Quantum Hall Transitions and Conformal Restriction

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Disordered electronic systems exhibit continuous quantum phase transitions between insulating and conducting phases (Anderson transitions). The nature of the critical state at and the critical phenomena near such a transition are of great current interest. A famous example is the integer quantum Hall (IQH) plateau transition. Recent experiments have provided very clear evidence for critical behavior near an IQH transition, and gave rather precise values of critical exponents. In spite of much effort over several decades, an analytical treatment of most of the critical states in disordered electronic systems has been elusive. We propose to use the recently developed rigorous theory of conformal restriction and Schramm-Loewner evolutions to study the IQH and other Anderson transitions in two dimensions, assuming conformal invariance at these critical points. We consider the so-called point contact conductances (PCC) and obtain, for the first time, exact analytical results for PCC's in the presence of a variety of boundary conditions at the IQH and similar critical points.