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Amplitude oscillations in a non-equilibrium polariton condensate RICHARD BRIERLEY, PETER LITTLEWOOD, University of Cambridge, PAUL EASTHAM, Trinity College Dublin — Like cold atomic gases, semiconductor nanostructures provide new opportunities for exploring non-equilibrium quantum dynamics. In semiconductor microcavities the strong coupling between trapped photons and excitons produces new quasiparticles, polaritons, which can undergo Bose-Einstein condensation. Quantum quenches can be realised by rapidly creating cold exciton populations with a laser [Eastham and Phillips, PRB 79 165303 (2009)]. The mean field theory of non-equilibrium polariton condensates predicts oscillations in the condensate amplitude due to the excitation of a Higgs mode. These oscillations are the analogs of those predicted in quenched cold atomic gases and may occur in the polariton system after performing a quench or by direct excitation of the amplitude mode. We have studied the stability of these oscillations beyond mean field theory. We show that homogeneous amplitude oscillations are unstable to decay into lower energy phase modes at finite wavevectors, suggesting the onset of chaotic behaviour. The resulting hierarchy of decay processes can be understood by analogy to optical parametric oscillators in microcavities. Polariton systems thus provide an interesting opportunity to study the dynamics of Higgs-like modes in a solid state system.

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