Investigation of Interplay between Ferromagnetism and Superconductivity in Single Crystal UCoGe

E. Steven (FSU, Physics), A. Kiswandhi (FSU, Physics), E. Prettner (FSU, Physics), E.S. Choi (NHMFL), G.M. Luke (McMaster U., Physics and Astronomy), J.S. Brooks (FSU, Physics)

Introduction
UCoGe is a candidate for triplet superconductor in which superconductivity occurs on the border of the ferromagnetic phase transition [1]. The study of UCoGe is important to elucidate further understanding of interplay between ferromagnetism and superconductivity (e.g.: how ferromagnetism may induce superconductivity). UCoGe crystallizes in orthorhombic TiNiSi structure with magnetic easy-axis along the orthorhombic c-axis.

Experimental
The 4-point contact resistance measurement (along c-axis) vs. magnetic field at different magnetic field direction and the temperature dependence of the resistance as well as the AC susceptibility are done by the 18 Tesla superconducting magnet (SCM1) in the millikelvin laboratory in a rotator probe.

Results and Discussion
Preliminary results are shown in Fig. 1. We find that there is a strong dependence of the normal state magnetoresistance (MR) on field direction, and that for fields parallel to the c-axis (0 deg), a MR kink appears near 10 T that is also observed in the ac susceptibility. Likewise, as the field approaches the a-b plane, Hc and the MR hysteresis rapidly increase, accompanied by a loss of the negative MR feature.

Conclusions
The sudden jumps in Hc accompanied by sudden hysteresis growth may suggest that superconductivity is induced when spins flip from c-axis to a(b)-axis. The loss of negative MR feature as B turns from c to a(b)-axis may suggest suppression of spin-orbit coupling as Hc grows. The clockwise hysteresis may suggest some kind of vortex dynamics in inhomogeneous system. Lastly, kinks observed in the low angle and AC susceptibility data may suggest some kind of phase transition. More work is underway to explore the unusual magnetic and superconducting aspects of this material.

Acknowledgements
This work is supported by NSF-DMR 06-02859.

Reference