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Distribution of Conductance Using Anderson Model of Disordered Conductors and Its Characteristics

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ABSTRACT

We have studied the distribution of conductance using disordered conductors. We have utilized random matrix model as a function of disorder across the Anderson transition. This produced the analytical framework for quantum phase transition having order parameter function. We have constructed the distribution from its moments and obtained joint probability distribution of transmission levels having the conductance as linear statistics. It was used to obtain the high symmetry in the crossover region in quasi one dimensional system. This was prevented for the gain. We have considered Wigner-Dyson interaction formation. We have found that eigen vectors of transmission matrices in quasi one dimensional were isotropically distributed at all disorder and joint probability distribution allowed a crossover from met al.lic to insulating regions.

KEYWORDS Conductance, disorder, random matrix, Anderson transition, quantum phase transition, quasi particle, isotropic.

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INTRODUCTION

Altshuler et al.[1] presented the distribution of conductance for reconstruction. Moments were found for perturbation dimensions but in the case or permittivity have unity value[2]. Field theory presented the distribution of conductance. Anderson et al.[3] explained transition corresponded to a metal. to insulator. Several investigators[4-9] studied mesoscopic fluctuations and transport properties of disorder conductor. It was studied that the shape of distribution of conductance changed when there was no phase transition[10-14]. Peter[15], Markos[16] and Ruhlander et al.[17] studied the case of tight binding Anderson model and experiments on gated GaAs:Si wires[18] and suggested that distributions were same as a in the case of three dimensional cases across the transition. Wang et al.[19], Yadav et al.[20-21] Studied the properties of conductance and it was found that density of the eigen values as function of anisotropy parameter. Xin Li et al.[22] studied the quantum transport for undoped Ge/SiGe hetrostructure. It was found that there was long hole degraded mobility in hetrostructure as the ideal platform for quantum device implementation. Song et al.[23] studied conductance quantization of super conductors as potential Majorana platform. In this study the conductance plateaus were found. Ohnishi et al.[24] studied defects on electrical conductance, thermal conductance and seebeck coefficient. It was found that defects strongly suppressed the electron conductance and deteriorated the thermoelectric performance of a carbon nanotube. Zhang et al.[25] presented conductance of dissipative quantum dot.

METHOD

We have taken into consideration random matrix model for the study. The probability distribution function for transmission is given by the relation when conductance is linear.

$$g = \sum_i \frac{1}{1+\lambda_i},$$

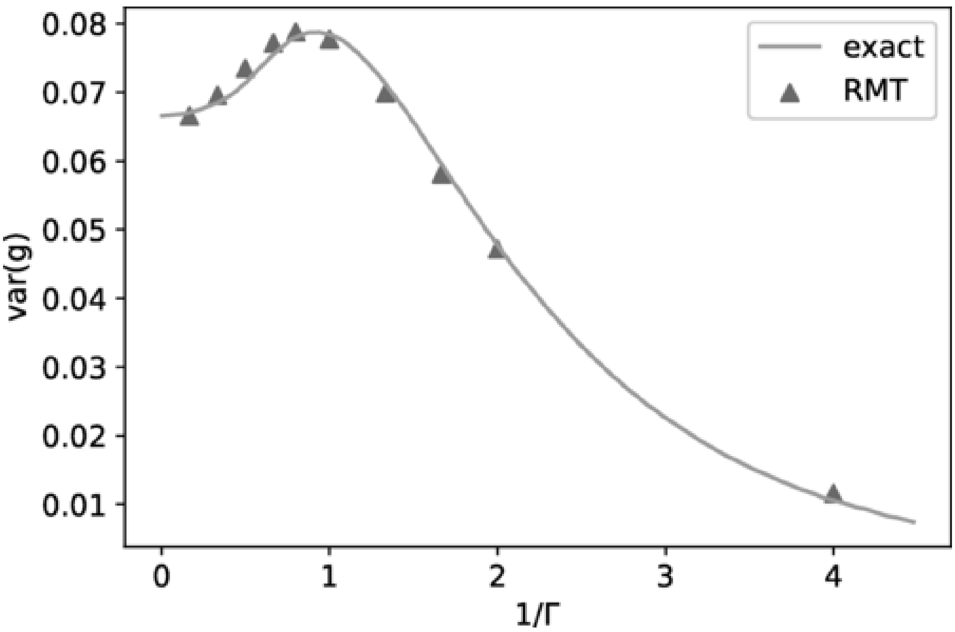
The distribution of conductance is as follows

$$\rho(g) = \int_0^\infty \prod_{i=1} d\lambda_i PN\{(\lambda_i)\}\delta \times \left(g - \sum_i \frac{1}{1+\lambda_i} \right)$$

