Spatial Wave Intensity and Field Correlations in Quasi-one-dimensional Wires

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Spatial intensity correlations between waves transmitted through random media are analyzed within the framework of the random matrix theory of transport. Assuming that the statistical distribution of transfer matrices is isotropic, we found that the spatial correlation function of the normalized intensity can be expressed as the sum of three terms, with distinctive spatial dependences. This result coincides with the one obtained in the diffusive regime from perturbative calculations, (Patrick Sebbah et al. in Phys. Rev. Lett. 88, 123901, 2002), but holds all the way from quasi-ballistic transport to localization. It is only the specific value of the coefficients which depends on the specific transport regime. Their values obtained from the Monte Carlo solution of the Dorokhov, Mello, Pereyra, and Kumar (DMPK) scaling equation are in full agreement with microscopic numerical calculations of bulk disordered wires. The experimental and numerical results are recovered inh the large-N (number of propagating channels) limit in Random Matrix theory. While correlations are positive in the diffusive regime, we predict a transition to negative correlations as the length of the system decreases.