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Nonequilibrium behavior in strongly correlated electron systems[1]

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There is growing evidence that nonequilibrium behavior may underlie many complex phenomena exhibited by strongly correlated electronic materials with disorder. A two-dimensional electron system (2DES) in Si metal-oxide-semiconductor field-effect transistors has emerged as an excellent model system for studying glassy or nonequilibrium charge dynamics near the metal-insulator transition (MIT). In particular, studies of both conductance relaxations and noise on disordered samples, using several different experimental protocols, have established that the 2DES in Si exhibits all the main manifestations of glassiness: slow, correlated dynamics, nonexponential relaxations, diverging equilibration time (as temperature $T \to 0$), aging and memory. The results provide strong evidence that many such universal features are robust manifestations of glassiness, regardless of the dimensionality of the system. In addition, the experiments show that the 2D MIT is closely related to the melting of this Coulomb glass. The observations are consistent with predictions of the theoretical models that describe the MIT as a Mott transition with disorder. Some effects that are unique to Coulomb glasses have also been revealed, which should have important implications for theoretical modeling of the glassy dynamics in a 2DES and other strongly correlated materials.

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