PHD GRANT

Electronic and magnetic properties of iron based superconductors

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Reaching a good understanding of the superconductivity of materials requires an accurate knowledge of their electronic and magnetic properties. During my PhD work I have implemented point contact spectroscopy and scanning Hall-probe microscopy to study the superconducting properties of iron based materials. The differential conductance of superconductor-metal junctions turned out to exhibit unexpected oscillating features related to the superconducting gap of the so-called 122-phases. I derived a model of this signal by undertaking a study of superconductor-metal-metal junctions.

In this model, the second metallic region emerges from a local transition from the superconducting to the normal state due to a local increase of the current density above the "depairing current". Alternatively, electron injection could also locally alter the electron energy distribution to the point of destabilizing the superconducting state. I also performed a study of the vortex creep in FeSe single crystals down to 0.3K [1] showing that the creep rate remains finite at zero temperature and hence that quantum creep plays a dominant role in the relaxation process at low temperature.

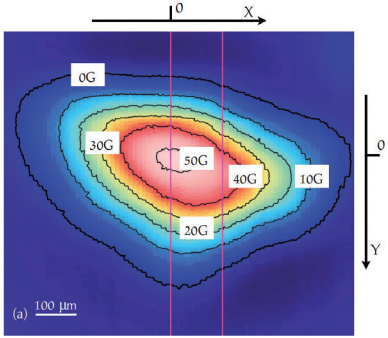

Fig. 1: Contour plot of the remanent magnetic induction in a FeSe superconductor.

OUTCOMES

[1] Vortex creep down to 0.3K in superconducting Fe(Te,Se) single crystals, Phys. Rev. B 89, 014514 (2014).

[2] Dynamically current-driven de Gennes-St James states in Metal-Superconductor junctions, arXiv1604.0839

Poster Conferences: Congrès SFP 2013 (Marseille), SCES 2014 (Grenoble) and M2S 2015 (Geneva).

Collaborations: Z.S.Wang & H.H.Wen, Chinese Academy of Sciences, Beijing and S.Ono CRIEPI, Tokyo-Japan.

Leverage: The development of this original point contact spectroscopy setup is widely used now to probe superconducting effects.