

Experimental report

14/05/2024

Proposal: 5-42-573

Council: 4/2023

Title: Unveiling the Self-organisation Mechanism of the Intermediate Mixed State

Research area: Physics

This proposal is a resubmission of 5-31-2950

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Experimental team: Xavier BREMS

Local contacts: Robert CUBITT

Samples: Nb

Instrument	Requested days	Allocated days	From	To
D33	4	4	03/11/2023	07/11/2023
D22	0	0		

Abstract:

A conventional type II superconductor can contain vortices all through the bulk, which collectively are displaced orthogonally under the influence of a sufficiently large applied current. This state of vortex or flux flow is easily confirmed by the observation of a voltage. Niobium has a form of superconductivity on the cusp of type I/II behaviour where an intermediate mixed state can be formed. Here vortices only partially occupy the sample and current can only pass through these regions. Our SANS experiments have shown when a sufficiently large current is applied the regions containing vortices reorganise into stripes in the direction of vortex flow. The strange result is this reorganisation appears to occur at a current well below the first voltage where vortices flow freely. This experiment is designed to establish how can rearrangement occur without flow.

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The experiment was a success. We have established that there are two transitions. The first being a local rearrangement of the mixed state domains as seen by the change in anisotropy of the IMS scattering followed by a voltage at a much higher current. We have developed a model where current flowing around the edges of mixed state domains locally aligns, via low density pins well before there is mass vortex flow. The data will very shortly be submitted to Superconducting Science and Technology

