Physical Mathematics Seminar

PATH-MEMORY DYNAMICS: EMERGENCE OF QUANTUM-LIKE BEHAVIOR AT THE MACROSCOPIC SCALE

EMMANUEL FORT

Institut Langevin, ESPCI ParisTech &
University Paris Diderot

ABSTRACT:

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. 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 and Zeeman-like effect. I will also discuss first experimental results on walkers confined in cavities and Anderson localization.

TUESDAY, MARCH 15, 2011
2:30 PM
Building 2, Room 105

Refreshments at 3:30 PM in Building 2, Room 290

Massachusetts Institute of Technology