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Rare Fluctuation Effects in the Anderson Model of Localization[1]

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Two significant advances in the theory of disordered systems in the past three decades have been (i) the development of large disorder Renormalization Group methods, and (ii) a more concerted effort to study of the effects of rare fluctuations or configurations, such as Griffiths' phenomena. A major problem facing the latter in many-body systems has been the enormous numerical resources needed to see these rare phenomena. In this talk, we examine the issue of rare configuration effects in Anderson's original model of localization (1958). In this talk, we examine the issue of rare configuration effects in Anderson's original model of localization. We show that effects due to resonant tunneling among neighboring sites leads not only to anomalous behavior of electronic eigenstates far in the Lifshitz tail, where the density of states is exponentially suppressed, but also leads to singularities in average properties (i.e. the inverse participation ratio) as a function of energy, where the density of states is large. The singular behavior, which separates resonant, Lifshitz-like states from typical, Anderson-localized states, occurs *in the insulating phase*, and thus is present in *all* dimensions [1]. Using the analytic solution of a toy model, as well as numerical results of the Anderson model for several different disorder distributions in dimensions d = 1, 2 and 3, we show that this separation of eigenstates due to rare fluctuations is a ubiquitous property of the Anderson model with *bounded* disorder. This suggests that the half-century-old model, being solvable in polynomial time, is a prime candidate for detailed numerical studies of rare fluctuation effects in disordered systems.

[1] Sonika Johri and R. N. Bhatt, arXiv1106.1131; and in preparation.

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