PHYSICAL MATHEMATICS SEMINAR

Statistical mechanics of aperiodic order and the role of complexity for crystal growth

MICHAEL ENGEL

Department of Chemical Engineering
University of Michigan

ABSTRACT:

Atoms like to order. And although ordering often results in simple lattices, surprises are frequently encountered. The discovery of the first quasicrystals was one such surprise. The growth of intermetallic crystals with thousands of atoms per unit cell another one. In many instances we do not yet understand why nature resorts to complexity, but we may certainly be intrigued by its observation. In this presentation I will discuss the origin and consequences of aperiodic order with the help of geometry and simple computer simulations (e.g. polyhedra [1] and pair potentials [2]). A description of the patterns we find involves the embedding of tilings onto a higher-dimensional lattice, which results in new low-energy Goldstone modes called phasons. Our findings are an important step towards addressing a central remaining question in the theory of crystal growth: How do atoms (or other elementary building blocks) arrange themselves rapidly, and with near structural perfection, into long-range ordered configurations on length scales that are significantly larger than the interaction range in the system, i.e. without the guidance of a unit cell?

[1] Damasceno, Engel, Glotzer, "Predictive self-assembly of polyhedra into complex structures", Science 337, 453 (2012).

[2] Engel, Damasceno, Phillips, Glotzer, "Computational self-assembly of a one-component icosahedral quasicrystal", Nature Materials 14, 109 (2015).

TUESDAY, OCTOBER 6, 2015
2:30 PM
Building E18, Room 466A

Reception following in Building E17, Room 401A
(Math Dept. Common Room)

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