Vortex dipoles in a Bose-Einstein condensate

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Abstract:

While quantized vortices and vortex lattices in Bose-Einstein condensates (BECs) have received much recent attention, the formation and dynamics of vortex dipoles have been nearly unexplored in experimental BECs. Vortex dipoles consist of a pair of vortices of opposite circulation moving under the influence of each other, and may be considered as metastable topological structures that carry linear momentum in a fluid. In this talk, a collaborative experimental and numerical study of the formation, dynamics, and lifetimes of vortex dipoles in BECs will be presented. In our work [1], single vortex dipoles were deterministically nucleated by causing highly oblate, harmonically trapped BECs to move past a repulsive obstacle above a supercritical flow velocity. Our measured critical velocity for vortex dipole shedding, and the subsequent dipole dynamics, are in good agreement with new numerical simulations. We find that vortex dipoles can survive for many seconds in the BEC without self-annihilation, and that multiply charged vortex dipoles can be formed with high enough flow velocities.

References:

1. T.W. Neely, E.C. Samson, A.S. Bradley, M.J. Davis, and B.P. Anderson, preprint available at http://arxiv.org/abs/0912.3773.