

Parametric resonances in Bose Einstein condensates
F. Dalfovo

Abstract: A Bose-Einstein condensate in an optical lattice exhibits parametric resonances when the intensity of the lattice is periodically modulated in time. A modulation at frequency Ω gives rise to a parametric instability of Bogoliubov excitations with frequency $\Omega/2$. The stability diagram for a condensate in a one-dimensional lattice is calculated using the Gross-Pitaevskii (GP) theory. Results for the growth rate of the unstable excitations are found with a Bogoliubov quasiparticle projection method. Analytic predictions are derived with a two-mode approximation, as well as in the tight-binding regime. The results agree with those of time-dependent GP simulations. The role of the seed excitations required to trigger the parametric amplification is discussed. The possible amplification of the quasiparticle vacuum via quantum fluctuations, beyond GP theory, is also addressed. Our results can be used in exploiting parametric instabilities for the purpose of spectroscopy, selective amplification of a particular excitation mode and for establishing a new kind of thermometry.