Passive and Active Transport in Turbulent Fluid Flow caused by Faraday Waves

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The study of passive and active transport in turbulent fluid flow is crucial for the understanding of a large variety of phenomena, e.g. the spread of oil spills, the patchiness and growth of plankton blooms, the distribution of larvae or the mixing in industrial reactors[1]. Therefore it is important to find model flows that allow to investigate turbulent transport on laboratory scales. We experimentally observe Richardson dispersion and a double cascade in a thin horizontal fluid flow induced by Faraday waves. The energy spectra and the mean spectral energy flux obtained from Particle Image Velocimetry data suggest an inverse energy cascade with Kolmogorov type scaling $E_k \propto k^\gamma, \gamma \approx -5/3$ and an $E_k \propto k^\gamma, \gamma \approx -3$ enstrophy cascade. Particle transport in this flow is studied analyzing absolute and relative dispersion as well as the Finite Size Lyapunov Exponent (FSLE) via the direct tracking of real particles and numerical advection of virtual particles. Richardson dispersion with $\langle R^2(t)\rangle \propto t^3$ is observed and is also reflected in the slopes of the FSLE ($\Lambda \propto \Delta R^{-2/3}$) for virtual and real particles[2]. Further we use active media in form of a Belousov-Zhabotinsky Reaction and study its behaviour in this experimental model flow. The behaviour of active and passive media is compared concerning its spreading and patterning behaviour[3].

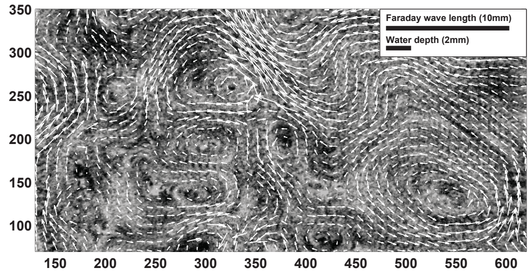

FIG. 1. The horizontal surface fluid flow induced by the Faraday waves at a forcing frequency of $\omega = 50$ Hz and acceleration $a = 1.5\, g_0$. Every second velocity arrow is shown. RMS velocity is $v_{rms} \approx 1.15$ cm/s. Reynolds number based on the Faraday wavelength and v_{rms} is $Re \approx 100$.

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[2] von Kameke, A.; Huhn, F.; Fernández-Garcia, G.; Muñuzuri, A. P. and Pérez-Muñuzuri, V.; *Double Cascade Turbulence and Richardson Dispersion in a Horizontal Fluid Flow Induced by FaradayWaves* Phys. Rev. Lett., American Physical Society, 2011, 107, 074502

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