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Anisotropic wave energy flux in ring waves on a shear current

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Extending the results of Ellingsen (Physics of fuids 2014), we calculate the flux of wave energy due to an initially symmetrical disturbance on a shear current of linear depth dependence. The presence of the shear makes the ring wave anisotropic, and similarly the flux of wave energy through a cylindrical control surface. Asymptotic expressions for long times are derived and made use of, allowing in general finite depth and effects of gravity and surface tension. Numerical results are presented for gravity waves in deep and shallow water, demonstrating how the presence of shear affects both the total time-integrated flux of energy and its time dependence. Phase velocity can differ greatly between shear-inhibited and shear-assisted directions of propagation, while in contrast the group velocity is only slightly affected by shear. Consequently, dispersion is weaker for wave components inhibited by the shear, and stronger in shear-assisted directions. Sher-assistance thus disperses wave energy over a long wave group of small amplitude which takes a longer time to cross a control surface. Conversely, the groups of shear-inhibited waves are compressed and steepened with correspondingly high energy density.