Flow diagram of the metal-insulator transition in two dimensions

SERGEY KRAVCHENKO, Northeastern University, SVETLANA ANISSIMOVA, Boston University, ALEXANDER PUNNOOSE, CCNY, ALEXANDER FINKEL’STEIN, Weizmann Institute, TEUN Klapwijk, TU Delft — Recently, a two-parameter scaling theory comprehensively describing the metal-insulator transition in 2D was developed by two of us [1]. Here, we report experimental verification of the basis of this theory. We demonstrate, for the first time, that as a result of the interplay between the electron-electron interactions and disorder, both the resistance and the interactions become scale (temperature) dependent. We show that not only the resistance but also the interaction amplitude exhibits a fan-like spread as the MIT is crossed. We use these data to construct a resistance-interaction flow diagram of the MIT that clearly reveals a quantum critical point, as predicted in Ref.[1]. The metallic side of this diagram is accurately described by the theory without any fitting parameters. In particular, the temperature dependence of the resistance, which is non-monotonic, passes through a maximum when the interaction amplitude reaches a certain value $\gamma_2 \approx 0.45$ that is in remarkable agreement with the calculated one.


Supported by NSF, ACS, and Minerva Foundation

Sergey Kravchenko
Northeastern University

Date submitted: 18 Nov 2006

Electronic form version 1.4