

Superconducting vortex imaging through scanning tunneling microscopy and spectroscopy at very low temperatures

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Scanning Tunneling Microscopy and Spectroscopy (STM/S) down to 100mK is an efficient tool to make real space images of individual vortices. When increasing temperature, thermal smearing of the tunneling conductance makes it more difficult to resolve individual vortices. Nevertheless, it has been possible to follow the vortex lattice until T_c , observing phenomena such as vortex lattice melting. However, the simple real space visualization of the vortex lattice at very low temperatures and in the whole magnetic field range remains a challenge. Here, we show how superconducting vortices enter the sample when increasing the magnetic field, we study the relationship of the vortex lattice with pinning centers, and provide for real space visualization of vortex arrangements at fields very close to H_{c2} , including the appearance of pairs of dislocations, its unbinding leading to a hexatic phase, and the crossover to a fully disordered phase.