Conductance distribution in the two dimensional Anderson transition

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The two dimensional metal-insulator transition has been attracting renewed interest. Since the conductance is a fluctuating quantity, to describe the transition, an analysis of the distribution function of the conductance is necessary. Here we have performed a large scale numerical calculation of conductance and analysed in detail the critical conductance distribution. We report results for two models, namely the Chalker-Coddington (CC) model \cite{1} and SU(2) model \cite{2}. The former describes the quantum Hall transition, and the latter systems where there is strong spin-orbit scattering. Using the transfer matrix method, we calculated the transmission matrix $t$, and the dimensionless two terminal conductance given by

\begin{equation}
g = 2 \text{Tr}t = 2 \sum_{i} \tau_{i}
\end{equation}

where $0 \leq \tau_{i} \leq 1$ is the transmission eigenvalue. In Fig. 1 we show the critical conductance distributions for the CC and SU(2) models. Both show a linear increase near $g = 0$ and a kink at $g = 2$. We also analysed the distribution of the transmission eigenvalues. We found that the conductance is almost determined by the largest transmission eigenvalue $\tau_{\text{max}}$, and that the distribution of this largest transmission eigenvalue, after being transformed to $\nu_{\text{min}}$ by $\tau_{\text{max}} = 2/(\cosh \nu_{\text{min}} + 1)$, is well described by the distribution function \cite{3}

\begin{equation}
P(\nu_{\text{min}}) = \frac{\nu_{\text{min}}}{2} \exp(-\nu_{\text{min}}^{2}/4).
\end{equation}

Figure 1: Conductance distribution at the 2D Anderson transition, for CC model (+) and for the SU(2) model (×).

References

\begin{enumerate}
\item Y. Asada, K. Slevin, T. Ohtsuki, Phys. Rev. Lett. 89 (2002) 256601.
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