CEA – Saclay, 91191 Gif-sur-Yvette Cedex
Service de Physique de l'Etat Condensé - UMR 3680

SÉMINAIRE

Mercredi 15 novembre 2017 à 11h15

Orme des Merisiers SPEC, Salle Itzykson, Bât.774

Benjamin FAVIER

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Internal and inertial wave turbulence driven by tidal flow

When a moon orbits around a planet, the rotation of the induced tidal bulge drives a homogeneous, periodic, large-scale flow in the external and internal fluid layers. The combination of such an excitation with the rotating motion of the planet has been shown to drive parametric resonance of a pair of inertial waves in a mechanism called the elliptical instability. However, geophysical fluid layers can also be stratified: this is the case for instance of the Earth's oceans and, as suggested by several studies, of the upper part of the Earth's liquid outer core. We thus investigate the stability of a rotating and stratified layer undergoing tidal distortion in the limits where one effect dominates the other. We show that the periodic tidal flow drives a parametric subharmonic resonance of inertial (resp. internal) waves in the rotating (resp. stratified) case. The instability saturates into a wave turbulence regime pervading the whole fluid layer with statistical properties drastically different from the classical Kolmogorov picture. In such a state, the instability mechanism conveys the tidal energy from the large scale tidal flow to the resonant modes, which then feeds a succession of triadic resonances non-locally generating small spatial scales. In the stratified regime where the timescale separation is increased between the tidal excitation and the Brunt-Väisälä frequencies, the temporal spectrum decays with a -2 power law up to the cut-off frequency N beyond which waves do not exist. This result is reminiscent of the Garrett and Munk spectrum observed in the oceans and theoretically described as a manifestation of internal wave turbulence. In addition to revealing an instability driving homogeneous turbulence in geophysical fluid layers, our approach is also an efficient numerical tool to investigate the possibly universal properties of three-dimensional wave turbulence.

A coffee break will be served at 11h00. The seminar will be given in English.

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