Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Origin and consequences of the disorder-induced inhomogeneities in cuprate superconductors DEBMALYA CHAKRABORTY, Indian Institute of Science Education and Research Kolkata, Mohanpur Campus, India-741246, RAJDEEP SENSARMA, Department of Theoretical Physics, Tata Institute of Fundamental Research, Mumbai-400005, India, AMIT GHOSAL, Indian Institute of Science Education and Research Kolkata, Mohanpur Campus, India-741246 — The effect of potential impurities on cuprate superconductors are investigated within a formalism suitable for addressing the complex interplay of the bare repulsive electronic correlations and disorder, both being strong. We show that the mechanism governing the demise of superconductivity is rather subtle and differs from the conventional weak-coupling descriptions. While the superconductivity remains surprisingly robust for up to moderate disorder, it crashes down sharply at stronger disorders. The initial robustness is attributed to the strong repulsive correlations that smear out charge inhomogeneities by reorganizing the hopping on the bonds prohibiting formation of superconducting "islands". However, with increasing strength of disorder, the potential difference across some bonds reach the scale of the bandwidth and the overall energy of the system is reduced by prohibiting hopping on such links. Integrating this concept within our formalism, we show that the correlations fail to homogenize the system across these "cut-bonds". This produces Mott-insulating, Anderson-insulating, as well as locally superconducting regions interspersed among each other at strong disorder, eventually destroying the global superconductivity.

Debmalya Chakraborty
Indian Institute of Science Education and Research Kolkata, Mohanpur Campus, India-741246

Date submitted: 04 Nov 2015 Electronic form version 1.4