Numerical Study on the Free Decay of Vortex Tangle at Zero Temperature

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The results of numerical simulation on the free decay of the inhomogeneous vortex tangle when mutual friction is absent are reported. The calculations were performed both with the use of the localized induction approximation (LIA), which neglects the nonlocal effects, and with the use of the full Biot-Savart law. The approximation in the time step was done by the Runge-Kutta method of the fourth order. Different boundary conditions were considered. One of them is an infinite volume, the another one is a cube with smooth walls. It was shown that the number of reconnections result of the breakdown of the loop significantly larger in the case of full Biot-Savart law, than in the LIA approach. We performed the proper monitoring of various mechanisms responsible for attenuation of the vortex line length. They are the changes of length owing to an escape of the small loops from the volume, the reconnection processes, the annihilation of small vortices below the space resolution, the insertion and removing of points. These mechanisms have a numerical nature (e.g. numerical loss of length at reconnection event), but clearly they have also obvious physical meaning. The obtained numerical results demonstrate that the diffusive-like smearing of the vortex tangle into ambient space, initially localized in the small region, is the major mechanism responsible for attenuation of the vortex length. The temporal evolution of vortex line density agrees with the ones, obtained from the solution of diffusion equation. The work was supported by RFBR (grants 10-08- 00369, 10-02-00514).