Complementary Thermodynamic and Optical Studies of Superconductivity - Induced Anomalies in an Iron Arsenide

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We critically examine the interplay between spin fluctuations and superconducting pairing in iron pnictides by complementary studies of the thermodynamic and optical properties of optimally doped BKFA single crystals.[1] We discuss the microscopic origin of superconductivity-induced electronic specific heat and infrared optical anomalies in the framework of a multiband Eliashberg theory with two distinct superconducting gap energies 6 k_BT_c and 2.2 k_BT_c. The observed unusual suppression of the optical conductivity in the superconducting state at energies up to 14 k_BT_c can be ascribed to spin-fluctuation-assisted processes in the clean limit of the strong-coupling regime.
An unusual complement to these results is the observation of a superconductivity-induced suppression of an absorption band at an energy of 2.5 eV, two orders of magnitude above the superconducting gap energy.[2] This anomaly is explained as a consequence of non-conservation of the total number of unoccupied states involved in the corresponding optical transitions due to the opening of the superconducting gaps and redistribution of the occupation of the different bands below T_c, which can potentially enhance superconductivity in iron-pnictides.

[1]P. Popovich *et al.*, Phys. Rev. Lett. **105**, 027003 (2010); A. Charnukha *et al.*, arXiv:1103.0938 (2011).
[2]A. Charnukha *et al.*, Nat. Commun. **2**, 219 (2011).

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