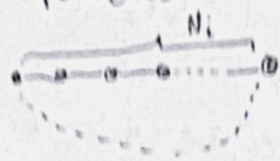* Born - Von Karman condition & number of electrons per unit cell

Born - Von karman

the boundary condition is the condition that implies the wave function was eigenstates of $\mathcal{H}$ are periodic

$$\psi(\vec{n} + N_i \vec{a}_i) = \psi(\vec{n}) \quad (*)$$

↑ primitive vector $\vec{a}_i$

$N_1 N_2 N_3 = N$

↓ number of primitive cells in the crystal

the largest potential that's we can go from vector $\vec{a}_i$

$(*) \Leftrightarrow \quad e^{i \vec{K} N_i \vec{a}_i} = 1 \quad \Leftrightarrow \quad \vec{K} = \sum \frac{n_i}{N_i} \vec{b}_i$

$\Leftrightarrow$ The smallest volume that contains one point K is

$$\Delta K = \frac{1}{N_1 N_2 N_3} \quad b_1 \cdot (b_2 \times b_3)$$

$$= \frac{V_{BZ}}{N}$$

V_{BZ} : Volume of the Brillouin zone

→ In the Brillouin zone, number of K points that's we can have

$$\boxed{\frac{V_{BZ}}{\Delta K} = N} \checkmark$$

° In the class, we mentioned about number of valence electrons. what the teachers means is number of valence electrons per unit cell

In total, number of valence electrons that's we have is

$$\boxed{n_e \cdot N_{unit-cell}} - = N$$

- Inside the Brillouin zone, we have all of K-pairs in our K space, because the points that's outside this volume have the correspondence inside this region.

so that,

- We For each band to full fill, we just need 1 valence electron.

- In the class, Lilia showed the Fermi level below, we have 3 band, so that if we have more than 6 valence electrons

fill   band that's

we will go the higher than the Fermi level s