## Nanoscale physics

# Fractal energy band structures of a Bloch electron moving on anisotropic 2D square lattice with magnetic field

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The case of a tight binding electron with anisotropic NN hopping in a 2D square lattice is considered. The influence of the homogenous, perpendicular to the lattice plane magnetic field is taken into account using the minimal substitution, leading to the anisotropic Harper equation. The fractal structured Cantor set of energy eigenvalues can be obtained both by transfer matrix approach or using the direct diagonalization of the secular matrix for both the isotropic and anisotropic case. The structure of each energy sub-band, obtained by magnetic splitting, can be also displayed in the first Brillouin zone. The symmetries found in energy spectrum can be explained using the magnetic translation group. A suitable basis exchange leads to the *q*-Symmetrized form of the anisotropic Harper equation and to the deduction of the general form of the equation's characteristic polynomial. This enables an optimal study of the anisotropy dependence of the energy band structures, and of other quantities like Green's function or the thermodynamic properties.

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