Vortices in Unconventional Superconductors

Speaker: Professor Simon Bending
Department of Physics, University of Bath, UK
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P.J. Curran[1], V.V. Khotkevych[1,2], A.N.Grigorenko[1,3], S.J. Bending[1], Y. Tsuchiya[4,5], T. Tamegai[4], A. Gibbs[6,7], S.L. Lee[6], A.P. Mackenzie[6,8]

[1]Department of Physics, University of Bath, Claverton Down, Bath; [2]Diamond Light Source, Harwell Campus, Didcot; [3]School of Physics & Astronomy, University of Manchester, Manchester; [4]Department of Applied Physics, University of Tokyo, Tokyo; [5]Department of Electrical Engineering, Nagoya University, Nagoya; [6]School of Physics and Astronomy, University of St Andrews, St Andrews; [7]ISIS Neutron & Muon Source, STFC, Rutherford Appleton Labs, Didcot; [8]Max Planck Institute for Chemical Physics of Solids, Dresden

The mixed state of type II superconductors contains topological excitations called vortices that usually carry a single quantum of magnetic flux. These flux lines typically form a triangular lattice under the influence of weak mutual repulsion. Since the characteristic elastic moduli of the lattice are small, the mixed state represents a form of soft (vortex) matter that exhibits thermodynamic phases and true phase transitions (e.g., melting) in which thermal fluctuations and disorder play key roles. Not only is a better understanding of vortices crucial to the exploitation of superconducting materials, it can also yield key information about the superconducting pairing state and the Fermi surface and effective mass anisotropies. Direct imaging using scanning probes has proved to be a powerful tool for studying vortex matter and is even capable of providing limited dynamic information. Recent case studies will be presented illustrating the use of scanning Hall probe microscopy (SHPM) to explore the physics of two very different superconducting systems. The talk will focus on results for the very highly anisotropic cuprate superconductor $Bi_2Sr_2CaCu_2O_{8+\delta}$ [1,2] as well as those on Sr_2RuO_4, which is widely believed to be a p-wave spin triplet superconductor with a two-component chiral order parameter [3,4]

[1] A.N. Grigorenko *et al.*, Nature **414**, 728 (2001).

[2] P.J. Curran *et al.*, Scientific Reports **8**, 10914 (2018).

[3] A.P. Mackenzie and Y. Maeno, *Rev. Mod. Phys.* **75,** 657 (2003).

[4] P.J. Curran *et al.*, Phys. Rev. B **84**, 104507 (2011); P.J. Curran *et al.*, Phys. Rev. B **89**, 144504 (2014).