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Unconventional Electronic Transport in Doped $SrTiO_3$ C. LEIGHTON, A. SPINELLI, M.A. TORIJA, C. LIU, C. JAN, University of Minnesota — Resistivity, Hall effect, and magnetoresistance are reported on a large set of semiconducting $SrTiO_{3-\delta}$ single crystals doped n-type (by reduction or Nb substitution) over a broad range of carrier density (10^{15} to $>10^{20}$ cm^{-3}). Temperature-independent densities, strongly temperature-dependent mobilities (up to 22,000 $cm^2V^{-1}s^{-1}$ at 4.2 K), and a remarkably low critical carrier density for the metal-insulator transition are observed, and interpreted in terms of the quantum paraelectricity of the host. We argue that an unusual, high mobility, low density, metallic state is thus established at carrier densities at least as low as 8.5 x 10^{15} cm^{-3}. At low temperatures the temperature dependence of the mobility and resistivity exhibit a non-monotonic carrier density dependence and an abrupt change in character near 2 x 10^{16} cm^{-3}, indicating a distinct crossover in conduction mechanism, perhaps associated with a transition from impurity band to conduction band transport. The results provide a simple framework for the understanding of the global transport behavior, and suggest some potential applications. Work supported by NSF.

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