Mass Renormalizations and Uncoventional Pairing in Multiband Superconducting Iron Pnictides - a Phenomenological Approach

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Combining density functional theory (DFT) calculations of the density of states (DOS) and plasma frequencies with experimental thermodynamic and optical data, such as electronic specific heat and penetration depth, as well as available ARPES and dHvA data taken from the literature, we estimate both the high-energy (Coulomb, Hund's rule coupling) and low-energy (el-boson coupling) electronic mass renormalization for several typical Fe-pnictides with $T_c < 40$ K, focusing on AFe_2As_2 (A=K,Rb,Cs), (Ca,Na)122, (Ba,K)122, LiFeAs, and $LaFeO_{1-x}F_xAs$ with and without As-vacancies [1]. Using multiband Eliashberg theory we show that these systems can NOT be described by a very strong el-boson coupling constant $\lambda \gtrsim 2$ or even larger as often proposed in the literature [2], being in conflict with the significant high-energy mass renormalization as seen by ARPES and optics. Instead, an intermediate $s_{\pm}$ coupling regime is realized, essentially based on interband spin fluctuations from at least one predominant pair of bands. In some cases, e.g. (Ca,Na)122, there is also a non-negligible intraband el-phonon or el-orbital fluctuation contribution [3]. The coexistence of magnetic As-vacancies and high-T_c superconductivity for $LaFeO_{1-x}F_xAs_{1-\delta}$ [4]-[6] probably excludes an orbital fluctuation dominated s_{++} scenario [7] at least for that special compound. Difficulties of the standard DFT based results with respect to calculated and empirical partial DOS and Fermi surface cross sections are discussed in terms of orbital dependent correlation effects as well as in terms of additional surface effects probably observed in recent ARPES measurements [8].

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