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Monte Carlo study of the three-dimensional Coulomb glass
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The memory and hysteresis effects found in strongly-disordered electron systems can be explained by the existence of a glassy phase, the Coulomb glass. Efros and Shklovskii have predicted the emergence of a soft Coulomb gap, resulting from the long-range interactions between the localized electrons. However, the relationship between the soft Coulomb gap in the density of states and the electron's glassy behavior has been a long-standing unresolved question. Only recently has it been surmised within the framework of a mean field theory that the disordered electron system undergoes a replica symmetry breaking transition at a finite temperature, similar to the Sherrington-Kirkpatrick model of spin glasses. Because it is not clear, however, whether the transition persists beyond the mean-field approximation, we study in detail the critical behavior and the shape of the Coulomb gap in three space dimensions using Monte Carlo methods. Furthermore, we compare our results for the (random-energy) Coulomb glass model to previous results on a random lattice version of the model. Since these models possess different symmetries, the equivalence of the phase diagrams is far from obvious, contrary to previous claims.

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