

PHYSICAL MATHEMATICS SEMINAR

WAVE-MEDIATED KURAMOTO-LIKE SYNCHRONIZATION OF BOUNCING DROPLETS

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ABSTRACT:

Couder and Fort (PRL 2006) discovered that a fluid droplet bouncing on the surface of a vertically vibrating silicon oil bath, forms a wave-particle system referred to as a hydrodynamic pilot-wave system. Much research has been done since this discovery and many problems emerged with uncertainty related issues. The main focus of this talk is on the nonlinear dynamics of oscillators, which are coupled by the underlying Faraday wavefield. We will briefly discuss our PDE/fluid dynamic modeling as well as the numerical method. Computationally we display regimes where two oscillating droplets, confined to separate wells, exhibit correlated features even when separated by a large distance. The particles' phase space dynamics is described in a holistic fashion and may not be decomposed into separate subsystems. We detect "coherence" when the bouncing droplets behave as nonlinearly-coupled oscillators which spontaneously synchronize, as in the celebrated Kuramoto model for phase oscillators. The droplet coupling is dynamic and implicit, being wave-mediated as opposed to the Kuramoto model where phase-coupling is explicit and pre-defined. We also discover a new regime where "coherence" emerges in a statistical fashion. Recent references are Nachbin, Milewski & Bush, Phys. Rev. Fluids (2017), Nachbin, Chaos (2018) and Nachbin, Fluids (2020) where more details from the 2018-paper are presented.

TUESDAY, MARCH 16, 2021

2:30 PM – 3:30 PM

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