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Phase Transitions in Networks of Memristive Elements FORREST SHELDON, MASSIMILIANO DI VENTRA, Univ of California - San Diego — The memory features of memristive elements (resistors with memory), analogous to those found in biological synapses, have spurred the development of neuromorphic systems based on them (see, e.g., [1]). In turn, this requires a fundamental understanding of the collective dynamics of networks of memristive systems. Here, we study an experimentally-inspired model of disordered memristive networks in the limit of a slowly ramped voltage and show through simulations that these networks undergo a first-order phase transition in the conductivity for sufficiently high values of memory, as quantified by the memristive ON/OFF ratio. We provide also a mean-field theory that reproduces many features of the transition and particularly examine the role of boundary conditions and current- vs. voltage-controlled networks. The dynamics of the mean-field theory suggest a distribution of conductance jumps which may be accessible experimentally. We finally discuss the ability of these networks to support massively-parallel computation. Work supported in part by the Center for Memory and Recording Research at UCSD. [1] Y.V. Pershin and M. Di Ventra, Proc. IEEE, **100**, 2071 (2012).

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