RESONANT ULTRASOUND SPECTROSCOPY OF Sr_2RuO_4

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Introduction

Sr_2RuO_4 is believed to be a spin triplet superconductor. In such a case a multiple component superconducting order parameter is possible. Even amongst unconventional superconductors there have not been many systems for which a multiple superconducting order parameter has been well established. For a single component order parameter a jump in the transverse sound velocity at the superconducting transition is not allowed on the basis of symmetry (in zero field). However, a multiple component order parameter is not held to this restriction.[1] The goal of this work was to see if a jump in the transverse sound velocity could be observed at the superconducting transition in Sr_2RuO_4 with resonant ultrasound spectroscopy.

Experimental

We used the 15 Tesla superconducting magnet at the NHMFL-LANL with the Resonant Ultrasound Spectrometer developed by A. Migliori. A single crystal of Sr_2RuO_4 with T_c of 1.4K was grown by floating zone methods and polished into a rectangular shape of dimensions 0.289 x 0.200 x 0.087 cm^3.

Results and Discussion

At room temperature over 60 frequencies were observed up to 3 MHz. A fit at room temperature yielded values of the elastic constants in agreement with previously published values.[2] This procedure was repeated at many temperatures down to 1.0K. T_c is easily determined by the change in slope of the frequencies of the individual resonances, which reflects the change in slope of several of the elastic constants. Figure 1 shows an example of one of the measured resonances. The assignment of this resonance to a particular elastic constant comes from the fit to all of the 60 measured resonances. Further analysis will conclude whether a jump in the transverse sound velocity can be determined from these measurements.

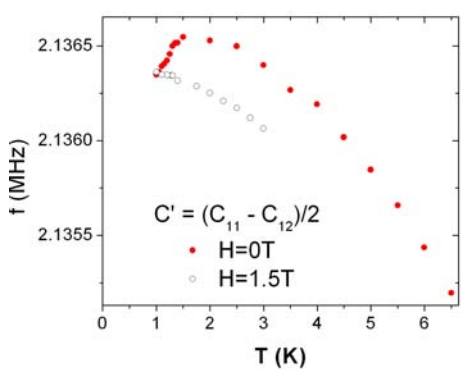

Figure 1: frequency versus temperature for one of the observed resonances in zero field and above H_{c2}.

Acknowledgements

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References

[1] Walker, M.B. and Contreras P., Phys. Rev. B, **66**, 214508-1-5 (2002).
[2] Paglione, J., *et al*., Phys. Rev. B, 65, 220506(R)-1-4 (2002).