EUROMECH Colloquium 567: Turbulent mixing in stratified flows
22-25 March 2015, DAMTP, Centre for Mathematical Sciences, Cambridge, UK

Barriers of mixing in 2D flows: a new experimental tool using stratified flows

P. Meunier[1]*, P. Huck[1], E. Villermaux[1]

[1]IRPHE, Aix-Marseille Univ./CNRS, Marseille, France

The problem of scalar mixing in a 2D flow has been extensively studied numerically by following Lagrangian tracers or theoretically by using the tools of dynamical systems (KAM tori, quasi-periodic orbits, chaotic attractors...). However, in all these modelisations, the diffusion of the scalar is usually neglected for the purposes of the numerical/theoretical tools. We present here an experiment with an exactly 2D flow, which allows to study properly the diffusive and mixing problem at very large Peclet number.

In order to avoid any 3D flow, the fluid is stratified with a linear density gradient using salted water. Moreover, the viscosity of the water is decreased by an order of magnitude by adding 10% ucon oil in the water. The flow under study is created by the co-rotation of two vertical cylinders, leading to a homoclinc point at the center. This base flow is perturbed periodically by a third oscillating cylinder. The dye injected at the center settles on the stable manifold whose amplitude can be measured and compared to the Melnikov theory. At late stages, the fractal pattern predicted by several theories is blurred by the presence of diffusion.

*corresponding author: euromech567@damtp.cam.ac.uk