Waves in Honeycomb Structures

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007 Kemeny, 4:00PM
Tea is at 3:30 pm in 300 Kemeny

Abstract

I will focus on the properties of waves in 2-dimensional honeycomb structures. Two areas where such structures have been explored extensively are (i) condensed matter physics (graphene) and (ii) photonics (honeycomb arrangements of waveguides).

Many of the remarkable wave propagation properties of honeycomb structures are related to the presence of conical singularities ("Dirac points") in the associated dispersion surfaces, which relate wavelength and wave-speed. Physical modeling (since Wallace, 1947) has centered on the tight-binding (discrete) approximation of the underlying partial differential equation (Schroedinger's eqn).

After giving an overview of basic mathematical notions in wave propagation, I'll present results (joint with C.L. Fefferman) on the existence of Dirac points for the Schroedinger equation with a generic honeycomb lattice potential. We also show that the very long time dynamics of wave-packets is governed by an effective two-dimensional Dirac system.

This talk should be accessible to graduate students.