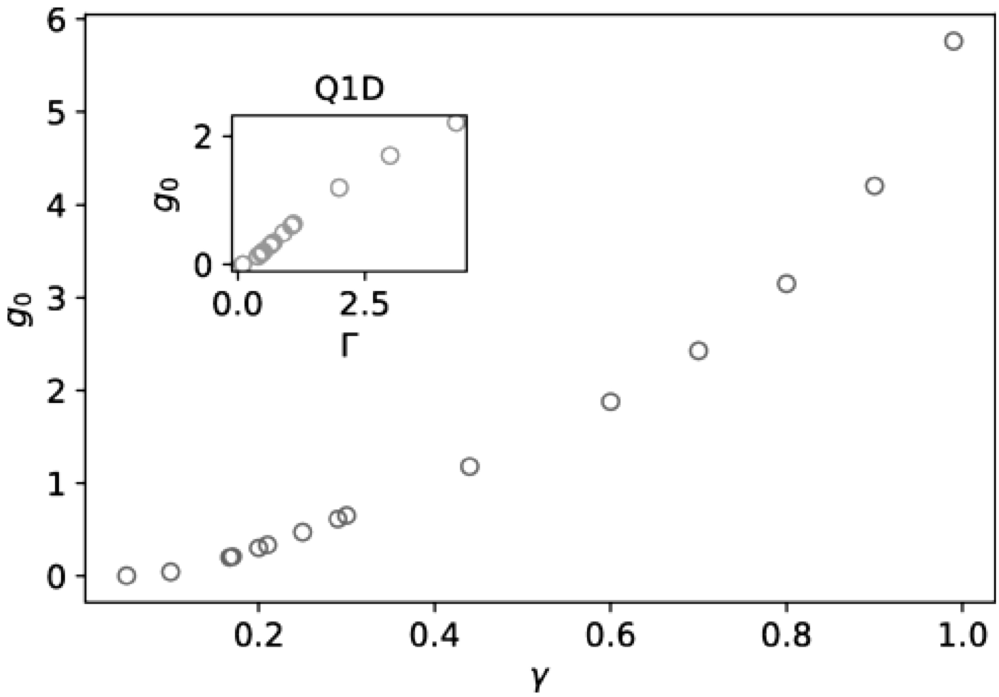
This relation was used to explain distribution of conductance in the cross over region. For quasi one dimensional case the eigen vectors were obtained for exact solution of distribution of conductance. From the solution of Dorokhov-Mell-Pereya equation that determined the evolution of joint probability distribution to obtain normal distribution. The characterization analysis was made by conductance. Three dimensional distribution were compared with random matrix model. Quasi-one-dimensional distribution was also compared with Anderson model conductance.

RESULTS AND DISCUSSION

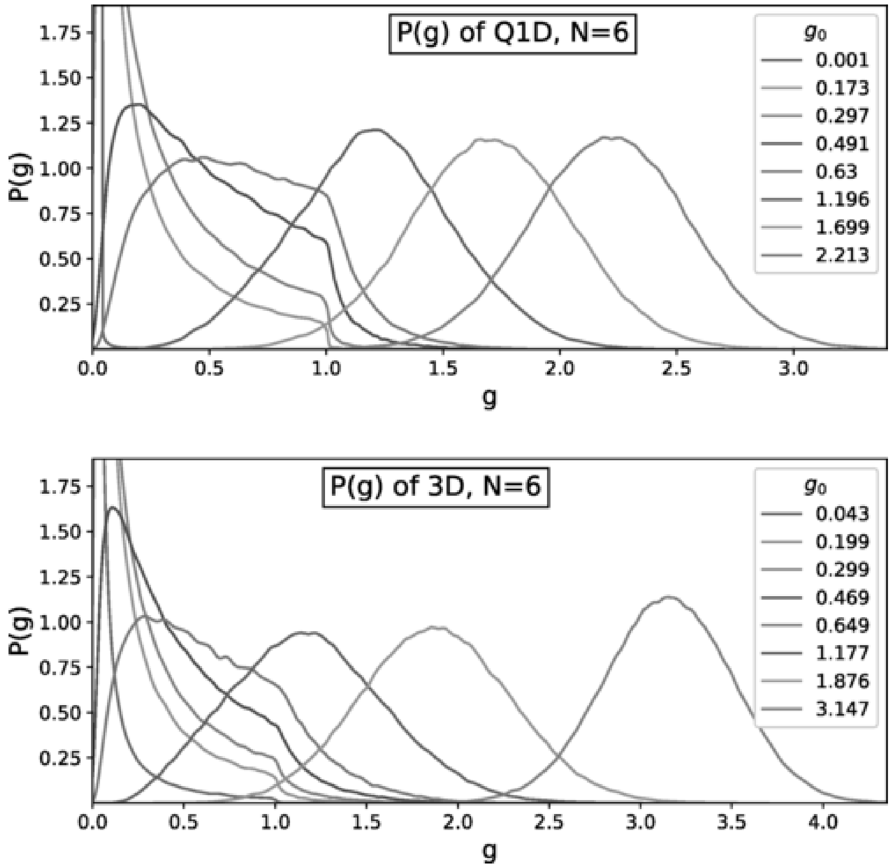
Graph (1) shows the variance of quasi on dimensional with linear sigma model, which shows that for $N = 6$ for all disorder in quasi one dimensional case when N is increased we found correct results. Graph (2) shows the comparison of plot of average conductance in three dimensional case for $N = 6$ vs quasi one dimensional case. It was found that in three dimensional case our result of model agreed well with previous results which determined full distribution of conductance. Graph (3) shows the distribution of conductance for three dimensional and quasi one dimensional case. Graph (1) shows the results for disorder in quasi one dimensional case. We have examined the variance of disorder when N was increased. In the case of three dimension when N value was small the variance in weak disorder was found. Graph (2) shows the changes of conductance in three dimensional case. Graph (3) shows the characteristics of disorder due to conductance in three dimensional case and quasi one dimensional case. Distribution changed from Gaussian to metallic.



Graph 1: Plot of variance of quasi one dimensional with linear $\sigma-$model.



Graph 2: Plot of average conductance in three dimension for $N=6$ vs quasi one dimensional.



Graph 3: Plot of different values of conductance for changing the distribution from met al.lic to insulating regions.

CONCLUSION

We have studied the distribution of conductance using Anderson model of disorder conductors and their characteristics. The random matrix theory was used for the study of distribution of conductance. It was found that the eigen vectors of the transmission matrices in quasi one dimensional was isotropically distributed at all disorder. So joint probability distribution was allowed.

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