Spectral theory of $n$-fold periodic graphs with applications to toroidal 6-cages, (3,6)-cages, and (2,6)-cages

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**Abstract**

Toroidal 6-cages (i.e., hexagonal tesselations of the torus, in a chemical context also called toroidal fullerenes) are used as prototypes for outlining a general spectral theory of $n$-dimensional toroidal graphs derived from some locally finite $n$-fold periodic graph.

The results are used to calculate explicitly spectra and orthonormal eigenvector systems of toroidal 6-cages, (3,6)-cages and (2,6)-cages (a $(q,6)$-cage, where $q \in \{2, 3, 4, 5\}$, is a two-connected cubic plane graph that has only $q$-gons and hexagons as its faces; the graph of an ordinary fullerene is a $(5,6)$-cage).