Tunneling with a Hydrodynamic Pilot-Wave Model

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The early work of Couder and Fort (PRL 2006) presented the walking droplet as a pilot-wave system of the form envisaged by Louis de Broglie: a particle moves in resonance with its guiding wave field thus forming a classical wave-particle association. We here consider hydrodynamic pilot-wave dynamics in a confined one-dimensional domain. Specifically, we present a one-dimensional water wave mathematical model that describes droplets walking in single and multiple cavities. The system of differential equations accounts for the droplet dynamics coupled to a (potential theory) wave equation. The nontrivial feedback between the two (time-dependent) set of equations gives rise to interesting dynamical features. The cavities are separated by a submerged barrier, and so allow for the study of tunneling. They also highlight the non-local dynamical features arising due to the spatially-extended wave field. Results from computational simulations are complemented by preliminary laboratory experiments.