FUNDAMENTALS OF NANOELECTRONICS

B. Quantum Transport

1. Schrodinger Equation
2. Contact-ing Schrodinger
3. Advanced Examples
4. Spin Transport

1.1. Introduction

1.2. Wave Equation

1.3. Differential to Matrix Equation

1.4. Dispersion Relation

1.5. Counting States

1.6. Beyond 1-D

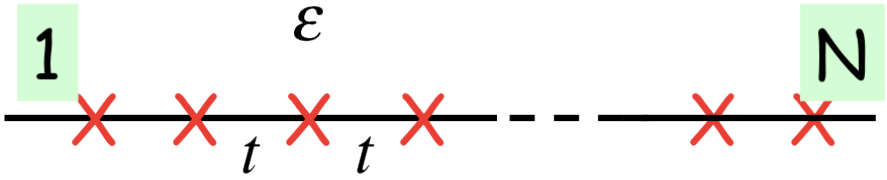
1.7. Lattice with a Basis

1.8. Graphene

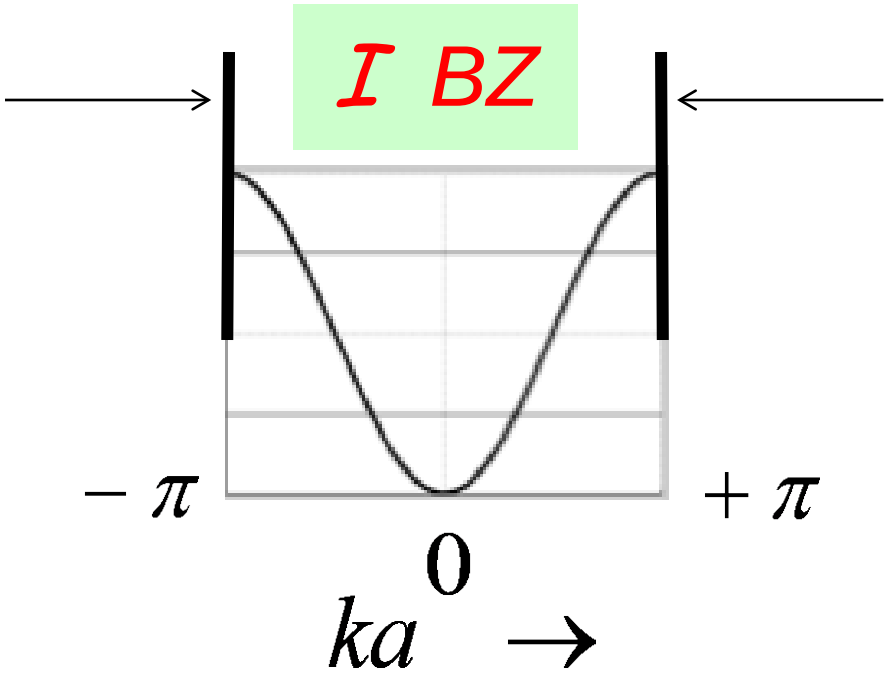
1.9. Reciprocal Lattice / Valleys

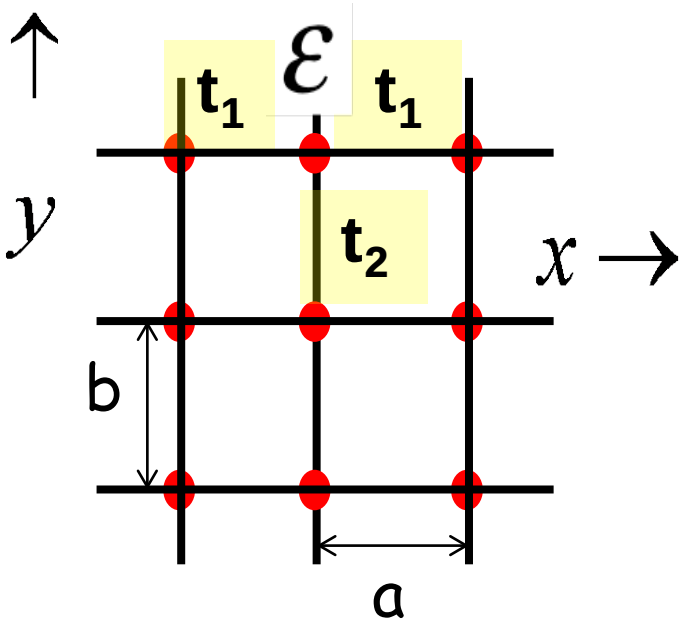
1.10. Summing up ..

