Two PhD positions on strongly correlated quantum matter

Dr. A. Kantian
Interviews for short-listed candidates to commence from August 1st 2023
Funded PhD project

Heriot-Watt University, School of Engineering and Physical Sciences, Institute of Photonics and Quantum Sciences

About the projects:

We offer two 3.5 year PhD positions for highly motivated candidates with strong scientific curiosity and an intrinsic desire for developing novel theoretical approaches to challenging problems in the area of correlated quantum systems and superconducting systems in particular.

Strongly correlated many-body systems are at the forefront of current research in condensed matter physics and beyond. Such systems feature centrally in the ongoing attempts to develop theories for high-temperature superconducting materials, which are of major importance for both fundamental and applied reasons.

Potential projects include the development of new cutting-edge methods to study strongly correlated electrons in unconventionally and high-temperature superconducting systems, and then deploying these methods e.g. for modelling experiments in analog quantum simulators based on ultracold atomic lattice gases. Other possible projects could be on charge-transport through noisy environments, i.e. the basic process behind light-harvesting nanostructures, or designing quantum simulations of dynamically induced superconductivity.

The PhD-project will be carried out in the group of Adrian Kantian at the Institute for Photonics and Quantum Sciences at Heriot-Watt University, Edinburgh (https://www.hw.ac.uk). We are a group working on the theory of strongly correlated quantum systems, with a special focus on unconventional and high-temperature superconductivity in novel model systems, and ultimately aiming at proposals of realistic materials and devices based on these models. A major aspect of our work is the development of quantitatively reliable theory beyond any currently available, in order to accurately predict the properties of these novel high-

temperature superconducting systems. Numerical techniques that we use range from the density matrix renormalization group (DMRG) to dynamical mean-field theory (DMFT) and Quantum Monte Carlo (QMC) techniques for fermions. These approaches are complemented with analytical techniques as necessary. This work has multiple connections to other the group's work on as low-dimensional correlated systems (2D magnets and quasi-1D superconducting materials such as the Beechgard and Fabre salts), flatband systems and analog quantum simulations of correlated lattice models in ultracold atomic gases. Besides the PI, the group currently consists of three postdoctoral researchers, as well as a PhD-student. We have an extended network of established contacts and collaborations with leading theoretical and experimental groups in the UK, Europe and the US. More background on the group and its activities is available at http://materials-theory.physics.uu.se/kantian/

Applicants must have or expect to have a first class degree or equivalent in physics, with a good background in computational physics including programming, and either the theory of condensed matter or strongly correlated systems.

Interested candidates are asked to please prepare

- a statement outlining your research interests and why you would like to pursue your PhD in this group
- a CV
- certificates of exams, degrees and grades
- a copy of your Masters thesis, or equivalent
- published articles and other relevant materials, if available
- contact information for at least two reference persons

and apply at https://www.hw.ac.uk/study/apply/uk/postgraduate.htm. Please direct any informal enquiries related to your these positions or your application to a.kantian@hw.ac.uk.

Funding notes:

The PhD project is funded for a duration of 3.5 years. This funding includes a tax-free stipend of 15.000 GBP per year.