# QPM Colloquium

پژوهشگاه دانش‌های بنیادی

# One Effect, Many Guises:

## The Casimir Effect as a Paradigm Unifying Fluctuation Physics from Quantum Fields to Soft Matter

Invited Speaker
**Ali Naji**


Date
**Wednesday, June 3, 2026**

Time
**14:00**

## Description


The quantum vacuum is not an inert background but supports zero-point fluctuations of quantized fields whose spectrum can be reshaped by boundary conditions and geometry. In a seminal 1948 work, Hendrik Casimir showed that confining electromagnetic vacuum fluctuations between two ideal reflecting plates produces a universal attractive force. Initially met with skepticism—with Pauli reportedly dismissing it as "all nonsense" at first, according to Casimir's memoir—the effect later became a major focus of theoretical and experimental research, especially after precision measurements in the late 1990s. What began as a striking consequence of quantum field theory has become a unifying thread linking fluctuation-induced phenomena from nano- and microelectromechanical systems through condensed matter and materials physics to soft matter—where soft modes, spontaneously broken symmetries, and conservation laws often make field-theoretic methods a natural framework. In the first part of this talk, I give a pedagogical overview of the Casimir effect and sketch its formal and conceptual development, from Casimir's original idealized setting to Lifshitz theory for real materials and modern scattering-based approaches, with a brief mention of ongoing theoretical debates. In the second part, I turn to recent approaches to manipulate Casimir forces in nanoengineered settings using tunable materials, and to broader manifestations of the effect in soft matter physics. Finally, I summarize our contributions at IPM, extending Casimir phenomenology to disordered Coulomb and elastic systems, the fluctuating hydrodynamics of thin fluid films, multilayer graphene stacks, and—more recently—to ferrofluid layers, and confined pseudospinors in graphene nanoribbons.


Venue

**Room D, Third Floor, Farmanieh Building, IPM**

Link

skyroom.online/ch/schoolofquantumphysicsandmatter/weeklyseminars

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