DYNAMICAL DIMENSION REDUCTION IN UNDERDOPED HIGH-T_c SUPERCONDUCTORS

G.G. Sergeeva, V.L. Vakula[1]

Institute for Theoretical Physics
of National Scientific Center
"Kharkiv Institute of Physics and Technology"
(*1, Akademichna Str., Kharkiv 61108, Ukraine;*
e-mail: gsergeeva@kipt.kharkov.ua),
[1]B.Verkin Institute for Low Temperature Physics
and Engineering, Nat. Acad. Sci. of Ukraine
(*47, Lenin Ave., Kharkiv 61103, Ukraine*)

S u m m a r y

We discuss a supposition according to which both pseudogap (PG) and superconducting (SC) states of underdoped high-T_c superconductors (HTSC) result from the dynamical dimension reduction when HTSC behave on cooling as if their dimensionality is changed. It is shown that the transition to a PG state at the temperature T^* occurs as a dimensional crossover from the three-dimensional ($3D$) motion of charge carriers to the two-dimensional ($2D$) one. It is this two-dimensionality at $T_c < T < T^*$ that is responsible for the crucial role of Jahn—Teller (JT) distortions, which bind up holes to form delocalized JT polarons as well as localized three-spin polarons in copper-oxygen planes, thus eliminating the competition between the pairing of carriers and their localization on JT distortions. As the temperature is lowered below $T_{\rm cr} < T^*$, local "hole—JT polaron" pairs, i.e. zero-dimensional ($0D$) SC fluctuations, are generated in the CuO_2 planes. In the temperature region $T_c < T < T_{\rm cr}$, the SC transition occurs as a sequence of two crossovers with respect to the dimensionality of SC fluctuations ($0D \to 2D$ and then $2D \to 3D$). We discuss some available experimental data on the local "hole—JT polaron" pairing and some results on the dynamical dimension reduction in the PG and SC states.