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Antagonistic effects of nearest-neighbor repulsion on the pairing dynamics of the extended Hubbard model

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While most experimental and theoretical clues lean towards a magnetic origin for the pairing mechanism of cuprates, the question of its degree of retardation in the strong correlation regime remains highly controversial.[1,2] The answer to this question lies partly in the frequency dependence of the anomalous spectral function of doped Mott insulators, extracted at finite temperature via the MaxEntAux method [3] for analytic continuation. Using Cellular Dynamical Mean-Field Theory for the Hubbard model with nearest-neighbor repulsion V, we show that this repulsion has antagonistic effects on the critical temperature T_c as it boosts T_c at low doping but diminishes it at large doping. The study of pair-breaking and pair-forming contributions to superconductivity clarifies the nature of these effects. They emerge from a compromise between the trivial Coulomb pair-breaking effect of V and a more subtle pair-forming effect of V. The latter arises from the strengthening of short-ranged antiferromagnetism through the coupling constant $J = 4t^2/(U - V)$ where U is the on-site Hubbard interaction, and t the hopping amplitude.

[1] P.W. Anderson, Science **316**, 1705 (2007).

[2] D.J. Scalapino, e-letter response to Science **316**, 1705 (2007).

[3] A. Reymbaut, D. Bergeron and A.-M.S. Tremblay, Phys. Rev. B **92**, 060509(R) (2015)

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