

PhD topics in Mathematical Physics, Roman Schubert

My research focuses around time dependent problems in quantum mechanics, in particular wave packet dynamics, and on the use of semiclassical analysis in quantum mechanics. These techniques have applications in many areas, ranging from fundamental question in quantum mechanics and quantum information theory, like entanglement and decoherence, to applications in chemistry and reaction dynamics. Recently I have been mostly interested in open systems, i.e, systems coupled to an environment which acts as noise.

Some keywords for possible projects are the following:

- (a) Wave-packets in open systems and decoherence. This project builds on previous work with my former student Tom Plastow and with Eva-Maria Graefe at Imperial College.
- (b) Time evolution in coupled systems and entanglement. Entanglement is a quantum property related to coupled systems, and the goal is to understand better how entanglement emerges and evolves in time using wave-packet dynamics in coupled systems.
- (c) An open system approach to the Born-Oppenheimer approximation near the breakdown of adiabaticity. The idea is to treat the electrons and nuclei in a molecule as two coupled subsystems and to trace out the electron degrees of freedom to get a density matrix for the nuclei. The breakdown of adiabaticity will be reflected in the degree of entanglement.

This field is constantly evolving and so new ideas for PhD projects are always emerging. Feel free to contact me (roman.schubert@bristol.ac.uk) if you are interested in a project in this area or if you have any questions.