

Fluid Mechanics visits Quantum Mechanics displaying new dynamical systems

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A hydrodynamic pilot-wave system was discovered a decade ago by Yves Couder and Emmanuel Fort. It takes the form of a millimetric fluid droplet walking on the surface of a vibrating fluid bath. This millimetric droplet can be self-propelled by virtue of a resonant interaction with its own (Faraday) wave field. This system represents the first known example of a pilot-wave system of the form envisaged by Louis de Broglie. Much research has been done studying the dynamics of this wave-particle association. A brief summary will be presented.

In our computational work we show that two oscillating walkers, confined to separate potential wells, exhibit correlated features even when separated by a large distance. Their phase space dynamics is given by the system as a whole and cannot be described independently. These particles' intricate distributions in phase space are indistinguishable, whereas removing one particle changes completely the phase portrait. The correlated-walkers also relate to nonlinearly-coupled oscillators where synchronization can break out spontaneously. The present oscillator-coupling is dynamic, implicit and mediated through the underlying wave field, as opposed to the Kuramoto model where the phase-coupling scheme is explicit and pre-defined.