Intermediate state: a new look at an old story\textsuperscript{1} VLADIMIR KOZHEVNIKOV, Tulsa Community College, RINKE WIJNGAARDEN, JESSE DE WIT, VU University Amsterdam, CHRIS VAN HAASENDONCK, KU Leuven

One of the central problems of superconductivity is magnetic structure of vortices and elicitation of microscopic parameters from parameters of the mixed state (MS) in type-II superconductors. Similar problem, i.e. magnetic structure of normal (N) domains and elicitation of the microscopic parameters from parameters of the intermediate state (IS) in type-I materials, is the longest standing problem of superconductivity advanced by Landau in 1930s. We will report on our recent study of the IS in a high purity indium films using magneto-optical imaging, and transport and magnetization measurements. The least expected observation is that the magnetic flux density in N-domains can be as small as nearly 40\% of the thermodynamic critical field $H_c$. This fact contradicts and hence overthrows a paradigm stating that the N-phase is unstable in the fields less than $H_c$. We will present a new theoretical model of the IS for the first time consistently addressing this and \textit{all} other properties of the IS. Moreover, our model, based on rigorous thermodynamics of the equilibrium flux structure, allows for quantitative determination of the domain-wall parameter and the coherence length. Possible impact of our model on the vortex structure will be discussed.

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