Effect of Laser Pulse on Sheet Currents of Superconductor Films

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It was discovered that after a laser pulse irradiation of a thin (0.1 μm) HTSC film which beforehand has been fixed in a strong (500 gauss) external magnetic field, the currents did not disappear but redistributed completely from the range of the laser beam footprint to surroundings without a change of the total number of current vortices. The current enhancement in the surrounding regions show that in the initial state of the film the currents were less than the critical current value J_c which should be on the whole film, according to the well-known Bean model.

A Hall probe with the sizes of 100 and 50 μm in the *x*-*y* plane and the depth of 10 μm was applied in experiments. The noise level was about 0.1 gauss. A method of retrieval of the 2-D vector field of sheet currents by measurements of the 2-D distribution of the perpendicular component of the magnetic field above films surface has been worked out. Using the Biot-Savart's law and the continuity condition, integral equations (of 2-D convolution type) for two components of current have been obtained and solved on the basis of the Tychonoff's method of generalized discrepancy.

In Figs.1,2 the vector distribution of currents in the initial (before laser pulse) and the final (after laser pulse) states of a disk film with the diameter of 20 mm, retrieved by the magnetic field measured at the level of 250 μm above the film surface is shown. In Fig.3 it is possible to see their difference. The currents vanished in the beam region which is seen as white in Fig.2 and as black in Fig.3, but appeared in the surroundings. These results show that the laser emission could be used as a method to form the magnetization of HTSC films.

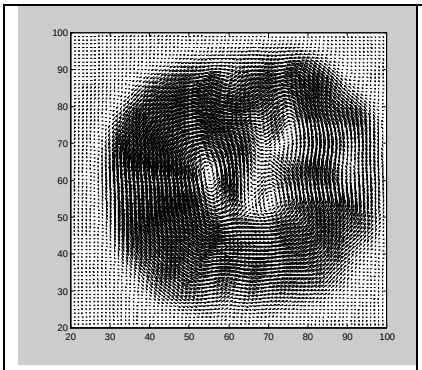

Fig1. Initial currents.

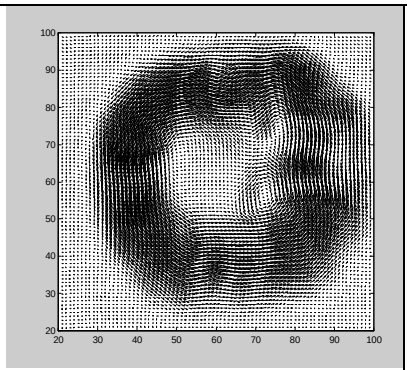

Fig.2. After a laser pulse.

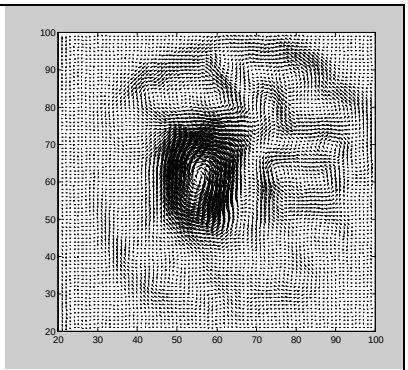

Fig.3. Currents difference.