Investigation of the enhancement factor in a transient region between regular and chaotic dynamics

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We present the results of an experimental study of the elastic enhancement factor W for microwave rectangular and rough cavities simulating, respectively, a two-dimensional quantum billiard in a transient region between regular and chaotic dynamics and a chaotic quantum billiard. The analogy between microwave cavities and quantum billiards is based upon the equivalency of the Helmholtz equation describing the microwave cavities and the Schroedinger equation describing the quantum systems. The cavities were coupled to a vector network analyzer via two microwave antennas. The experimental results for the rectangular cavity are compared with the ones obtained for a microwave rough cavity simulating a chaotic quantum billiard. The experimental results were obtained for moderate absorption strength γ = 5.2-7.4 in the frequency range ν = 16-18.5 GHz. We show that the elastic enhancement factor for the rectangular cavity lies below the theoretical value W=3 predicted for integrable systems and it is significantly higher than the one obtained for the rough cavity. The departure of the rectangular system from the integrable one due to presence of antennas acting as scatterers is characterised by the parameter of chaoticity κ = 2.8. The results obtained for the microwave rough cavity are in general close to the ones obtained within the framework of Random Matrix Theory. We also discuss the elastic enhancement factor W in the case of microwave networks and quantum graphs possessing time reversal symmetry and the ones with broken time reversal symmetry. Our experimental results suggest that the enhancement factor can be used as a measure of internal chaos that can be especially useful for systems with significant absorption or openness.

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