Numerical evidence of breaking of vortex lines in an ideal fluid

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Abstract Emergence of singularity of vorticity at a single point, not related to any symmetry of the initial distribution, has been demonstrated numerically for the first time. Behaviour of the maximum of vorticity near the point of collapse closely follows the dependence $(t_0-t)^{-1}$, where t_0 is the time of collapse. This agrees with the interpretation of collapse in an ideal incompressible fluid as of the process of vortex lines breaking.

1. Introduction

The problem of collapse in hydrodynamics, i.e. of a process of singularity formation in a finite time, is essential for understanding of the physical nature of developed turbulence. Despite a progress in construction of the statistical theory of Kolmogorov spectra within both diagram and functional approaches (see, e.g., Monin & Yaglom 1992; L'vov 1991 and references therein), so far the question whether the Kolmogorov spectrum is a solution to the statistical equations of hydrodynamics remains open. Another important problem, as yet unsolved, is the one of intermittency. In statistical sense intermittency can be interpreted as a consequence of a strongly non-Gaussian distribution of turbulent velocity, resulting in a deviation of exponents for higher correlation functions from their Kolmogorov values (Frisch 1995). Non-Gaussian behaviour