STM Spectroscopy Probe of Field Depairing and Vortex Lattice Transition in a Multiband Superconductor

I. FRIDMAN, University of Toronto, V. LUKIC, Stevens Institute of Technology, C. KLOC, Nanyang Technological University, C. PETROVIC, Brookhaven National Laboratory, J.Y.T. WEI, University of Toronto and Canadian Institute for Advanced Research — The Cooper pairing in a variety of superconductors involves carriers from multiple bands, which can optimize the pairing phase space and provide novel pairing interactions. We have developed a novel technique to probe multiband pairing, using a directional diamagnetic supercurrent to perturb the quasiparticle density-of-states spectrum, and measuring the spectral evolution due to pair breaking by finite superfluid momentum. This technique is demonstrated on the layered superconductor 2H-NbSe2, using a scanning tunneling microscope (STM) at 300 mK with an in-plane magnetic field up to 9 T [1]. The STM spectroscopy measurements revealed unambiguous evidence for multiband pairing [2], as well as a novel reorientation transition of the in-plane vortex lattice [3]. We will discuss the first-order and quantum-critical characteristics of this transition, in terms of the geometric frustration of a distorted hexagonal vortex lattice, and show that this transition is intimately related to the multiband pairing.


1Work supported by NSERC, CFI/OIT, CIFAR, U.S. DOE and Brookhaven Science Associates (No. DE-Ac02-98CH10886).