Analytical Localization Lengths in an One-Dimensional Disordered Electron System

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Analytical approximations of the Lyapunov exponent are derived for a random displacement model with equal potential barriers and random positions of the scatterers. Two asymptotic regions are considered corresponding to high and low reflectivity of the single scattering potential. The analytical results are in terms of a distribution function W for certain phases of the transfer matrices. A functional equation for W is derived and numerically solved. This serves to validate the analytical asymptotic formulas which turn out to be accurate in the high and low reflectivity regions with dimensionless wave number $K < 2$ and $K > 6$, respectively. The high wave number asymptotics allows for an analytical examination of the sufficient conditions for Anderson localization.

Key words: Anderson Localization; Lyapunov Exponent; Transfer Matrix; Functional Equation.
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