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Efros-Shklovskii variable range hopping conductivity without Coulomb gap TIANRAN CHEN, Department of Physics, West Chester University of Pennsylvania, BRIAN SKINNER, Center for Excitonics, Massachusetts Institute of Technology — In doped semiconductors and Coulomb glasses, in the limit of weak coupling, the electron conductivity primarily proceeds by phonon-assisted tunneling or hopping between different sites through the insulating gaps that separate them. Electron conduction can occur both through nearest-neighbor hopping and through cotunneling of electrons between distant sites via a chain of intermediate virtual states. In the presence of some disorder, the latter mechanism dominates at low temperatures, where the length of the hops grows to optimize the conductivity. This transport mechanism was introduced by Mott, and is called variable range hopping. When the Coulomb interaction between localized electrons is taken into account, it can be shown that at a sufficiently low temperature, variable range hopping conductivity obeys the Efros-Shklovskii (ES) law, which has been observed in a number of amorphous semiconductors and granular metal systems at low temperatures. ES conductivity has been long understood as the result of a soft, Coulomb gap at the Fermi level. However, such a theory overlooks the presence of spatial correlations between site energies and their possible effects on electrical conductivity. In this talk, we show both analytically and numerically that in systems where spatial correlations must be taken into account, ES conductivity may persist far outside the Coulomb gap, in contrast to conventional transport theory for doped semiconductors and Coulomb glasses where ES conductivity only occurs within the Coulomb gap.

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