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Turbulence on the water surface: formation and generation of coherent structures

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Motion of fluid on the surface perturbed by waves is a notoriously difficult problem with 200 years long history. Yet, little is known about flows formed by nonlinear 3D waves of high steepness, such as Faraday waves. It has recently been discovered, that the motion of neutral floaters on the surface perturbed by Faraday waves reproduces in detail statistics of two-dimensional turbulence [1,2]. This opened new opportunities to model 2D turbulence in laboratory in a substantially broader range of scales and Reynolds numbers than ever before. Since particles' motion on the surface is essentially 3D, this discovery extends a list of recently found examples of 2D turbulence in 3D flows [3].

In this paper we investigate how 2D turbulence forms on top of the Faraday wave field, how vorticity is created, and how energy spreads in the turbulent spectrum between the scales. In particular, we demonstrate that the vertical energy of the fluid motion, which is stored in waves, can be accumulated in the horizontal kinetic energy of turbulence by inversely cascading towards larger scales. In the presence of a boundary, turbulent energy may be stored in the coherent structures, which are generated in the process of spectral condensation of 2D turbulence [4].

Reference:
1. A. von Kameke, et al., Physical Review Letters 107, 074502 (2011).
2. N. Francois, H. Xia, H. Punzmann, and M. Shats, Physical Review Letters 110, 194501 (2013).
3. H. Xia, D. Byrne, G. Falkovich, and M. Shats, Nature Physics 7, 321-324 (2011).
4. H. Xia, M. Shats, and G. Falkovich, Physics of Fluids 21, 125101 (2009).