SESSION 7

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Stripes, spin and lattice fluctuations

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Correlation bags, vibrons, and strong-correlation fluctuations in the copper oxides

J. B. Goodenough and J.-S. Zhou
Texas Materials Institute, ETC 9.102, University of Texas at Austin, USA.

The lattice instabilities in the copper-oxide superconductors are due to the coexistence of equilibrium bond lengths $(Cu\text{-}O)_{loc} > (Cu\text{-}O)_{itin}$ in the CuO_2 sheets for localized and itinerant electrons, respectively. At higher temperatures in the system $La_{2-x}Sr_xCuO_4$, an evolution with increasing x from single-hole to multihole correlation bags occurs near x = 0.10, from multihole bags to vibronic states in the range 0.10 < x < 0.20, and from vibronic states to strong-correlation fluctuations at higher values of x. A single-hole correlation bag occupies 5 to 6 Cu centers with $(Cu\text{-}O)_{itin}$ in a matrix of $(Cu\text{-}O)_{loc}$; a bipolaron bag contains two holes in 4 Cu centers. Strong-correlation fluctuations are clusters of Cu centers with $(Cu\text{-}O)_{loc}$ in a matrix of $(Cu\text{-}O)_{itin}$. On lowering the temperature, spinodal phase segregation occurs between an antiferromagnetic parent phase and the superconductive phase on the underdoped side; between the superconductive and overdoped phases on the overdoped side. In the superconductive phase, localized vibronic states at higher temperatures become itinerant vibronic states as the holes order into alternate Cu-O-Cu rows at a composition $x \approx 1/6$. High-T_c superconductivity is due to Cooper-pair formation of the heavy electrons, which gives a gap symmetry $d_{x^2-y^2} + id_{xy}$.

Keywords: *Spinodal phase segregation, high-temperature superconductivity, large polarons, vibronic states.*

J.B. Goodenough
University of Texas at Austin
bldg. ETC. 9.102
Austin, TX 78712, USA
phone: +1 512 471-1646
fax: +1 512 471-7681
e-mail: jgoodenough@mail.utexas.edu

A topological mechanism for superconductivity in cuprates

A. H. Castro Neto
Department of Physics, University of California, USA.

We propose a model for a spatially modulated collective state of superconducting cuprates in which the electronic properties vary locally in space. In this model the regions of higher hole density (called stripes) are described as Luttinger liquids and the regions of lower density (antiferromagnetic ladders) as an interacting bosonic gas of $d_{x^2-y^2}$ hole pairs. We show that the transition to the superconducting state is topological and driven by decay processes among these elementary excitations in the presence of lattice vibrations.

Antonio H. Castro Neto
Dept. of Physics
University of California
Riverside CA 92521
phone: (909) 787-6469
fax: (909) 787-4529
e-mail: neto@phyun6.ucr.edu

Stripe fluctuations, electron- and polaron-1ike carriers, and the physics of the high-T_c cuprates

J. Ashkenazi
Physics Department, University of Miami, U.S.A.

Evidence is growing that the high-T_c cuprates are characterized by a fluctuating structure of stripes. A theory based on both "large-U" and "small-U" orbitals results in such a structure, and three types of carriers: polaron-like "stripons" carrying charge, "quasielectrons" carrying charge and spin, and "svivons" carrying spin and lattice distortion. It is shown that this elecironic structure leads to the anomalous physical properties of the cuprates, and specifically the systematic behavior of the resistivity, Hall constant, and thermoelectric power. High-T_c pairing results from transitions between pair states of quasielectrons and stripons through the exchange of svivons. A pseudogap phase occurs when pairing takes place above the temperature where stripons become coherent, and this temperature determines the Uemura limit.

Josef Ashkenazi
Physics Department
University of Miami
P. O. Box 248046, Coral Gables, FL 33124, U.S.A.
fax: +1-305-284-4222
e-mail: Ashkenazi@phyvax.physics.miami.edu

Doped stripes in models for the cuprates emerging from the one-hole properties of the insulator

E. Dagotto
Department of Physics, Florida State University, Tallahassee, USA.

The extended and standard t-J models are computationally studied on ladders and planes, with emphasis on the small J/t region [1].
The t-J_z model is also analyzed and the results are similar to those of the t-J model [2]. At couplings compatible with photoemission results for undoped cuprates, half-doped stripes separating π-shifted antiferromagnetic (AF) domains are found, as in Tranquada's interpretation of neutron experiments. Our main result is that the elementary stripe "building-block" resembles the properties of *one* hole at small J/t, with robust AF correlations across-the-hole induced by the local tendency of the charge to separate from the spin (G. Martins et al., Phys. Rev. B **60**, R3716 (1999)). This suggests that the seed of half-doped stripes already exists in the unusual properties of the insulating parent compound.

Keywords: *stripes, t-J model, spin incommensurability*.

References

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Elbio Dagotto
Dept. of Physics
Florida State University
Tallahassee, FL32306, USA
phone: (850) 644-1726
fax: (850) 644-5038
e-mail: dagotto@magnet.fsu.edu