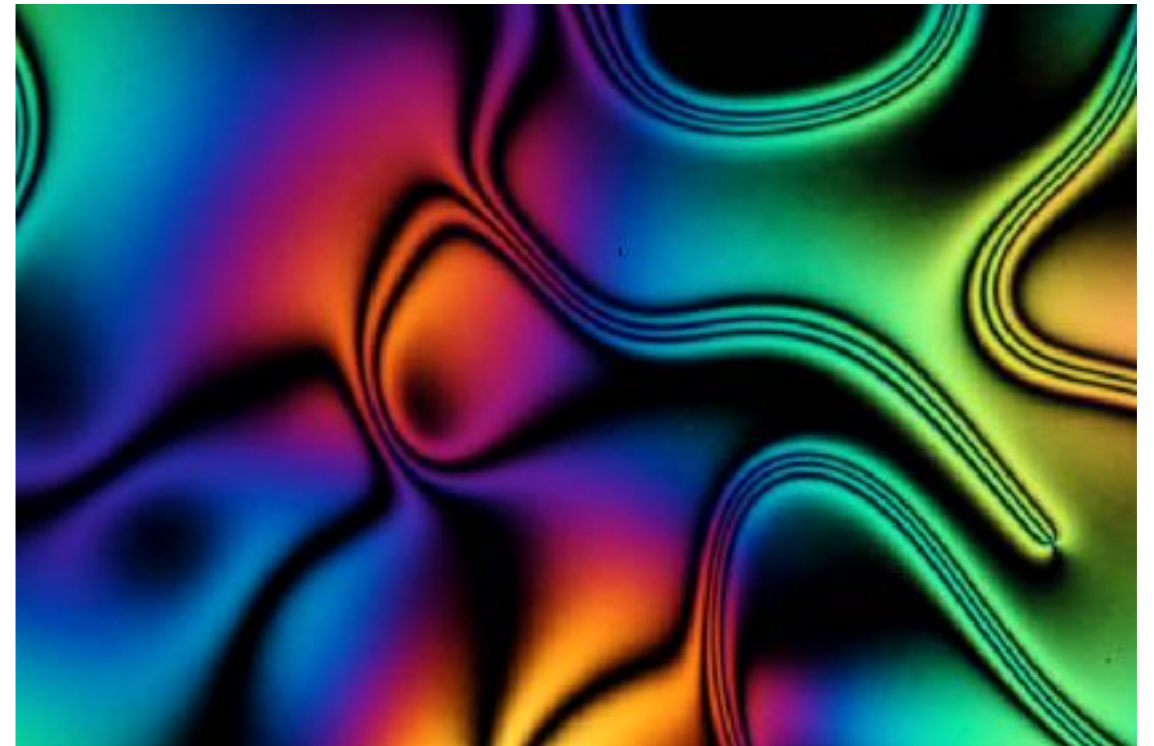
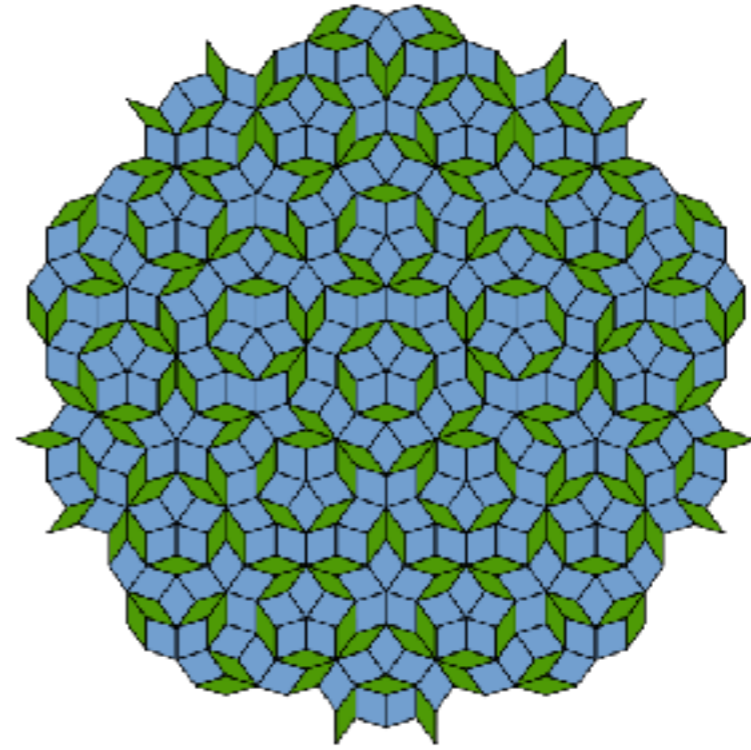


