Centre for Doctoral Training in Condensed Matter Physics

CDT-CMP Seminar Series

2:30pm Tuesday 8th May 2018

'Investigation of energy gap structure of strongly correlated superconductors using linear and non-linear magnetic penetration depth measurements'

Joe Wilcox
School of Physics, University of Bristol

"One of the open questions concerning unconventional superconductivity is the origin of the electron pairing interaction. The superconducting energy gap is intimately linked to the pairing interaction, and so by probing the energy gap it is possible to help understand the pairing mechanism. There are a number thermodynamic probes, such as heat capacity or thermal conductivity, that can probe the existence of low energy quasi-particle excitations, and thus infer details about the structure of the energy gap. It is also possible to observe gaps in the density of states using surface probes. However, the observed behaviour is not always indicative of the bulk behaviour and can be complicated due to surface effects. The magnetic penetration depth is a property of all superconductors and describes the length scale over which an applied field decays into a superconductor due to the diamagnetic response of the screening currents. It has the advantage of being sensitive to electronic excitations, being a measure of the supercurrent density, and not to other excitations such as phonons. By measuring the temperature dependence of the penetration depth, it is possible to establish whether the energy gap of a superconductor is finite at all points on the Fermi surface, leading to an exponential T dependence, or if there are points at which the gap vanishes to zero, so-called nodes, leading to linear or power-law type dependence. However, it is possible that fundamentally different gap structures can give rise to the same, or similar, thermodynamic signatures. It has been shown that by combining measurements of the penetration depth with other methods, such as controlled disorder, it is possible to differentiate between the different possible scenarios.

I will present an overview of this topic along with some of the work that I have carried out during my PhD on a number of unconventional compounds. In particular, I will demonstrate how measurements of the penetration depth, combined with the application of a small dc magnetic field to introduce non-linear corrections to the supercurrent response (the so-called Non-linear Meissner Effect), can be used as a technique to reveal information of the structure and symmetry of the gap in these unconventional materials."

3W 4.1, University of Bath

If you would like to meet with the speaker before or after the seminar, please contact cdt-cmp@bristol.ac.uk

For information about other talks in the CDT-CMP Seminar Series please see our website:
www.cdt-cmp.ac.uk/events/cdt-cmp-talks-201718/

University of Bristol

UNIVERSITY OF BATH