Wave intensity fluctuations in small disordered systems

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The statistical properties of wave transport through diffusive media have long been a topic of large interest and relevance to fields from astrophysics or “white paints” to electronic transport in mesoscopic media. Most of the work has been focused on the diffusive and localization regimes where the system size is much larger than the mean free path. The most useful theoretical approach that takes into account both multiple scattering effects as well as the system size is the (Dorokov-Mello-Pereyra-Kumar) DMPK equation. The statistical properties of a thin slab (``building block") of length dL has been recently derive [1] from a potential model and used to find the evolution with length of the expectation value of different physical quantities. It was found that the corresponding statistical properties of the full system depend only on the mean free paths and on no other property of the slice distribution. The universality that arises demonstrates the existence of a generalized central-limit theorem. However, these results were restricted to quasi-one-dimensional (Q1D) geometries.
Here we present a detailed analysis of the statistics of wave (light or electrons) intensity fluctuations and correlations in the limit when the system thickness is much smaller than the mean free path. The results of extensive numerical calculations are in good agreement with analytical results based on perturbative expansions. The extension of this perturbative approach to study wave transport through disordered thin films without the Q1D constrain will be discussed.

[1] L.S. Froufe-Pérez, M. Yepez, P.A. Mello and J.J. Sáenz,
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