MFM INVESTIGATION OF UNEXPLAINED MAGNETISM IN NORMAL METAL INDUCED REMOTELY BY A SUPERCONDUCTING SPIN-VALVE

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Superconducting spintronics has emerged in the past decade as a promising new field that seeks to open new dimensions for nanoelectronics. Its basic building blocks are spin-triplet Cooper pairs with equally aligned spins, which are promoted by proximity of a conventional superconductor to a ferromagnetic material with inhomogeneous macroscopic magnetization. Recent low-energy muon spin-rotation (LE-μSR) experiments (designed to measure paramagnetic response of superconducting Nb layer with great spatial sensitivity) reported results that are in conflict with current theoretical predictions. They found a switchable magnetic moment, induced remotely from the superconductor-ferromagnet interface, at a non-magnetic superconductor-normal metal interface about 150 atomic layers away from the ferromagnet. The moment appeared, however, not inside the superconducting (S) layer, but in an adjacent normal metal (N) layer.[1]

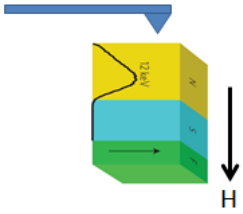

Fig.1 Sample architecture and experimental arrangement. Trilayer consist of Au(40nm)/Nb(45nm)/Co(2nm)

We have carried out low temperature magnetic force microscopy investigation on a simpler Au/Nb/Co structure that still demonstrated similar behavior. While cooling below the critical temperature of the superconductor (7-8 K) in zero applied field, appearance of superconducting vortices was observed. At 5 K, where vortices were well established, magnetic field was incrementally increased up to 500 Oe. Density of the vortices grew linearly with the field. Behavior of induced magnetism measured by LE-μSR and vortices by MFM seems to be correlated and therefore such vortices should be taken into account while modelling Meissner screening for the whole trilayer.

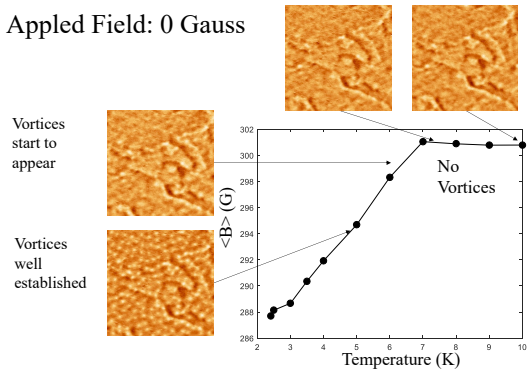

Fig.2 Vortices and reduction of magnetic flux in Au

References

1. M. G. Flokstra, et al, *Nature Physics*, **12**, 57 – 61 (2016)

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