
Quasiperiodic composites: homogenization and spectral properties

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Abstract

From quasicrystalline alloys to twisted bilayer graphene, materials with a quasiperiodic structure exhibit unusual properties that drastically differ from those with periodic structures. A key feature of quasicrystalline microgeometry is a long-range order in the absence of periodicity. Quasiperiodic geometries can be modeled using the cut-and-projection method that restricts or projects a periodic function in a higher dimensional space to a lower dimensional subspace cut at an irrational projection angle. Homogenized equations for the effective behavior of a quasiperiodic composite can be derived by cutting and projecting a periodic function in a higher dimensional space. Using equations for the local problem in the higher dimensional space established in the homogenization process, we develop the Stieltjes analytic representation of the effective properties of quasiperiodic materials; this representation determines the spectral characteristics of fields in quasicrystalline composites and used to derive bounds for the effective properties. This is a joint work with Niklas Wellander and Sebastien Guenneau.

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