Keynote Lecture

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Soft Quasicrystals

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The scope of the field of quasicrystals has expanded greatly in recent years owing to the advent of a host of new experimental systems exhibiting aperiodic long-range order. Among these are soft-matter quasicrystals whose building blocks—rather than being individual atoms—are composed of large synthesized particles such as macromolecules, block copolymers, nanoparticles, and colloids. At these dimensions it is possible to design the interaction between particles and manipulate their positions. It may also be possible to track the dynamics of individual particles, and in the optical domain even observe quantum wave functions. Consequently, these mesoscopic-scale soft quasicrystals provide rich and versatile platforms for the fundamental study of the basic physics of quasicrystals. At the same time they hold the promise for new applications based on artificial or self-assembled well-ordered nanomaterials with unique physical properties that take advantage of the lack of periodicity, such as novel photonic metamaterials.

After giving a brief overview of the rapidly expanding field of soft-matter quasicrystals, I shall demonstrate how a quantitative understanding of their thermodynamic stability [1] has given us the ability to control the self-assembly of a variety of periodic and aperiodic soft-matter crystals (at the moment only on the computer), and has led to the numerical discovery of a novel phase—a so-called "cluster quasicrystal" [2]. If time permits, I shall describe the design of nonlinear photonic quasicrystals for optical frequency-conversion applications [3].

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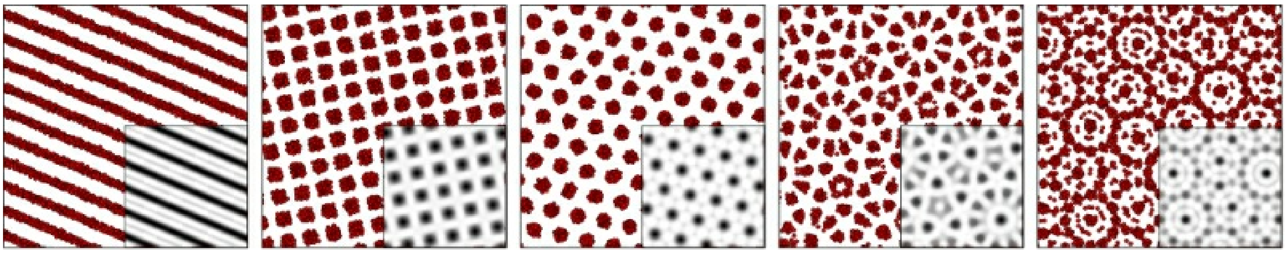

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