Experimental report

04/01/2021

Proposal: 5-31-2534 **Council:** 4/2017

Title: Characterization of the Intermediate Mixed state in Niobium

Research area: Physics

This proposal is a new proposal

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Samples: Nb

Instrument	Requested days	Allocated days	From	To
D11	3	3	23/03/2018	26/03/2018

Abstract:

Type II superconductors allow magnetic flux to penetrate the bulk in the form of vortices of supercurrent. When a current is applied and these vortices are free to move under the Lorentz force, zero electrical resistance is lost. From Amperes law current can only pass in regions where there is a gradient in vortex density and vortices can only move in the presence of a current. Some rare type II superconductors have an additional phase between the zero internal field Meissner state and the mixed state of vortex penetration- the intermediate mixed state (IMS). Here, due to an attractive interaction between vortices micron scale patches of vortex matter coexist with patches of zero field. Exactly how the current passes through interconnected areas of vortex matter is unknown just as what structure they form when in motion or not. SANS is the perfect tool to answer these questions and a novel method of measuring on the micron scale at D11 will be exploited.

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The experiment required us to be able to exceed the critical current in the intermediate state of superconducting Niobium. The low fields made this extremely difficult. The sample with a low enough critical current was not pure enough to show any intermediate mixed state and the sample which did, had a too high critical current.

The experiment should be considered a failure due to the inappropriate samples.