Homework 1. Tight-binding approximation

<center>September 5, 2018</center>

1. Derive the dispersion equation and plot the band structure of a infinite chain of atoms: each unit cell consists of three atoms: first atom is connected with the third atom from the previous unit cell with coefficient $t_1 = te^{i\varphi_1}$, first with the second with coefficient $t_2 = te^{i\varphi_2}$, and second with third - with coefficient $2t$. $t = 1$, $\varphi_1 = \pi/3$, $\varphi_2 = pi/6$.

2. Derive the dispersion equation of the chessboard square lattice, where tonnelling coefficients are equal to t, but the site energy of neighboring atoms differs by δ.

3. How the answer in problem 2 changes, if we add the tonneling between the next nearest neighbours with coefficient $t/5$?