HIGH FIELD THERMAL TRANSPORT IN $BaCuSi_2O_6$

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Spin gap compounds can exhibit many interesting quantum effects that can be realized only at low temperatures and high magnetic fields. One of the most exciting possibilities is that these spin gap compounds may be magnetic analogs of the Bose Einstein Condensate (BEC). Thermal conductivity, κ, measurements may provide a more direct probe of the BEC state, e.g. κ of superfluid liquid ^{4}He is extremely large below the BEC λ-transition. Therefore, we have measured the thermal conductivity in the spin-gap compound $BaCuSi_2O_6$, one of the potentially best realizations of a spin BEC [1].

We display our results for the thermal conductivity of $BaCuSi_2O_6$ in the high-field state in Fig. 1. The *T-H* phase diagram is shown in the inset of Fig. 1, delineating the quantum paramagnetic and AF/BEC state [1]. We have tracked the thermal conductivity across the phase boundary down to temperatures of 2 K at various fields. Interestingly, no clear features were seen upon crossing the phase boundary, though clearly there are some field-induced changes in the thermal conductivity. Whether or not the thermal conductivity can probe the magnetic degrees of freedom depends on a subtle balance between spin coherence and spin-lattice relaxation times [2].Since a thermal gradient primarily couples to the lattice, it is not unusual that the thermal conductivity will show no drastic features in the absence of a significant spin-lattice coupling. Indeed, the crystal symmetry of the BaCuSi2O6 structure is such to minimize certain types of spin-lattice coupling, which is what makes this compound such a good candidate for a spin-BEC. Nevertheless, at lower temperatures it may become possible to observe heat transport in the BEC state as the coherence and spin-lattice relaxation times reach an appropriate balance.

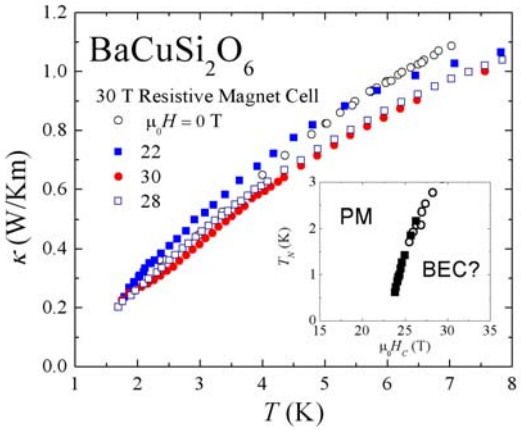

Fig. 1. *Thermal conductivity of $BaCuSi_2O_6$ as a function of temperature at various fixed fields. The inset displays the T-H phase diagram.*

Judging from these preliminary findings, it is of great interest to extend these measurements to even lower temperatures. We plan to measure this compound down to ^{3}He temperatures up to 30 T in the future.

Acknowledgements

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References

[1] Sebastian, S.E., *et al.*, Phys. Rev. B, **72**, 100404 (2005).
[2] Berman, R., *Thermal Conduction in Solids*, Oxford University Press (1976).