a : Lattice spacing



$$E = \varepsilon + 2t\cos ka$$



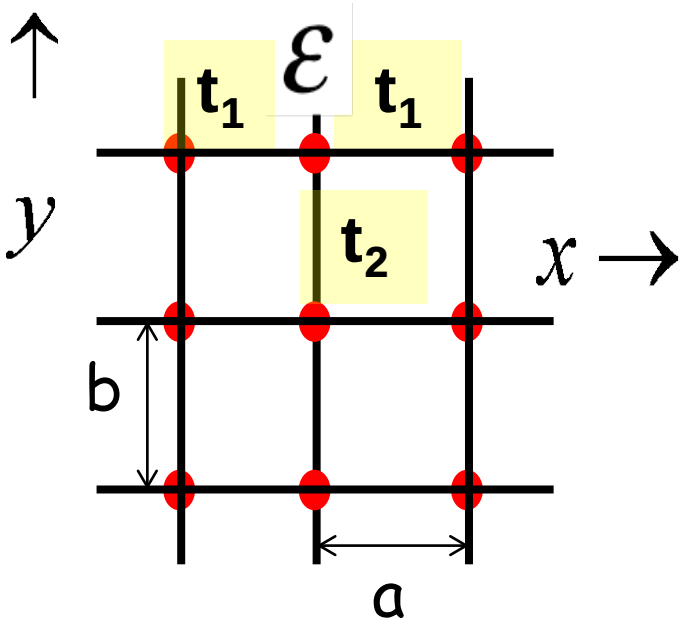


$$E\psi_n = \sum_m H_{nm}\,\psi_m$$

$$\psi_n = \psi_0\, e^{+i\vec{k}.\vec{r}_n}$$

$$E\psi_0\, e^{+i\vec{k}.\vec{r}_n} = \sum_m H_{nm}\,\psi_0\, e^{+i\vec{k}.\vec{r}_m}$$

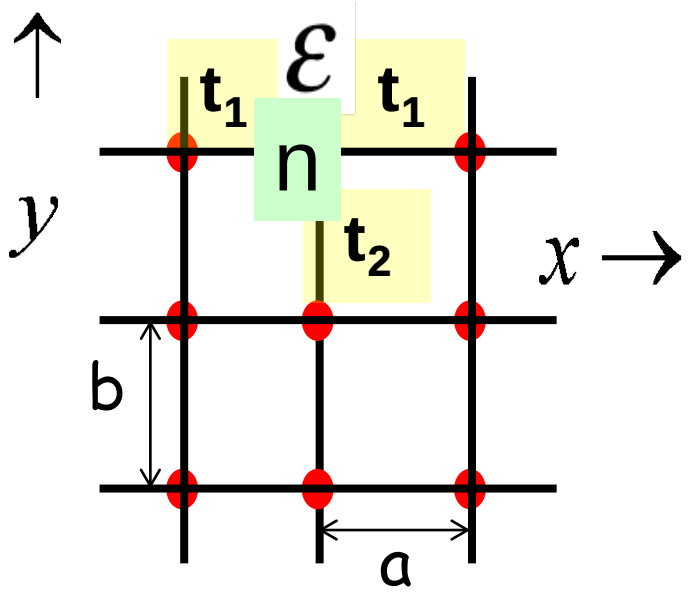
$$E(\vec{k}) = \sum_m H_{nm}\, e^{+i\vec{k}.(\vec{r}_m - \vec{r}_n)}$$



