RESEARCH PROJECT ABSTRACT

1. Research objective / research hypothesis

The objective of this project is the study of quantum systems with half-integer spin which are described by the Gaussian symplectic ensemble. They belong to GSE symmetry class, that is fundamental symmetry in random matrix theory (RMT), nonetheless have been studied insufficiently so far. We are motivated to carry out insightful research for GSE, considering indirectly also GUE system. The analysis of energy levels correlation in spectra allow to verify the basic properties of system, i.e. its symmetry in the RMT approach, the degree of chaoticity, information about incompleteness of spectra. The following goals of project will be examined experimentally, theoretically and numerically:

1. ***Simulation of quantum systems with symplectic symmetry, including mixed boundary conditions at vertex and isoscattering graphs.***
2. ***Analysis of spectral correlations of GSE systems in the RMT approach.***
3. ***Examine the openness of GSE system in terms of elastic enhancement factor.***

2. Research method / methodology used

We propose the new and more advanced concept of GSE system, involving mixed boundary conditions at vertices: Neumann and Dirichlet and isoscattering graphs. Symplectic one-dimensional quantum graph can be simulated by microwave network of proper topology. In the measurements of two-port scattering matrix we utilize PNA Network Analyzer Agilent E8364B. The length of microwave network is controlled using phase shifters. The eigenvalues in resonance spectra are determined and unfolded. In the analysis of the energy levels fluctuation the short- and long- range correlation functions are studied. In the case of strong overlapping the elastic enhancement factor becomes an applicable measure. Experimental results will be verified by numerical simulations and compared with RMT predictions.

3. Influence of the expected results on the development of science

The quantum and wave phenomena in low-dimensional systems are studied mainly theoretically due to difficulties in experimental research. In principle the investigation of GSE system is still insufficient since its first experimental realization has been done merely few times. The proposed topics enable to expand the current knowledge about GSE and GUE system. The understanding of their behavior is crucial in nuclear physics, many-body systems, as well as in chemistry, astrophysics, biology, geology or quantum information.