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Gap structure of iron-pnictide superconductors from low-temperature heat transport

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The structure of the superconducting gap provides important clues on the symmetry of the order parameter and the pairing mechanism. Here I describe how measurements of the thermal conductivity at very low temperature can be used to determine whether nodes are present in the gap function of a particular superconductor, and how the application of a magnetic field probes the low-energy quasiparticle excitations. Measurements on hole-doped and electron-doped pnictide superconductors, $Ba_{1-x}K_xFe_2As_2$ [1] and $Ba(Fe_{1-x}Co_x)_2As_2$ [2], reveal a negligible residual linear term at T$\rightarrow$0, showing that the gap of these two superconductors has no nodes, at least in the basal plane. In both pnictides, a small field is found to be very effective in exciting quasiparticles, showing that the gap must be very small in some direction on the Fermi surface. In $Ba(Fe_{1-x}Co_x)_2As_2$, the evolution with doping x is as follows: at low x, the gap is large everywhere on the Fermi surface, and beyond optimal doping the minimum gap becomes progressively smaller. I discuss what these features tell us about the nature of the superconducting state in pnictide superconductors. * Measurements of heat transport performed in collaboration with X.-G. Luo, H. Shakeripour, M.A. Tanatar, N. Doiron-Leyraud and L. Taillefer. [1] X.-G. Luo et al., Phys. Rev. B 80, 140503 (2009). [2] M.A. Tanatar et al., arXiv:0907.1276.