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The breakdown of the weakly-nonlinear regime for kinetic instabilities DAVID SANZ-OROZCO, University of Tampa, HERBERT BERK, Univ of Texas, Austin, GE WANG, University of Texas at Austin — The evolution of marginally-unstable waves that interact resonantly with populations of energetic particles is governed by a well-known cubic integro-differential equation for the mode amplitude. One of the outcomes predicted by the equation is the so-called explosive regime, where the amplitude grows indefinitely, eventually taking the equation outside of its domain of validity. Beyond this point, only full Vlasov simulations will accurately describe the evolution of the mode amplitude. In this work, we study the breakdown of the cubic equation in detail. We find that, while the cubic equation is still valid, the distribution function of the energetic particles locally flattens or folds in phase space. This feature is unexpected in view of the assumptions of the theory that are given in. We also derive fifth-order terms in the wave equation, which not only give us a more accurate description of the marginally-unstable modes, but they also allow us to predict the breakdown of the cubic equation. Our findings allow us to better understand the transition between weakly-nonlinear modes and the long-term chirping modes that ultimately emerge.

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