SEMINAR IN PHYSICS

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~ Refreshments ~

A BRIEF INTRODUCTION TO PILOT-WAVE HYDRODYNAMICS AND THE QUANTUM CORRAL ANALOG

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A pilot-wave hydrodynamic system consists of a small droplet of viscous fluid that is propelled across a vibrating bath of the same fluid. Bouncing vertical motion and "walking" horizontal motion of the droplet can be achieved with careful control over the frequency and amplitude of the bath's oscillation. The droplet avoids merging with the fluid from which it was generated and exhibits intricate motion across the fluid surface. Of particular importance, the observed walking motion is due to the droplet's interaction with the waves it generates as it bounces off of the vibrating liquid surface. With each rebound, it receives transverse kicks in its motion dependent on the waves generated by its previous bounces.

Ultimately, it is the droplet's interaction with the superposition of these waves that generates the complex motion observed. With variations in bath geometries and subsurface structures, the probability distribution of the droplet's trajectory can be manipulated to induce fascinating behavior. Over short timescales, a droplet will exhibit seemingly random trajectories. However, when the droplet is observed over long timescales, patterns in the cumulative motion of the droplet begin to emerge. The patterns this system maps out over long timescales demonstrate a compelling macroscopic analog to Louis de Broglie's double-solution theory of quantum mechanics. A brief introduction to pilot-wave hydrodynamics, and the hydrodynamic behavior of a circular bath geometry analogous to a quantum corral, is presented.

CARBON NANOTUBES AS LIQUID CRYSTALS

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Carbon nanotubes (CNTs) have been observed to have liquid-crystalline behavior. In both multi-walled and single-walled carbon nanotubes, nematic, smectic, and columnar liquid crystal phases have been observed. By inducing these phases it is possible to isolate the mechanical, thermal, and electrical properties of CNTs. The challenge, however, is creating macroscopic assemblies with these features. By studying the formation of liquid crystal phases researchers have learned new ways to manipulate CNT structure.