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Real space imaging of the superconducting vortex lattice: Recent results and prospects

*Hermann Suderow¹

Dpto Física de la Materia Condensada, Instituto Nicolás Cabrera, IFIMAC, Universidad Autónoma de Madrid¹

I will review vortex lattice imaging using scanning probe microscopes and discuss recent prospects. First, I will discuss the behavior of vortex lattices in tilted magnetic fields. Many practical applications of high T_c superconductors involve anisotropic materials and magnetic fields applied on an arbitrary direction. The shape and properties of vortices in titled magnetic fields is largely unknown and I will discuss the insight won about vortex properties and manipulation by imaging experiments in several anisotropic superconductors [1,2]. I will also review vortex distributions at very high magnetic fields and make a comparative discussion of results in the new 1144 family of pnictide superconductors[3]. I will finally make the point about new techniques in achieving atomic scales measurements of the Josephson effect using superconducting tips and recent (and rather serendipitous) insight into the shape of the superconducting transition[4,5].

[1] Tilted vortex cores and superconducting gap anisotropy in 2H-NbSe₂, JA Galvis et al, Communications Physics 1, 30 (2018).

[2] Attractive interaction between superconducting vortices in tilted magnetic fields, A. Correa et al, Communications Physics 2, 31 (2019).

[3] Influence of multiband sign-changing superconductivity on vortex cores and vortex pinning in stoichiometric high- T_c CaKFe₄As₄, A. Fente et al., Physical Review B **97**, 134501 (2018); Superconductivity and vortex lattice in the hedgehog magnetic phase of Ni-doped CaKFe₄As₄, J. Benito et al, in preparation; On hyperuniform distributions of superconducting vortices, J. Benito et al, in preparation.

[4] Low frequency AC oscillations in superconductor-superconductor atomic size tunnel junctions, V. Barrena et al, in preparation.

[5] On the coupling between heat and current flow in the resistive transition of superconductors: obtaining the bolometric parameters of the layered superconductor 2H-NbSe₂, D. Perconte et al, in preparation.