$$H_{nm}\, e^{+i\vec{k}.(\vec{r}_m-\vec{r}_n)}$$

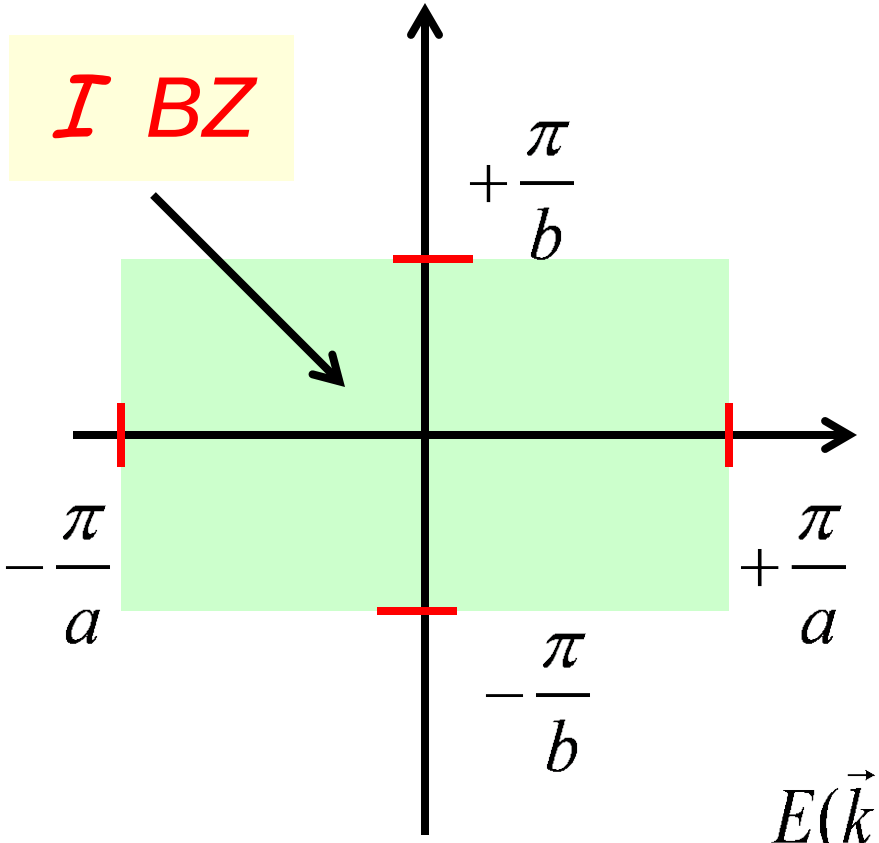
$\vec{r}_m-\vec{r}_n=0$	ε
$\vec{r}_m-\vec{r}_n=\hat{x}\,a$	$t_1\, e^{i\vec{k}.\,\hat{x}\,a} = t_1 e^{i\,k_x a}$
$\vec{r}_m-\vec{r}_n=-\hat{x}\,a$	$t_1 e^{-i\,k_x a}$
$\vec{r}_m-\vec{r}_n=\pm\hat{y}\,b$	$t_2 e^{\pm i\,k_y b}$

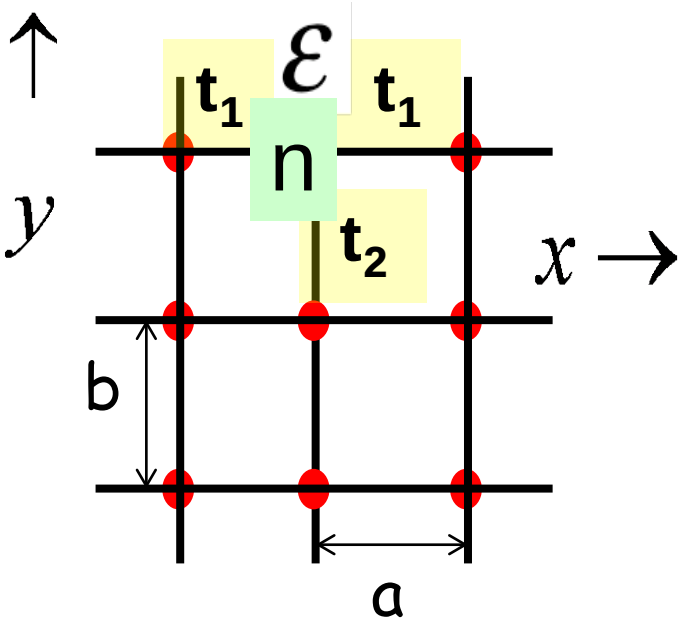
$$E(\vec{k}) = \sum_m H_{nm}\, e^{+i\vec{k}.(\vec{r}_m-\vec{r}_n)}$$



$$E(\vec{k}) = \varepsilon + 2t_1\cos k_x a + 2t_2\cos k_y b$$

$$E(\vec{k}) = \sum_m H_{nm}\, e^{+i\vec{k}.(\vec{r}_m - \vec{r}_n)}$$





$$E(\vec{k}) = \varepsilon + 2t_1 \cos k_x a + 2t_2 \cos k_y b$$

Coming up next ..