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On-demand Smooth Flow by Stirring a Racetrack Atom Circuit[1]
MARK EDWARDS, OLATUNDE OLADEHIN, BENJAMIN ELLER, Georgia Southern University, CHARLES CLARK, JQI and NIST — We studied how smooth flow can be produced by stirring an ultracold atom circuit consisting of a gaseous Bose–Einstein condensate (BEC) confined in a "racetrack" potential. We assume that the BEC is strongly confined in a horizontal plane by a vertical harmonic trap and, within this plane, subjected to an arbitrary two–dimensional potential using laser light. The racetrack potential is made up of two straight parallel channels of length L connected on both ends by semicircular channels of the same width and (energy) depth as the straightaways. We used the Gross–Pitaevskii equation (GPE) to simulate the behavior of the BEC in this potential when stirred by a rectangular paddle at various speeds and barrier heights. For fixed L we stirred the BEC at four different speeds and with barrier heights that varied from 0.5μ to 2.0μ. This series of conditions was performed for seven different values of L. We also devised a simple 1D model of the stirring of the BEC based on the GPE in order to understand how smooth flow is produced by stirring. This understanding should enable the design of a stirring sequence that would produce a given flow on demand.

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