



MECHANICAL ENGINEERING SEMINAR

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Hydrodynamic quantum analogs: from foundations to applications

Valeri Frumkin, Ph.D.

Massachusetts Institute of Technology

Email: valerafr@mit.edu

Hosted by: Prof. Oleg Gendelman

One of the beauties of fluid mechanics is that it provides a framework for describing a broader class of nonfluidic systems that are comparable to it in significant respects owing to similarities in their essential physics and underlying mathematical structure. In 2006, Yves Couder and coworkers discovered that droplets walking on a vibrating fluid surface exhibit many features previously thought to be limited to the microscopic quantum realm. These include, but are not limited to, single-particle interference, tunneling across potential barriers, spin lattices, Friedel oscillations, the quantum corral and statistical projection effects. In this talk I will give a brief introduction to the new and exciting field of hydrodynamic quantum analogs and will present some of my recent contributions to it. Specifically, I'll discuss the appearance of "surreal" particle trajectories in pilot-wave hydrodynamics, superradiant emission of droplets from parametrically excited cavities, and observation of the Aharonov-Bohm effect in a hydrodynamic pilot-wave system. Finally, I will discuss my long-term goal of developing a platform that would allow the implementation of quantum-inspired computation based on pilot-wave hydrodynamics.

Valeri Frumkin is a post-doctoral associate at the Massachusetts Institute of Technology, where he conducts experimental and theoretical research on hydrodynamic quantum analogs. Valeri received his Ph.D. in applied mathematics from Technion, studying nonlinear dynamics of thin liquid films. He continued to a postdoctoral position at the Technion Faculty of Mechanical Engineering, where he focused on experimental research of interfacial phenomena and developed novel technologies with applications in optics and additive manufacturing. He is a recipient of the foundation for excellence in mathematics award, the Gemunder prize for space-defense related technologies and of the Fulbright postdoctoral scholar fellowship.

