A MODEL FOR $d_{x^2-y^2}$ SUPERCONDUCTIVITY IN THE STRONGLY CORRELATED FERMIONIC SYSTEM

I. Bariakhtar[1,2], *A. Nazarenko*[1,3]

[1]Institute of Magnetism, Nat. Acad. of Sci. of Ukraine
(*36-b, Vernadsky Blvd., Kyiv 03142, Ukraine*),
[2]Boston College, Department of Physics
(*140, Commonwealth Avenue, Chestnut Hill, MA 02467, USA*),
[3]Harvard University, IAM-HUIT
(*1033, Massachusetts Avenue, Cambridge, MA 02138, USA*)

S u m m a r y

Based on the known phenomenology of high-T_c cuprates and the available numerical calculations of the $t-J$ model, a two-dimensional effective fermionic model with the nearest neighbor attraction is proposed. Numerical calculations suggest that the model has the $d_{x^2-y^2}$ superconductivity (SC) in the ground state at a low fermionic density. We argue that this model captures the important physics of the $d_{x^2-y^2}$ superconducting correlations found earlier in the $t-J$ model by the exact diagonalization approach. Within a self-consistent RPA diagrammatic study, the density and the coupling strength dependence of the critical temperature is calculated. We also investigate the influence of the impurities on our results and show that the suppression of the superconductivity is insignificant, when the retardation effects are accounted for as opposed to the Hartree–Fock approximation.