

Many-Body Localisation in Ultracold Quantum Atomic Gases

Using highly controllable settings of disordered ultracold quantum atomic gases, this theoretical PhD project aims to obtain greatly improved understanding of a novel state of matter that never thermalises. Known as many-body localised (MBL) systems, they are of fundamental interest as the only generic exceptions to thermalisation and thus fail to be described by standard quantum statistical mechanics. They are also of potential interest for quantum technology applications due to the possibility of using them to retain a quantum memory of their initial state and protect quantum information from de-coherence.

This project covers several interesting topics: (1) developing powerful analytical and numerical approach to tackle the MBL challenge; (2) revealing the nature of the MBL quantum phase transition in highly excited states in ultracold quantum atomic gases, by using a range of innovative model systems that include polarons with/without spin-orbit coupling and dipolar systems with long-range interactions; and (3) clarifying realistic experimental schemes for characterising such an MBL transition. Theoretical predictions might be stringently tested by experimentalists at the Centre for Quantum and Optical Science (CQOS) at Swinburne University of Technology and in other collaborated laboratories world widely.

This PhD position will be based in the Theory Group within CQOS. Our centre is one of three physics research centres at Swinburne University, a university that was placed in the top 100 universities worldwide for Physics research in the latest Academic Ranking of World Universities (ARWU) 2015. Swinburne University is located in Hawthorn, just 8km from the centre of Melbourne.

Details of our research group can be found here: <http://www.swin.edu.au/caous/theory>, and if you have any questions please contact A/Prof. Xia-Ji Liu (xiajiliu@swin.edu.au) or A/Prof. Hui Hu (hhu@swin.edu.au).

For this position we are seeking a PhD candidate with a strong Theoretical Physics, Condensed Matter Physics, or Atomic and Molecular Physics background (honours degree or equivalent) and a willingness and ability to find novel exotic states of matter that will bring potential applications in the next generation of quantum technology.