Low frequency spectra of bending wave turbulence

Benjamin Miquel[1], Antoine Naert[2] & Sébastien Aumaître[3]

[1] Laboratoire de Mécanique des Fluides et d'Acoustique de l'Ecole Centrale de Lyon, CNRS UMR 5509, 36 avenue Guy de Collongue, 69134 Ecully cedex, France
[2] Laboratoire de Physique statistique de l'Ecole Normale Supérieure, CNRS UMR 8550, 24 Rue Lhomond, 75231 Paris Cedex 05, France
[3] Service de Physique de l'Etat Condensée, Direction des Sciences de la Matière, CEA-Saclay, CNRS UMR 2464, 91191 Gif-sur-Yvette cedex, France

sebastien.aumaitre@cea.fr

Most of the turbulent studies focus on the direct cascade of energy from the forcing scale, which is usually the largest scale, to the dissipative scale. However flow properties at scales larger than the forcing can be relevent in geophysical background for instance. For 3D turbulence, no mean energy flux is expected between these large scales. In the context of wave tubulence, an inverse cascade to the larger scale is predicted sometime but it is not the case for the bending waves in a thin elastic plate. Thus similarly to 3D turbulence, one can expect that there is no no mean flux through the largest scales. Here we study experimentally the dynamics of such long waves among turbulent bending waves in a thin elastic plate set into vibration by a monochromatic forcing at a frequency f_0. This frequency is chosen large compared with the characteristic frequencies of bending waves. As a consequence, a range of conservative scales, without energy flux in average, exists for frequencies $f < f_0$. Within this range, we report a flat power density spectrum for the orthogonal velocity, corresponding to energy equipartition between modes. Thus, the average energy per mode β^{-1}—analogous to a temperature—fully characterizes the large-scale turbulent wave field. We present an expression for β as a function of the forcing frequency and amplitude, and of the plate characteristics.

This work is supported by the French National Research Agency (ANR DYSTURB Project No. ANR-17-CE30-0004).

Références

1. B. Miquel, A. Naert, S. Aumaître *Phys. Rev. E* **103**, L061001 (2021)