STEADY STATE AND DYNAMIC ASPECTS OF PHOTON LOCALIZATION IN QUASI-ONE-DIMENSIONAL DISORDERED SYSTEMS

Anderson Localization is a wave interference phenomenon that causes absence of diffusion and spatial localization of waves in multiply scattering media in the presence of disorder. This regime of transport is in contrast to wave diffusion which may occur in random media with dimensions less than the wave localization length. We have designed and built an experimental setup to study steady-state and dynamic aspects of wave transport in quasi-one dimensional (Q1D) systems using statistics of microwave transmission through ensembles of realizations of disorder. We (i) find a breakdown of universal conductance fluctuations in dynamics within diffusive Q1D systems, (ii) introduce statistical criteria of single-channel transport in Q1D systems which can be used to chart the crossover from multi-channel transport in the diffusive regime to single-channel transport in the localized regime, (iii) show that the statistics of transmittance in the single-channel regime can be mapped onto a 1D system with a renormalized localization length, (iv) demonstrate that in the single-channel regime, the dominant eigenchannel is formed by a single localized mode or necklace state, (v) explore the dynamics of the single-channel transport, and (vi) investigate if the formation of optimal-order necklaces may occur in Q1D systems. These results are fundamental to understanding the static and dynamic behavior of waves in random media and can be useful in describing transmitting energy and information transfer through strongly scattering complex systems.