Low-Temperature Heat Transport of Spin Gapped Quantum Magnets

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Low-dimensional or frustrated quantum magnets were revealed to exhibit exotic ground states, magnetic excitations, and quantum phase transitions (QPTs). For a particular case of the spin-gapped antiferromagnets, the external magnetic field can close the gap in the spectrum, which results in a QPT between a low-field disordered paramagnetic phase and a high-field long-range ordered one. An intriguing finding is that this ordered phase can be approximately described as a Bose-Einstein condensation (BEC) of magnons. In this work, we study the low-temperature and high-field thermal conductivity (κ) of several spin gapped quantum magnets, including the quasi-one-dimensional S=1 chain compound $NiCl_2$-$4SC(NH_2)_2$, the layered spin-dimer compound $Ba_3Mn_2O_8$, and the ferromagnetic-antiferromagnetic alternating chain compound $(CH_3)_2CHNH_3CuCl_3$, etc. It is found that the magnetic excitations are commonly scattering phonons rather strongly in these materials; in some particular cases they can also act as heat carriers and make a substantial contribution to the heat transport.[1]

[1]X. F. Sun, W. Tao, X. M. Wang, and C. Fan, Phys. Rev. Lett. **102**, 167202 (2009); W. P. Ke, X. F. Sun *et al.*, unpublished; L. M. Chen, X. F. Sun *et al.*, unpublished.