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Percolation via combined electrostatic and chemical doping in complex oxide films[1] PETER P. ORTH, Iowa State University, RAFAEL M. FERNANDES, JEFF WALTER, C. LEIGHTON, B. I. SHKLOVSKII, University of Minnesota — Electric field control of magnetism in complex oxide thin films provides many opportunities for novel storage and information processing devices with low power consumption. Electrolyte gating was successfully employed to electrostatically induce and control large charge densities in these systems. Attainment of sufficient densities to induce magnetic/electronic phase transitions, however, remains a challenge. One obvious strategy is to employ a combination of chemical and electrostatic doping. Stimulated by experimental advances in electrolyte gating methods, we theoretically investigate percolation in thin films of inhomogenous complex oxides, such as $La_{1-x}Sr_xCoO_3$ (LSCO), induced by a combination of bulk chemical and surface electrostatic doping. We identify two mechanisms that describe how bulk dopants reduce the amount of surface charge required to reach percolation: (i) bulk-assisted surface percolation, and (ii) surface-assisted bulk percolation. We show that thin films can be driven across the percolation transition by modest surface charge densities. We further show that if percolation is associated with the onset of ferromagnetism, the presence of critical magnetic clusters extending from the surface into the bulk leads to enhanced saturation magnetization

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