Simulation of quantum graphs by microwave networks

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Abstract

We show that chaotic quantum graphs of connected one-dimensional wires can be experimentally simulated by irregular microwave networks consisting of coaxial cables. The spectra of the microwave networks are measured for bidirectional and directional networks. The directional networks consisting of coaxial cables and microwave circulators simulate quantum graphs with broken time reversal symmetry. In this way the statistical properties of the graphs such as the nearest neighbor spacing distribution and the spectral rigidity are obtained. We also demonstrate that microwave networks with absorption can be used to investigate properties of open quantum systems which recently have been extensively studied in the context of transparent electronics and new biosensors. We report the first experimental studies of the distributions of Wigner's reaction K matrix and the enhancement factor for the networks simulating open quantum graphs with broken time reversal symmetry. We demonstrate that the experimental results are in good agreement with the random matrix theory predictions. Furthermore, we present the results of studies of the parametric level correlations and the fidelity decay in the graphs.

Acknowledgments. This work was partially supported by the Ministry of Science and Higher Education grant No. N N202 130239 and the Innovative Economy Programme POIG.01.01.02-00-008/08.