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Superconductivity and ferroelectricity in calcium-substituted-oxygen-reduced strontium titanate

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Strontium titanate (SrTiO3) becomes a metal upon removal of a tiny fraction of its oxygen atoms. The metal goes through a superconducting instability in spite of its tiny Fermi energy, an order of magnitude small then than the Debye energy [1]. The resistivity is quadratic in temperature, a hallmark of electron-electron scattering. The T-square behavior persists in the single-band dilute limit despite the absence of the two known mechanisms for generating it [2]. Substituting strontium with calcium gives rise to a percolative ferroelectric order, which coexists with metallicity and its superconducting instability in a narrow range of doping. Upon further doping, the ferroelectric-like order is destroyed by a quantum phase transition at a critical doping level at which the Friedel oscillations generated by neighboring dipoles interfere destructively. In the vicinity of this quantum phase transition, the superconducting critical temperature is enhanced by calcium substitution. We will discuss possible origins of this enhancement caused by calcium substitution [3]. 1) X. Lin, Z. Zhu, B. Fauqué and K. Behnia, Phys. Rev. X 3, 021002 (2013). 2) X. Lin, B. Fauqué and K. Behnia, Science 349, 945 (2015). 3) C. W. Rischau, X. Lin, C. P. Grams, D. Finck, S. Harms, J. Engelmayer, T. Lorenz, Y. Gallais, B Fauqué, J. Hemberger and K. Behnia, to be published (2016).