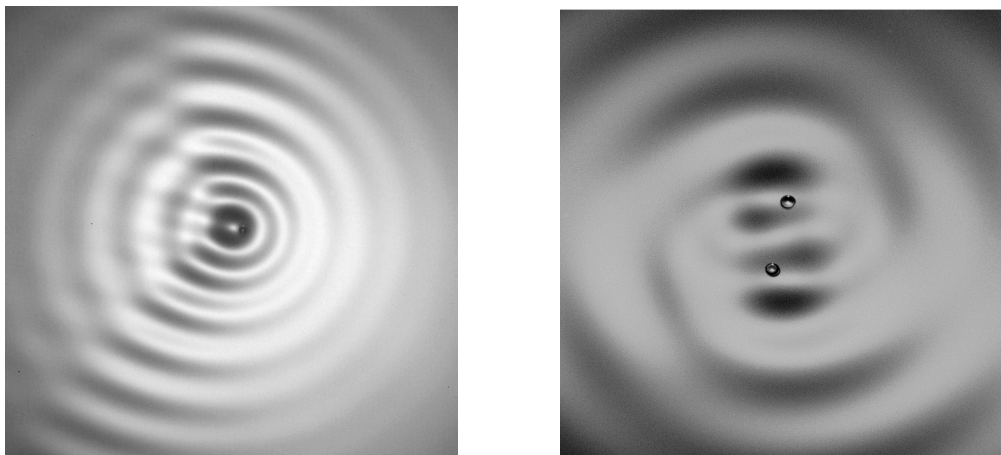


Wave-particle duality with naked eye

Emmanuel Fort

Institut Langevin, ESPCI ParisTech, Université Paris Diderot

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.



*Figure: “Walker” composed of its droplet and associated wave (left);
Droplets orbiting on a discrete orbit (right)*

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. Although based on fundamental concepts, commonly found in living systems, this path-memory driven dynamics is still unexplored in physics elementary objects.

This new class of memory-encoded systems which possess a spatiotemporal nonlocality shakes the frontiers between macroscopic and microscopic world. In this talk, I will present the dynamics of this object in experiments similar to the historical ones in quantum physics: diffraction and interference through slits, tunneling, Landau quantization... I will also discuss the implications for quantum objects.