Disorder induced transition between $s_\pm$ and $s_{++}$ states Fe-based superconductors

M.M. KORSHUNOV, Kirensky Institute of Physics, Krasnoyarsk 660036, Russia, D.V. EFREMOV, O.V. DOLGOV, Max-Planck-Institut FKF, D-70569 Stuttgart, Germany, A.A. GOLUBOV, Faculty of Science and Technology and MESA+ Institute of Nanotechnology, University of Twente, The Netherlands, P.J. HIRSCHFELD, Department of Physics, University of Florida, Gainesville, Florida 32611, USA — The symmetry and structure of the superconducting gap in recently discovered Fe-based materials is one of the main challenges in this exciting new field (see, e.g. P.J. Hirschfeld, M.M. Korshunov, and I.I. Mazin, Rep. Progr. Phys. 2011). We have reexamined the problem of disorder in 2-band superconductors, and shown within the framework of the $T$-matrix approximation that the suppression of $T_c$ can be described by a single parameter depending on the intra- and interband impurity scattering rates. $T_c$ is shown to be more robust against nonmagnetic impurities than would be predicted in the trivial extension of Abrikosov-Gor’kov theory. We find disorder-induced transition from the $s_\pm$ state to a gapless and then to a fully gapped $s_{++}$ state, controlled by the sign of the average coupling constant.

Partial support was provided by DOE DE-FG02-05ER46236 (PJH and MMK), and RFBR 09-02-00127, Presidium of RAS program N5.7, Russian FCP GK P891, President of Russia MK-1683.2010.2 (MMK)

Maxim Korshunov
Kirensky Institute of Physics, Akademgorodok, Krasnoyarsk 660036, Russia

Date submitted: 21 Sep 2011