

1176-81-45

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Spectral decimation of piecewise centrosymmetric Jacobi operators on graphs.

We study the spectral theory of a class of piecewise centrosymmetric Jacobi operators defined on an associated family of substitution graphs. Given a finite centrosymmetric matrix viewed as a weight matrix on a finite directed path graph and a probabilistic Laplacian viewed as a weight matrix on a locally finite strongly connected graph, we construct a new graph and a new operator by edge substitution. Our main result proves that the spectral theory of the piecewise centrosymmetric Jacobi operator can be explicitly related to the spectral theory of the probabilistic Laplacian using certain orthogonal polynomials. Our main tools involve the so-called spectral decimation, known from the analysis on fractals, and the classical Schur complement. We include several examples of self-similar Jacobi matrices that fit into our framework. As an application, we introduce self-similar versions of the one-dimensional almost Mathieu operators and derive an explicit formula of the integrated density of states of the self-similar almost Mathieu operators as the weighted pre-images of the balanced invariant measure on a specific Julia set. (Received January 09, 2022)