Metal-Insulator Anderson transition: numerical results

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Disorder induced transition from the metallic to the insulating regime was predicted by P. W. Anderson (1958) who showed that randomly distributed impurities can prevent the propagation of electron across the sample. Electron becomes localized in certain region of the lattice. Physical origin of the localization lies in the quantum character of electrons. The localization of electrons is crucial for the understanding of transport properties of mesoscopic structures at low temperatures.

While the transport of electrons in weakly disordered structures can be described analytically, the quantitative description of the localization, in particular the critical regime between the metallic and localized phases is still not complete. There is no agreement between results of analytical theories and numerical simulations.

We numerically demonstrate main phenomena observed in studies of the electron localization: absence of diffusion, the metal-insulator transition, sensitivity to small fluctuations, absence of self-averaging of physical quantities, and summarize main ideas and results of the scaling theory of localization obtained by the analysis of the electron conductance and the inverse participation ratio. Then we discuss possible origin of discrepancies between predictions of the analytical theories and numerical data.

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