Project 5.1 Studies of Spectrum Broadcast Structures in Quantum Open Systems Models

Supervisor: Jarosław Korbicz, PhD Dsc.
Institute: Center for Theoretical Physics PAS
www: https://www.cft.edu.pl/

Background:

The project combines several fascinating topics from modern quantum theory. The question why the world of everyday experience does not behave quantumly and understanding how exactly the quantum-classical transition looks like has been one of the fundamental challenges of science, undertaken by subsequent generations of physicists. In the modern approach to this problem, the leading role is played by quantum open systems, offering a realistic description of the microworld, where quantum systems are not considered in academic isolation but interact with the environment. This gives rise to rich physics, which has recently been studied using the latest achievement of quantum science, that is quantum information theory. The project will focus on a new approach to open systems using quantum information methods. Possible connections to quantum technologies, which heavily rely on both open systems and quantum information, will also be researched alongside with fundamental questions.

The project is financed by the NCN Preludium Bis grant for 4 years and includes:

- 3-month doctoral internship at the Institute of Photonic Sciences (ICFO) in Barcelona https://www.icfo.eu/. It is one of the leading European research institutions in quantum physics and quantum technologies;
- unique opportunity to work on IBMQ quantum computers, which can be used for the PhD research;
- possibility of collaboration with other quantum science groups from the active scientific environment at CTP PAS.

Aim:

1. Examination of advanced "classicization" processes, such as the so-called broadcast structures, in important models of quantum open systems. Understanding the physics of these processes and their importance for the foundations of quantum mechanics and quantum technologies.
2. Programming and simulating simple open systems on IBMQ quantum computers.
3. Preparation of a PhD thesis based on the above research.

Requirements:

- solid knowledge of quantum mechanics (theory) on the university physics course level,
- knowledge of basics of quantum information theory will be an advantage but is not required.