# ULTRA-LOW TEMPERATURE DE HAAS-VAN ALPHEN OSCILLATIONS IN $CeCoIn_5$

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## Introduction

Our previous de Haas-van Alphen oscillation measurements on the heavy fermion superconductor $CeCoIn_5$ revealed an anomalous temperature dependence of the oscillation amplitude in the vicinity of the field-tuned quantum critical point [1] : instead of saturating at low temperature, in accordance with conventional Lifshitz-Kosevich theory, the amplitude continued to increase to temperatures as low as 6 mK, which was the lowest measured. Failure of Lifshitz-Kosevich theory suggests a breakdown in the underlying Fermi Liquid theory, a phenomenon which is being observed in a growing number of metallic compounds close to quantum phase transitions but has not, to date, been observed in the de Haas-van Alphen effect, or at such low temperatures. To extend these measurements to even lower temperatures, and look for a recovery, or otherwise, of Lifshitz-Kosevich behaviour, we developed an ac susceptometer and related detection electronics for use on the NHMFL high B/T facility at the University of Florida, Gainesville.

## Results and Discussion

In the first ac susceptibility experiment to be performed on the high B/T system, we succeeded in measuring de Haas-van Alphen oscillations at a range of temperatures down to 900 ❍K.

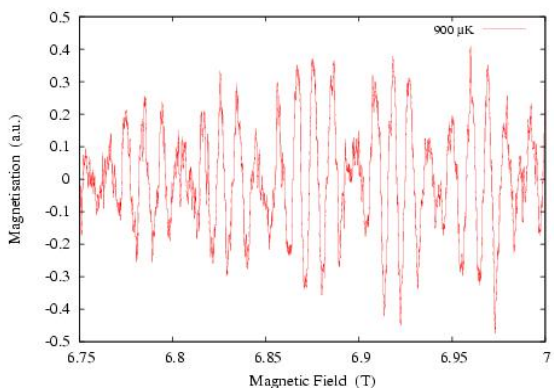


**Fig. 1.** de Haas-van Alphen oscillations between 6.75 T and 7 T, at 900 ❍K, in $CeCoIn_5$.

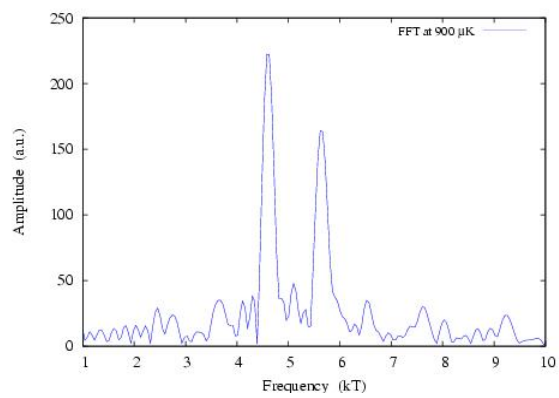


**Fig.2.** Fast Fourier transform of the data in Fig.1.

Comprehensive measurements were made at magnetic fields between 6 T and 7 T, using the field modulation technique. Not all of the known de Haas-van Alphen frequencies were observed, but those we did observe agreed very well, in frequency and amplitude, with previous results. Detailed analysis of the data is underway.

## Acknowledgements

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## References

[1] McCollam, A, *et al*., Physical Review Letters, **94**, 186401 (2005).