Incommensurate and disordered quantum systems

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Abstract

After recalling the standard mathematical formalism used to model disordered materials such as doped semiconductors, alloys, or amorphous materials, and classical results about random Schrödinger operators (Anderson localization), I will present a tight-binding model for computing the electrical conductivity of multilayer 2D materials. All these models fall into the scope of the mathematical framework, based on non-commutative geometry, introduced by Bellissard to study the electronic properties of aperiodic systems. I will finally present numerical calculations of the electronic conductivity of 1D incommensurate bilayer systems as a function of the lattice constant ratio and the Fermi level. The plot of the so-obtained function is reminiscent of Hofstadter's butterfly.