Kármán Vortex Street in an Immiscible Two-component Bose-Einstein Condensate

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Research Article

Keywords: Bose-Einstein Condensate, Two-component Gross-Pitaevskii system, Kármán Vortex Street, Ghost Vortex Street

Posted Date: February 11th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-209903/v1>

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Abstract

In this paper, we investigate a two-component Gross-Pitaevskii system with a moving obstacle potential, which describes the vortex shedding for an immiscible binary Bose-Einstein condensate composed of different hyperfine states of 87 Rb atoms. Numerical simulations indicate that, the Kármán vortex street is discovered in one component, while the Kármán-like vortex street named "ghost vortex street" is formed in the other. The other typical patterns of vortex shedding, such as vortex dipoles, V-shaped vortex pairs and corresponding "ghost vortex shedding", can also be found in the wake of obstacle. The instantaneous and time-averaged drag force acting on obstacle potential are calculated, which show the contribution to drag force from vortex shedding. The parameter region for various vortex patterns, critical velocity for vortex emission, and superfluid Reynolds number are presented and discussed. Finally, we provide an experimental protocol for the above realization and observation.

Full Text

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Figures

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