Many-body Localisation

Dr Zlatko Papic

Most systems in nature reach thermal equilibrium during the course of their evolution because their microscopic dynamics is chaotic. Recently, many-body localisation – a phenomenon which arises due to quenched disorder and interactions – has come to the attention as a generic mechanism that breaks ergodicity and prevents the system from thermalising. Many-body localised systems are promising for applications in quantum computing because they are able to "escape" thermalisation even at "infinite" temperature. Because of this, their states can retain quantum coherence and realise quantum order even at high temperature.

The goal of this project is to use quantum information techniques to study properties of many-body localised systems and, more generally, the dynamics of interacting disordered systems far from equilibrium. The project will focus on quantum entanglement in such systems and will include the development of numerical algorithms based on "tensor networks". In addition to advancing the theoretical understanding of quantum many-body systems far from equilibrium, the project will also study the interplay of exotic types of order, such as topological order, with many-body localisation.