Project 4.16. Quantum and wave-dynamical chaos in low dimensional systems

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Institute: Institute of Physics PAS

Organisational unit: ON2.2 – experimental and theoretical physics

Website: http://www.ifpan.edu.pl/ON-2/on22.QChG/

Background:
In this interdisciplinary project we will focus on the experimental and theoretical study of generic properties of quantum systems in the realm of quantum chaos using quantum graphs and microwave networks as model systems. Quantum graphs, that is, networks of bonds connected at vertices, provide in many respects the most universal model system for the experimental and the theoretical study of closed and open quantum systems with chaotic classical dynamics. The pioneering experiments performed at the Institute of Physics PAS clearly demonstrated that quantum graphs with preserved or violated time-reversal invariance may be experimentally simulated with microwave networks. For example, using microwave networks we have recently presented the first experimental realization of non-Weyl graphs which do not obey the Weyl's law (M. Ławniczak, J. Lipovský, L. Sirko, Phys. Rev. Lett. **122**, 140503 (2019).).

Aim:
In the project we will study experimentally and theoretically some most challenging open problems on one-dimensional quantum systems:

1. Fermi's golden rule for quantum graphs and networks.
2. Spectral statistics of nearly unidirectional quantum graphs and networks.
3. Test of the validity of a semiclassical trace formula, i.e., the limits of universality of the spectral properties of quantum graphs and networks.
4. Wigner's reaction matrix for quantum graphs and networks belonging to the symplectic universality class.

The project will be implemented in close collaboration with the theoretical/experimental group of professor Liang Huang from the Lanzhou University, China. Expected Candidate's contribution to the project: implementation of the experiment, analysis of the experimental data, participation in the numerical analysis of the experimental data, preparation of publications.

Candidate requirements:
- Experience with numerical computation – available platforms: Matlab, Fortran, Mathematica.
- A good knowledge of physics, particularly, quantum physics, properties of the electromagnetic field.
- A good English proficiency.