Dynamics of vortex filaments in turbulent flows and their impact on particle dispersion

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We study, by means of state-of-the-art DNS, the dynamics of pointwise particles passively advected by a turbulent flow. We focus on the connection between preferential concentration of particles and the underlying topological Eulerian structures in general and with vortex filaments in particular. We characterize the latter by tracking particles lighter than the fluid, which tend to accumulate inside vortex filaments [1, 2] and there remaining trapped [3, 4] even for very long time. We study the temporal evolution of the *momentum of inertia* of bunches of particles. From the time lag during which this quantity remains under a certain threshold, we can estimate the vortex filaments life–times. The preferential concentration of heavy/light particles inside/outside vortex filaments has been also used to investigate the fluctuations of the autocorrelation time of vorticity along particle trajectories. The intense clustering of light particles, due to trapping phenomena inside vortex filaments, has a dramatic impact on their long term pair dispersion. This can be quantified in terms of the evolution of particle pairs distances PDFs and of the finite time Lyapunov exponents for particle trajectories.

References

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