Grid States and Nonlinear Selection in Parametrically Excited Surface Waves

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The nonlinear interactions of parametrically driven surface waves (Faraday waves) have been shown to yield a rich family of nonlinear states. When the system is driven by two commensurate frequencies, a number of interesting superlattice type states are generated via different resonant interactions [1, 2, 3]. We find [4] that in the region of phase space where quadratic (three-wave) self interactions are dominant, *all* of the observed states share a common characteristic, which corresponds to "grid-states". Grid states are nonlinear states which are composed of two co-rotated sets of critical wavevectors that are spanned by a sublattice whose basis states are linearly stable modes [5]. We will present a number of such states observed in our system.

We have reexamined superlattice states that were observed in a number of pattern forming systems in the past and found some to be grid states, although they were not identified as such originally. We will demonstrate this on an optical system [6] and a gas discharged system [7]. Moreover, we will show that by varying the phases of the driving frequencies, a variety of different grid states are selected. This selection is consistent with recent theoretical predictions of generalized phases that govern the pattern selection [8].

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