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Dynamics of Vortex Dipoles in Confined Bose-Einstein Condensates

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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.

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