Formation of vortex filaments in the regions of bi-axial strain

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The intricate structure of the vorticity field at small scales of turbulence has been revealed in recent years. The idea that at least the dissipative scales of turbulence might be well represented by random distribution of vortex tubes was put forward by Burgers and pursued in the laboratory experiments by Townsend. The evidence of intermittency was found in the statistical meausurements, the nature of the structures could not be verified. More recently the small-scale coherent structures were identified in numerical simulations of fully developed turbulence and also visualised in laboratory experiments. The two approaches give estimates of the cross-sectional length scale of the coherent structures somewhere between the Kolmogorov scale and the Taylor microscale, the two being not far apart at the values of the Reynolds number that could be achieved. The data is still too scarce for the definite scaling of the cross-sectional length scale, if such definite scaling exists, to be derived.

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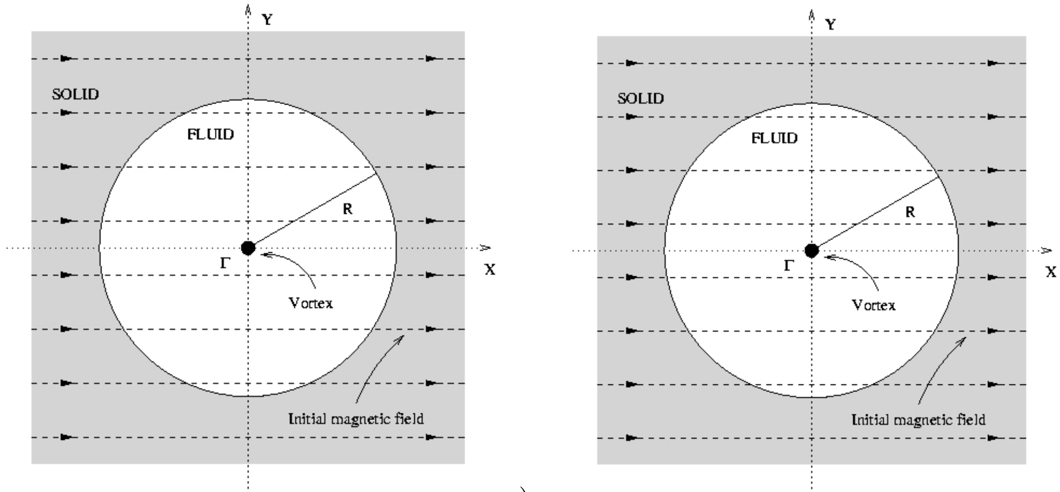

a) b)

Figure 1: Solid with fluid-filled cylindrical cavity penetrated by the magnetic field which is uniform at $t = 0$. of the streamlines around a line vortex

References

[1] Bajer, K. & Moffatt, H. K. (1997). On the effect of a central vortex on a stretched magnetic flux tube. *J. Fluid Mech.* **339**, 121–142.

[2] Bajer, K. (1998). Flux expulsion by a point vortex. *Eur. J. Mech.* B – *Fluids*, **17** (4), 653–664.

[3] Bajer, K. & Moffatt, H. K. (1998). Theory of non-axisymmetric Burgers vortex with arbitrary Reynolds number. In *Dynamics of Slender Vortices, Eds. E. Krause* & *K. Gersten* Proceedings of the IUTAM Symposium held in Aachen, Germany, 31 August – 3 September 1997, pp. 193–202, Kluwer.