

QUANTUM GRAPHS WITH TIME REVERSAL NON-INVARIANT VERTEX COUPLINGS

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We analyze the band spectra of several periodic quantum graphs equipped with examples of the vertex condition that violates the time reversal invariance of the system. The first one takes the form of a chain of rings connected by line segments with coupling interpolating between the δ coupling and the one determined by a simple circulant matrix, the so-called R coupling. We find that flat bands are generically absent and that the negative spectrum is nonempty even for interpolation with a non-attractive δ coupling, while we also determine the high-energy asymptotic behaviour of the bands. The second one is a periodic hexagonal lattice with the $-R$ coupling - we give its complete spectral picture and compare it to earlier results for the R coupling. Later we show that the spectral character remains the same even for the dilated lattice, with the exception of flat bands, which are absent if the lengths of the elementary cell are incommensurate.