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Velocity Oscillations of a Walking Droplet[1] SAM TURTON, MATTHEW DUREY, JOHN BUSH, Massachusetts Institute of Technology — Couder *et al.* (2005) demonstrated that a droplet bouncing on the surface of a vertically oscillating bath may destabilize to a walking state characterized by rectilinear motion across the bath surface at a constant speed. When a walking droplet is perturbed, there is experimental (Wind-Willassen *et al.* (2013)) and theoretical (Bacot *et al.* (2019)) evidence suggesting that its velocity may return to its free walking speed via over- or underdamped oscillations. By revisiting the stroboscopic pilot-wave model of Oza *et al.* (2013), we demonstrate that linear stability analysis of the walking state predicts velocity oscillations over a lengthscale that becomes commensurate with the Faraday wavelength as the vibrational acceleration approaches the Faraday threshold. Furthermore, we demonstrate that this model predicts that the walking state destabilizes via a subcritical Hopf bifurcation, where the associated unstable limit cycle consists of periodic velocity oscillations, also on a scale comparable to the Faraday wavelength. This behavior conditions the droplet's histogram to develop a coherent structure on the scale of the Faraday wavelength, and so provides new insight into the emergence of quantum-like statistics from pilot-wave hydrodynamics.

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