University of BRISTOL

Science and Technology Facilities Council
ISIS Neutron and Muon Source

Spin Excitations in High-Temperature Superconductors and Strange Metals

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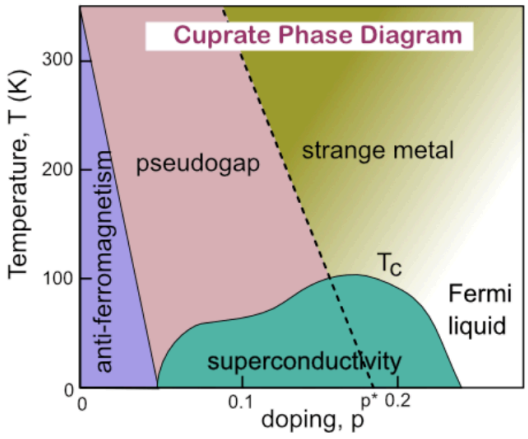
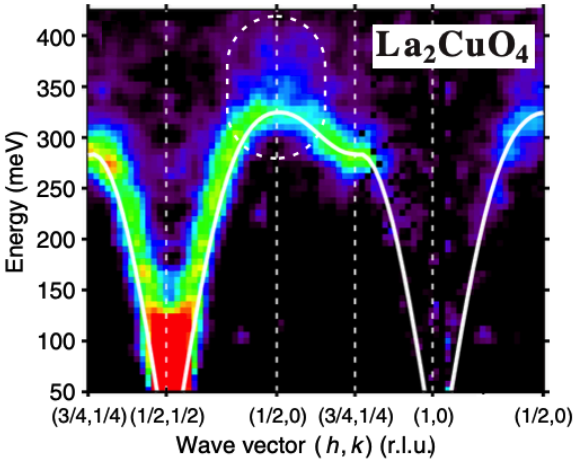
This project involves investigating the collective spin excitations in high-temperature cuprate superconductors using inelastic neutron scattering and resonant x-ray scattering techniques.

Low-energy collective excitations determine many of the electronic properties of materials, including the resitivity, heat capacity and whether a material is superconducting or not. In this project, you will use inelastic neutron scattering and resonant x-ray scattering techniques to measure these excitations. It has become clear in recent years that high-temperature superconductivity in cuprates develops from a highly anomalous “strange metal” state which exists for $T>T_c$. The strange metal state has a resistivity proportional to temperature down to the lowest temperatures and is not described by the conventional (Fermi-liquid) theory usually applied to metals. We have recently found evidence that this behaviour is connected to the low-energy spin excitations.





In this project you will use neutron and x-ray techniques to study the collective spin excitations at the atomic level. Experiments will be carried out at international facilities (including the ISIS Neutron Source). You will also prepare and characterise samples using low-temperature measurement systems at Bristol. The scattering experiments involve processing multi-dimensional data and part of the project would be to develop new techniques to optimise this. We will use theoretical models fit and interpret the data. The project would suit a student with experimental skill and an interest in data analysis.

The project is joint between the University of Bristol and the ISIS Neutron and Muon Source at the Rutherford Appleton Laboratory (closeby to Oxford). The student would spend at least one year at both institutions and the project comes with generous funding.

Please make contact to discuss the project.