Hydrodynamic analog of wave-particle duality

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We have recently discovered a macroscopic object composed of a material particle dynamically coupled to a wave packet. The particle is a droplet bouncing on the surface of a vertically vibrated liquid bath; its pilot-wave is the result of the superposition of the surface waves it excites. Above an excitation threshold, this symbiotic object, designated as a "walker" becomes self-propelled. Such a walker exhibits several features previously thought to be specific to the microscopic realm. The unexpected appearance of both uncertainty and quantization behaviors at the macroscopic scale lies in the essence of its "classical" duality. The dynamics of the droplet depends on previously visited spots along its trajectory through the surface waves emitted during each bounce. This path memory dynamics gives a walker an intrinsic spatio-temporal non-locality. I will discuss the characteristics of these objects that encode a wave memory. In particular, I will introduce the concept of time mirror to interpret the characteristics of the driving wave packet.