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Dynamics of Vortex Dipoles in Confined Bose-Einstein Condensates

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(Submitted on 28 Jun 2011)

We present a systematic theoretical analysis of the motion of a pair of straight counter-rotating vortex lines within a trapped Bose-Einstein condensate. We introduce the dynamical equations of motion, identify the associated conserved quantities, and illustrate the integrability of the ensuing dynamics. The system possesses a stationary equilibrium as a special case in a class of exact solutions that consist of rotating guiding-center equilibria about which the vortex lines execute periodic motion; thus, the generic two-vortex motion can be classified as quasi-periodic. We conclude with an analysis of the linear and nonlinear stability of these stationary and rotating equilibria.

Comments:8 pages, 3 figures, to appear in Phys. Lett. ASubjects:Quantum Gases (cond-mat.quant-gas); Pattern
Formation and Solitons (nlin.PS)Journal reference:Phys. Lett. A 375 (2011) 3044-3050DOI:10.1016/j.physleta.2011.06.061Cite as:arXiv:1106.5764 [cond-mat.quant-gas]
(or arXiv:1106.5764v1 [cond-mat.quant-gas] for this
version)

Submission history

From: Panayotis Kevrekidis [view email] [v1] Tue, 28 Jun 2011 19:12:27 GMT (137kb)

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