

## **Project 5.2. Studies of aspects of objectivity in quantum mechanics**

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### **Background:**

The quantum-classical transition is still not fully understood and fascinating area of quantum mechanics. In recent years, research has intensified on a new aspect of this transition - the quantum explanation of the objective, observer-independent, nature of the macroscopic world. The main theoretical idea is the so-called quantum Darwinism and Spectrum Broadcast Structures (SBS). These are specific multi-body quantum states "encoding" some form of objectivity of physical quantities. These states were theoretically predicted in a number of quantum open system models as well as indirectly confirmed experimentally. Their further theoretical research is the main goal of the project. It is a fascinating research area, connecting practical calculations with fundamentals of quantum theory and, to some extent, philosophy.

The project is based on a direct study of the dynamics of open quantum systems with an application of quantum information methods. The project allows for a great flexibility in the selection of the concrete research topic - from specific physical models to mathematical physics topics and the physics/philosophy border. Basic numerical skills, especially Mathematica operation, will be useful.

The doctorate will be financed by the OPUS project "Novel approach to decoherence and information transfer in open quantum systems", which envisages creation of a research team consisting of the project leader, a PhD student, a post-doc researcher and graduate students. Project duration - 36 months.

### **Aim:**

The main goal is a theoretical study of specific quantum states called Spectrum Broadcast Structures (SBS). We will search for them in specific models of quantum open systems as well as in general situations, e.g. in continuous variable systems. Another goal is to understand their exact structure and the exact role in the quantum-classical transition.

### **Requirements:**

- very good knowledge of quantum theory
- high level of mathematical skills
- good knowledge of English
- good attitude for cooperation
- some competences in programming, esp. in Mathematica
- experience in research in quantum open systems or decoherence theory will be an additional asset.