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Room Temperature Superconductors based on Universal Scaling Laws Firmly predicted by the Principle of Spin-charge coupling in High Tc Cuprate Oxides

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Abstract

The phase diagrams for the superconducting phase transition in high temperature cuprate superconductors are known to show the monotonously decreasing pseudogap (spin gap) temperature and the dome-shaped bose-condensation temperature in the plane of temperature vs. hole doping concentration. Our rigorous theory (Ref.1) of gauge theoretic slave-boson representation of the t-J Hamiltonian has been successful in reproducing variety of key observations: They are not only the phase diagrams but also the angle-resolved photo-emission spectroscopy and superfluid weight, including both the charge dynamics/optical conductivity and the spin dynamics/susceptibility (Refs: 1 to 6) owing to the role of spin-charge coupling. To be specific, our accurately derived Heisenberg term manifests the presence of the spin-charge coupling which reveals coupling between the spin pairing order and the charge pairing order, thus allowing the plausibility of forming the Cooper pairing order. First we discuss how our theory fits various observations mentioned above, in light of a crucial role played by the principle of the spin-charge coupling which we uniquely discover, being absent in other proposed theories. Further it is found to be responsible for the two observed universal scaling laws of involving the two different energy scales: one for the simultaneous increase of both the spin gap temperature T* and the superconducting phase transition temperature Tc and, the other for that of the magnetic (antiferromagnetic spin) resonance energy Eres and Tc, both of which are shown to increase proportionally to the Heisenberg coupling i.e., the antiferromagnetic spin coupling strength J. To put it otherwise, the higher the T* (Eres), the higher the Tc by disclosing their proportional increment with J. Thus, most importantly both universal scaling laws unveil the plausibility of room temperature superconductors, which will be met by a proper chemical synthesis which satisfies a sufficiently high J value (higher than currently available cuprate oxides). This claim will be highlighted by making a judicious comparison with the observed high Tc phase diagrams.

Biography:

Vice President, KAST (Korea Academy of Science and Technology),Chief Officer of Information and Publications, KAST, Korea Advanced Institute of Science and Technology, Board Member, Pohang University of Science and Technology, Professor, Academician/Permanent Fellow, The Korean Academy of Science and Technology, Professor Emeritus: Pohang University of Science and Technology, Advisory Committee Member of various Organizations

Speaker Publications:

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2. S. -S. Lee and S. -H. S. Salk, Phys. Rev. B 71, 134518 (2005); J. -H. Eom, S. -H. S. Salk, Phys. Rev. B 72, 064508 (2005); J. -H. Eom, S.-S. Lee, K. -S. Kim, S.-H. S. Salk, Phys. Rev. B 70, 024522 (2004);
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