Wave-Vortex Interaction

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Abstract

We study, theoretically and experimentally, gravity waves-vortex interaction in a newtonian fluid. Our experimental setup consists of a rectangular tank filled with water up to a height h. Waves are generated with an electromechanical vibrator that moves horizontally, with frequency ω, the entire tank and the vortical field is generated by four motors, rotating with frequency Ω, placed at the bottom of the tank. We measure the surface deformation η in one point, the acceleration of the tank a, and the force in the wall F. We compute the transfer function $T(\omega) = |\frac{\eta(\omega)}{a/\omega^2}|^2$ for several values of ω, Ω, and h. In particular, we study low frequency resonances and show how vorticity attenuates $T(\omega)$. Theoretically, we use the Navier-Stokes equations to calculate the dissipation for this particular geometry and, using the standard normal mode representations for rectangular boxes, the dissipation coefficient.