The influence of magnetic history on critical state stability and on flux jumps' dynamics in conventional NbTi superconductor

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Thermomagnetic avalanches, called flux jumps, are commonly observed in type II superconductors and problematic from the viewpoint of their practical application. The for the applications used superconductors are usually characterized by high critical current densities and, as a result, by strong magnetic hysteresis. Hence, it is necessary to understand the influence of the magnetic history on critical state stability and on flux jumps' dynamics in these materials.

In our experiment we study the influence of the magnetic history on critical state stability and on flux jumps' dynamics in conventional NbTi superconductor. Our sample, a 4.5 x 4.5 x 4.5 mm^3 cube, was put into conventional VSM magnetometer. Additionally, a pick-up coil was wound up around the investigated sample and connected to data acquisition board in the computer. Such system enabled us simultaneous registration of the magnetic moment of the sample and of the dynamic changes of the magnetic flux in the sample. The pick-up coil was used to study dynamics of the flux jumps.

We have found that both critical state stability and flux jumps' dynamics is strongly influenced by the magnetic history and by the magnetic field distribution induced in the sample by preceding jumps. This magnetic field distribution can be particularly complex in the area of the hysteresis loop where the external magnetic field changes its sign (remagnetization area), because of demagnetizing effects. For this reason, the most complex structure of the flux jumps is observed in the third quadrant of the magnetization hysteresis loop.

The in the remagnetization area observed flux jumps have different dynamics in comparison to the jumps observed in other areas of the magnetization hysteresis loop. Duration of these jumps is usually significantly longer than others, and their structure is more complex.