MAGNETIC FIELD INDUCED LATTICE ANOMALY INSIDE THE SUPERCONDUCTING STATE OF $CeCoIn_5$: ANISOTROPIC EVIDENCE OF THE POSSIBLE FULDE-FERRELL-LARKIN-OVCHINNIKOV STATE

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Introduction

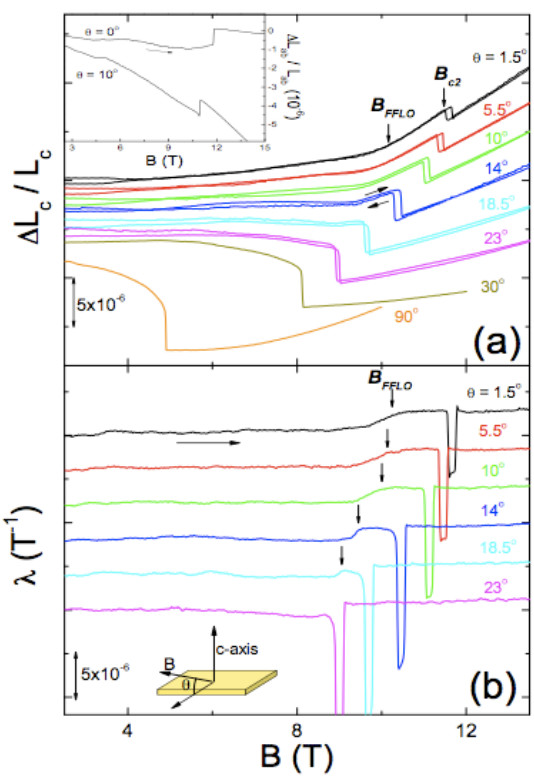
$CeCoIn_5$ is a heavy fermion superconductor (T_c = 2.1 K) that has recently attracted a lot of interest due to a unique phase that is claimed to develop within the mixed state.[1,2] As with any proposed new state of matter, there is a serious debate regarding the character and nature of the phase, thus illustrating the need for new experimental information. In this work, we study the coupling of the order parameter to the lattice through magnetostriction experiments. Besides its amazing sensitivity, linear magnetostriction is a powerful technique to study anisotropy and reduced dimensionality because each crystal axis can be measured independently for different directions of the applied magnetic field.

Experimental

The isothermal linear magnetostriction experiments were performed on a 1X1X1.5 mm^3 flux grown single crystals using a titanium capacitance dilatometer[3] and all measurements were taken in SCM1. Magnetostriction measurements were then taken with the magnetic field applied at varying angles with respect to the conducting planes.

Results and Discussion

Fig.(a) displays the c-axis linear magnetostriction for different directions of B at T ≈ 30mK. Two features are clearly distinguishable. A higher field first order transition which monotonically moves to lower B as the field is rotated towards the c-axis. This discontinuity occurs at 11.7T for $\theta = 0^o$ and 4.9T for $\theta = 90^o$ confirming that it corresponds to the upper critical field B_{c2}. The length change at B_{c2} also increases continuously as the field moves away from the ab-planes in agreement with published results. Below H_{c2}, a second order anomaly occurs at low angles. This can be clearly seen in Fig.(b) where the field dependence of the c-axis magnetostriction coefficient is shown. B_{c2} and the second order transition are detected as a peak and a "jump", respectively. The hysteresis between the up and down-sweep curves is appreciable at B_{c2} but negligible at the lower field transition.



Conclusions

These results provide further support of the proposed FFLO character of the state and are inconsistent with the proposed field induced magnetic order.

Acknowledgements

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References

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