Day - 3

→ Symmetry of a lattice : Crystal system

↓

Operator

Rotation   Inversion

↓

Roto-inversion

☆ Pentagon has 5- fold symmetry but for a lattice it does not exist (2 such needed)

→ Symmetry operators (in n-D) are $n \times n$ matrices $(n = 2, 3)$

→ Rotation operator :

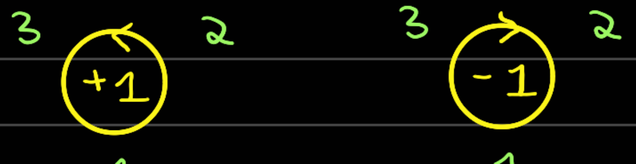
$$D_{ij} = \delta_{ij} \cos\theta - \varepsilon_{ijk} n_k \sin\theta + (1-\cos\theta) n_i n_j$$

[δ_{ij} → Kronecker Delta

↳ $= 0, \quad i \neq j$

$ 1, \quad i = j$]

ε_{ijk} → Permutation operator



$[n_i \rightarrow v_{ij}$ refer day 2]

→ Problems:

1.) 6-fold : $\theta = \frac{2\pi}{6} = \frac{\pi}{3}$

$$D_{11} = \delta_{11}\cos\theta + (\underset{0}{\underline{\varepsilon_{111}}}\,\underset{0}{\underline{n_1}} + \underset{0}{\underline{\varepsilon_{112}}}\,\underset{0}{\underline{n_2}} + \underset{0}{\underline{\varepsilon_{113}}}\,\underset{1}{\underline{n_3}})\sin\theta$$
$$+ (1-\cos\theta)\, n_1^2$$

$$= \frac{1}{2}$$

$$D = \begin{bmatrix} 1/2 & -\frac{\sqrt{3}}{2} & 0 \\ \sqrt{3}/2 & 1/2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

2.) 5-fold rotation axis is inconsistent with the definition of a lattice.

→ Bravais lattices:

2D lattices or nets

↓

General consideration which can be extended to 3D

↓

14 Bravais Lattices

→ Unit cell : That construct which will reprod-

-uce the lattice upon the action of symmetry elements.

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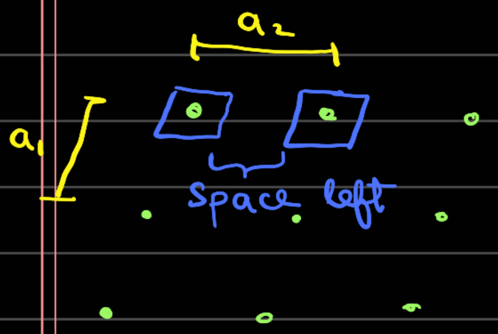
We could have chosen just one atom as unit cell, but it leaves space on translation.



→ 2D Bravais Nets:

mP → monoclinic Primitive

oP → orthic "

hP → hexagonal "

tP → tetragonal "

→ oC – orthic centred