics that occurs in this heaviest naturally occurring element.



D. Graf, R. Stillwell, T.P. Murphy, J.-H. Park, M. Kano, E.C. Palm, P. Schlottmann, J. Bourg, K.N. Collar, J. Cooley, J. Lashley, J. Willit, S.W. Tozer, submitted to Phys. Rev. Lett.

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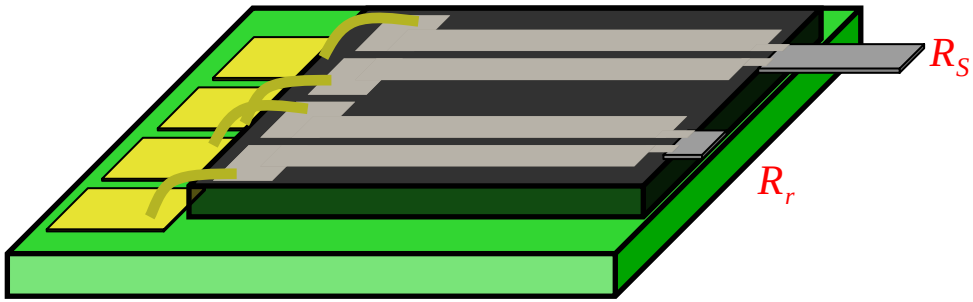
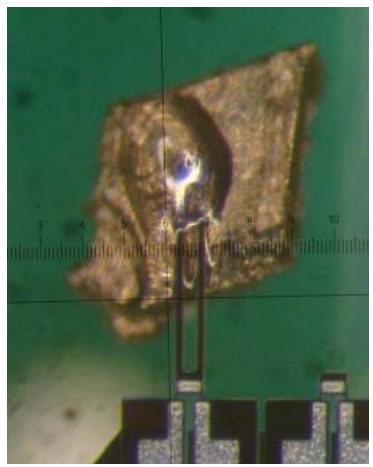


A piezoresistive cantilever was used as a torque magnetometer. This extremely sensitive instrument allows magnetic measurements at close to the quantum noise limit in the worlds highest DC fields.



This work provides valuable insight into the f-electrons in Uranium. It will provide guidance to theorists whose models can provide insight into issues such as the source of the rich phase diagrams in Uranium and related actinides such as Plutonium. These issues are of major concern to understanding and optimizing nuclear power, the chemistry of nuclear waste mitigation, and nuclear stockpile stewardship.

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