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Possible existence of a filamentary state in type-II superconductors V. KOZHEVNIKOV, TCC, A.-M. VALENTE-FELICIANO, Thomas Jefferson Lab, P. CURRAN, University of Bath, A. SUTER, PSI, H. LIU, KU Leuven, G. RICHTER, Max-Planck-Institut for Intelligent Systems, E. MORENZONI, PSI, S. BENDING, University of Bath, C. VAN HAESENDONCK, KU Leuven — The standard interpretation of the phase diagram of type-II superconductors was developed in 1960s and has since been considered a well-established part of classical superconductivity. However, upon closer examination a number of fundamental issues arise that leads one to question this standard picture. To address these issues we studied equilibrium properties of Nb samples near and above the upper critical field H_{c2} in parallel and perpendicular fields. The samples were very high quality Nb films and single crystal discs with the Ginzburg-Landau parameters 0.8 and 1.3, respectively. A range of complementary measurements have been performed, which include dc magnetometry, electrical transport, muSR and scanning Hall-probe microscopy. Contrarily to the standard scenario, we observed that a superconducting phase is present in the sample bulk above H_{c2} and the field H_{c3} is the same in both parallel and perpendicular fields. Our findings suggest that above H_{c2} the superconducting phase forms filaments parallel to the field regardless on the field orientation. Near H_{c2} the filaments preserve the hexagonal structure of the preceding vortex lattice of the mixed state and the filament density continuously falls to zero at H_{c3} .

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