Forced three-wave interactions of capillary-gravity waves

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Waves propagating on a water surface can exchange energy due to the quadratic non-linearity induced by the response of a free-surface. In weakly non-linear regime, Three-Wave resonant interactions [1] for pure capillary waves and gravity-capillary waves close to the crossover frequency are usually used to explain the dynamics of a set of dispersive, random interacting waves using the Wave Turbulence theory [2]. The interaction of two mother waves 1 and 2 produce a daughter wave 3, when the resonant conditions are satisfied. Previously, we demonstrated experimentally [3], the relevance of Three-Wave resonant mechanism for capillary-gravity wave. We have shown that the saturation of the daughter wave is due to the viscous dissipation. Here, we show using the same experimental setup, that in configurations not allowing simultaneously the resonant conditions and the linear dispersion relation, we observe a daughter wave verifying the resonant conditions but not the dispersion relation. By modeling the response of the free surface at the lowest nonlinear order, we explain this observation as a forced interaction. The significant viscous dissipation increases indeed the band-pass of the free-surface. The observation of free-surface excitations not following the linear dispersion relation become then possible. This forced Three-Wave interaction mechanism could have important consequences for Wave Turbulence in experimental or natural systems with non-negligible dissipation.

References

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