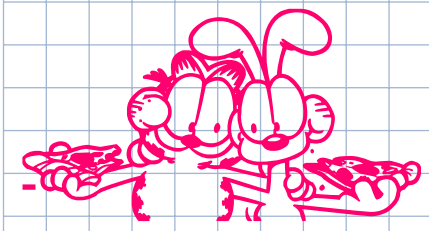
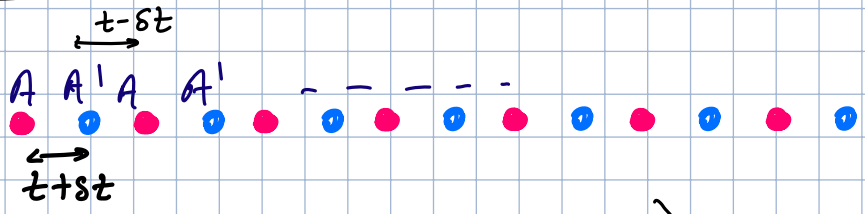
Practical reality of doing tight binding method.



Examples :- SSH model (only tBM)



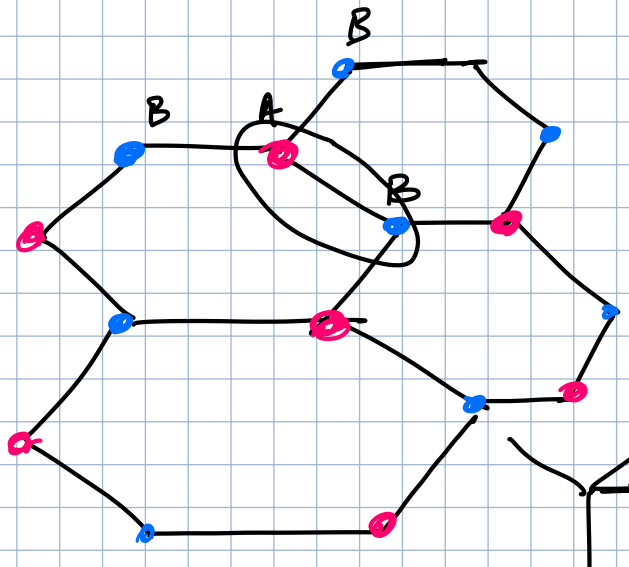
$$H = \begin{pmatrix} 0 & \underbrace{e^{-ika}(t-\delta t) + (t+\delta t)e^{ika}}_{E} \\ E^* & 0 \end{pmatrix}$$

$$= \begin{pmatrix} 0 & 2t\cos ka + 2i\delta t \sin(ka) \\ 2t\cos ka - 2i\delta t \sin ka & 0 \end{pmatrix}$$

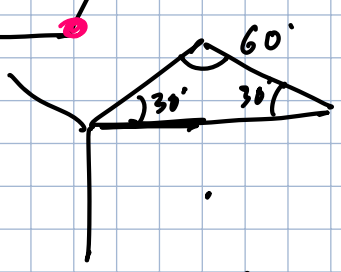
$$E = \pm\sqrt{4t^2\cos^2 ka + 4\delta t^2 \sin^2 ka}$$

for dimerisation $k \to \frac{k}{2}$ with $k \in [-\pi, \pi]$

Example 2



$$H = \begin{pmatrix} \epsilon_a & \underbrace{t\left[1 + e^{-i\vec{k}\left[\frac{\sqrt{3}a}{2}, \frac{a}{2}\right]} + e^{-ik\left[\frac{-\sqrt{3}a}{2}, \frac{a}{2}\right]}\right]}_{\varepsilon} \\ \varepsilon^* & \epsilon_b \end{pmatrix}$$

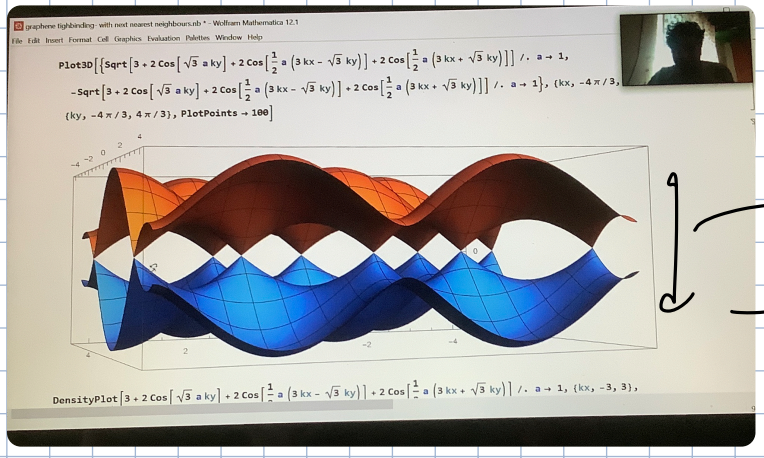


p-vector = $(0, -a)$, $\left(\frac{\sqrt{3}a}{2}, \frac{a}{2}\right)$

$$\mathcal{E} = \pm t \sqrt{\left| 1 + e^{-i\vec{k}\left[-\frac{\sqrt{3}a}{2}, \frac{a}{2}\right]} + e^{-i\vec{k}\left(\frac{\sqrt{3}a}{2}, \frac{a}{2}\right)} \right|^2}$$

touch at 6 places

Claim:- even after adding qmmb, the effective ft doesn't change a lot.



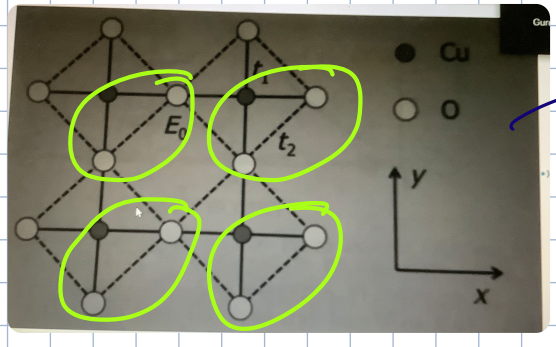
1.5 - 2eV

for $V_a = V_b = 0$

for $V_a = V_b \neq 0$, then there's a Gap.

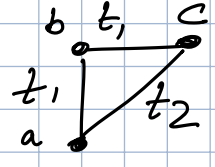
↳ Chiral symmetry / inversion symmetry Breaking

Example 3 :-



→ cuprates of hTSC.

→ 3x3 Basis



$$H = \begin{pmatrix} & a & b & c \\ a & 0 & t_1(1+e^{i2k_y a_y}) & t_2 + t_2 e^{-ik[-a} \\ b & t_1(1+e^{-i2k_y}) & 0 & \\ c & & 0 & \end{pmatrix}$$