Probing the interplay among superconductivity, pseudogap, and stripe correlations by Zn substitution in high-T_c cuprates

S. H. Naqib and R. S. Islam*

Department of Physics, University of Rajshahi, Raj-6205, Bangladesh

ABSTRACT

The effect of Zn substitution on the superconducting transition temperature, T_c, was investigated for the $La_{2-x}Sr_xCu_{1-y}Zn_yO_4$ and $YBa_2(Cu_{1-y}Zn_y)_3O_{7-\delta}$ compounds over a wide range of hole concentration, p, and Zn content (y) in the CuO_2 planes. Zn induced rate of suppression of T_c, $dT_c(p)/dy$, was found to be strongly p-dependent and showed a monotonic variation with p, except in the vicinity of $p \sim 0.125$, *i.e.*, near the $1/8^{th}$ anomaly where the charge/spin stripe correlations are at its strongest. $dT_c(p)/dy$ decreased significantly around this hole concentration *i.e.*, Zn suddenly became less effective in degrading T_c near the $1/8^{th}$ anomaly. We have discussed the possible scenarios that can give rise to such a non-monotonic $dT_c(p)/dy$ near $p \sim 0.125$. On the other hand, the p-dependent characteristic pseudogap energy scale, $\varepsilon_g(p)$, shows a nearly linear decrease with increasing p with no noticeable extra feature at $p \sim 0.125$. Also, there is no significant effect of the level of Zn substitution on $\varepsilon_g(p)$. All these findings are indicative of a complex and competing interplay among the superconducting, pseudogap, and stripe correlations in the hole doped cuprates.

Keywords: Zn substituted La214 and Y123; stripe correlations; pseudogap

PACS: 74.72.Dn; 74.72Bk; 74.62.Dh; 74.25.Dw