Abstract Submitted
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Enhancing bulk superconductivity by engineering granular materials[1] JAMES MAYOH, ANTONIO GARCÍA GARCÍA, University of Cambridge — The quest for higher critical temperatures is one of the main driving forces in the field of superconductivity. Recent theoretical and experimental results indicate that quantum size effects in isolated nano-grains can boost superconductivity with respect to the bulk limit. Here we explore the optimal range of parameters that lead to an enhancement of the critical temperature in a large three dimensional array of these superconducting nano-grains by combining mean-field, semiclassical and percolation techniques. We identify a broad range of parameters for which the array critical temperature, T_c^{Array}, can be up to a few times greater than the non-granular bulk limit, T_{c0}. This prediction, valid only for conventional superconductors, takes into account an experimentally realistic distribution of grain sizes in the array, charging effects, dissipation by quasiparticles and limitations related to the proliferation of thermal fluctuations for sufficiently small grains. For small resistances we find the transition is percolation driven. Whereas at larger resistances the transition occurs above the percolation threshold due to phase fluctuations.

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