Double wells in Bose-Einstein Condensates

Chenyu Wang
Department of Mathematics & Statistics, University of Massachusetts, Amherst MA 01003, U.S.A.
Tel: 413-5450713, email: chenyu@math.umass.edu

Abstract:

I will introduce some models motivated by studies of Bose-Einstein condensates (BECs) trapped in double-well potentials (DWPs), within the context of the well-established mean-field model, namely the Gross-Pitaevskii equation (GPE).
In previous work, the prototypical model in a quasi-1D setting was examined by using a Galerkin-type two-mode approach, a powerful handle on studying the steady states and predicting the bifurcation diagram. We aim at extending the analysis of the DWP setting to various modified models.
We first consider a collisionally inhomogeneous environment, in which case a potential spatial variation of the nonlinearity is to be introduced. It turns out that the inhomogeneity induces a significant modification of the bifurcation diagram.
We then move on to some multi-component systems. We begin with a two-component system, i.e. a mixture of two hyperfine states of the same species, followed by a three-component system, where the spin degree of freedom is considered. Numerous branches of steady solutions that involve one, two or three counterparts are observed.
We also extend to a 2D model in the setting of a four-well potential, combined by a strong harmonic trap and a periodic potential. Due to the 2D nature, a four-mode reduction is developed.
Lastly, a model with nonlocal interactions will be considered to examine how, in turn, nonlocality may affect the bifurcation picture.