

The Anderson-Mott transition for the disordered Hubbard model in $2d$

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Abstract

The interplay of disorder and interaction in $2d$ systems it's far from being understood. The disordered Hubbard model at half-filling is the simplest model exploiting the competition between disorder (strength = D) and interaction (the on-site repulsion U). We study the ground state properties of this model by means of variational Montecarlo. We show that the Gutzwiller wave function, using as uncorrelated Slater determinant the ground state of a non-interacting disordered tight-binding model (the strength of disorder D^* determined variationally), supplemented by a long-range Jastrow factor is a good trial ground state. It extrapolates from the exact ground state in the $U = 0$ limit, where the system is an Anderson insulator, to the almost homogeneous Mott insulator in the very large U limit. We focus on the most compelling regime of U and D finite where the system has a phase transition from a compressible electron glass to an incompressible Mott insulator. We identify in the compressibility fluctuation an order parameter for this phase transition that is directly accessible to our variational method since in a disordered interacting system the compressibility fluctuation can be related to the disconnected contribution of the static structure factor, $\lim_{q \rightarrow 0} \langle \rho(q) \rangle \langle \rho(-q) \rangle$. Finally we address both the paramagnetic and the magnetic sector of the phase diagram.