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Experimental study of Benjamin-Feir instability on sheared currents

James Steer (1), Dimitris Stagonas (2), Eugeny Buldakov (2), Alistair Borthwick (1), and Ton van den Bremer (1)
(1) University of Edinburgh, Edinburgh, UK, (2) University College London, London, UK

Non-linear surface gravity waves are subject to an instability that can lead to the generation of spectral-sidebands and the eventual break- up of the waves known as the modulational or Benjamin-Feir instability (Benjamin Feir 1967). The instability is captured by the non-linear Schrödinger equation. The stability of unidirectional surface waves on a sheared current with constant vorticity may be described by deriving a relevant non-linear Schrödinger equation (the vor-NLS equation), as derived by Thomas, Kharif Manna (2012). We report on experiments examining the stability of modulated periodic wave trains in a laboratory flume, where the waves are superimposed on a vertically sheared current with a constant vorticity. We keep the shear profile constant along the length of the tank and are able to observe enhanced growth of instabilities comparing to the case without shear. We obtain estimates of the observed growth rate of the side-bands and the occurrence of Fermi-Pasta-Ulam recurrence to predictions based on the vor-NLS equation.