# Estructura cristalina

Curso de Física Atómica y Materia Condensada  
26 de abril de 2018

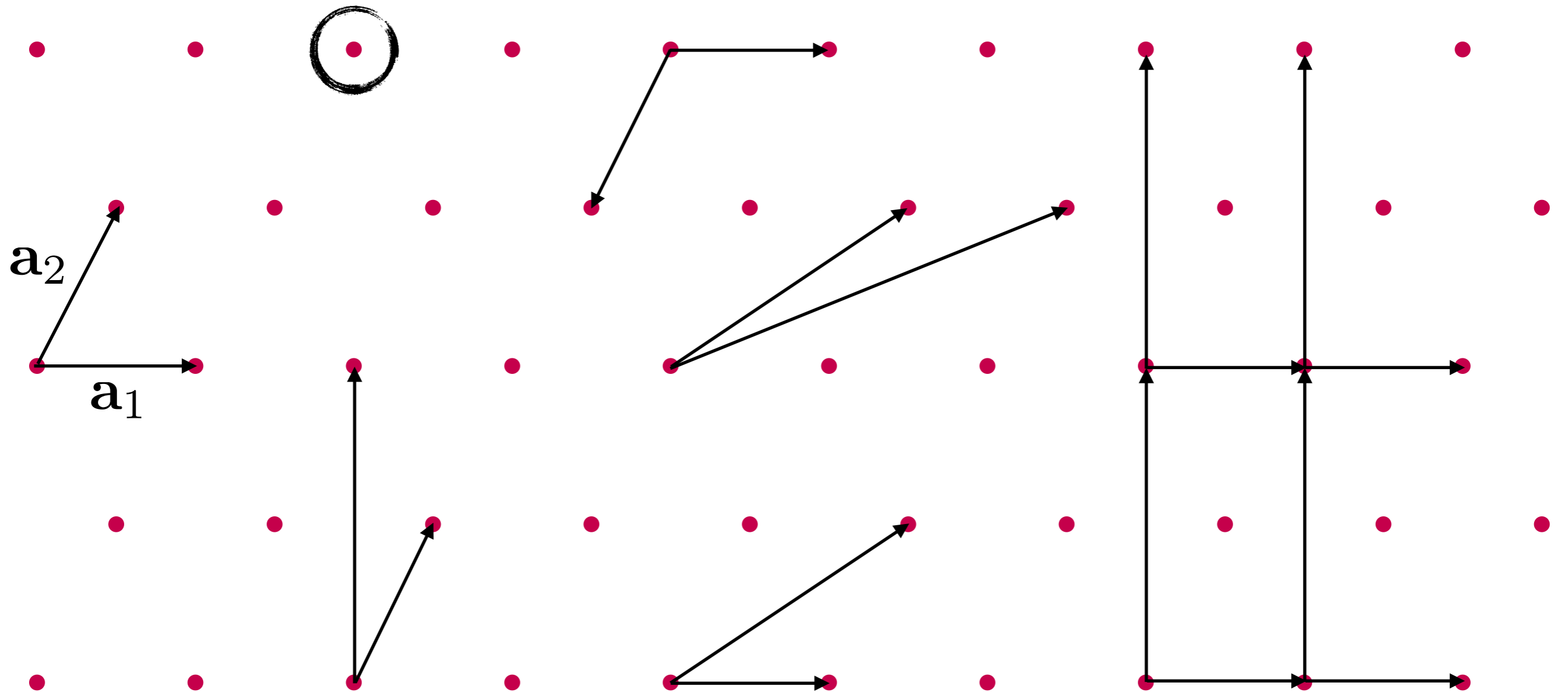


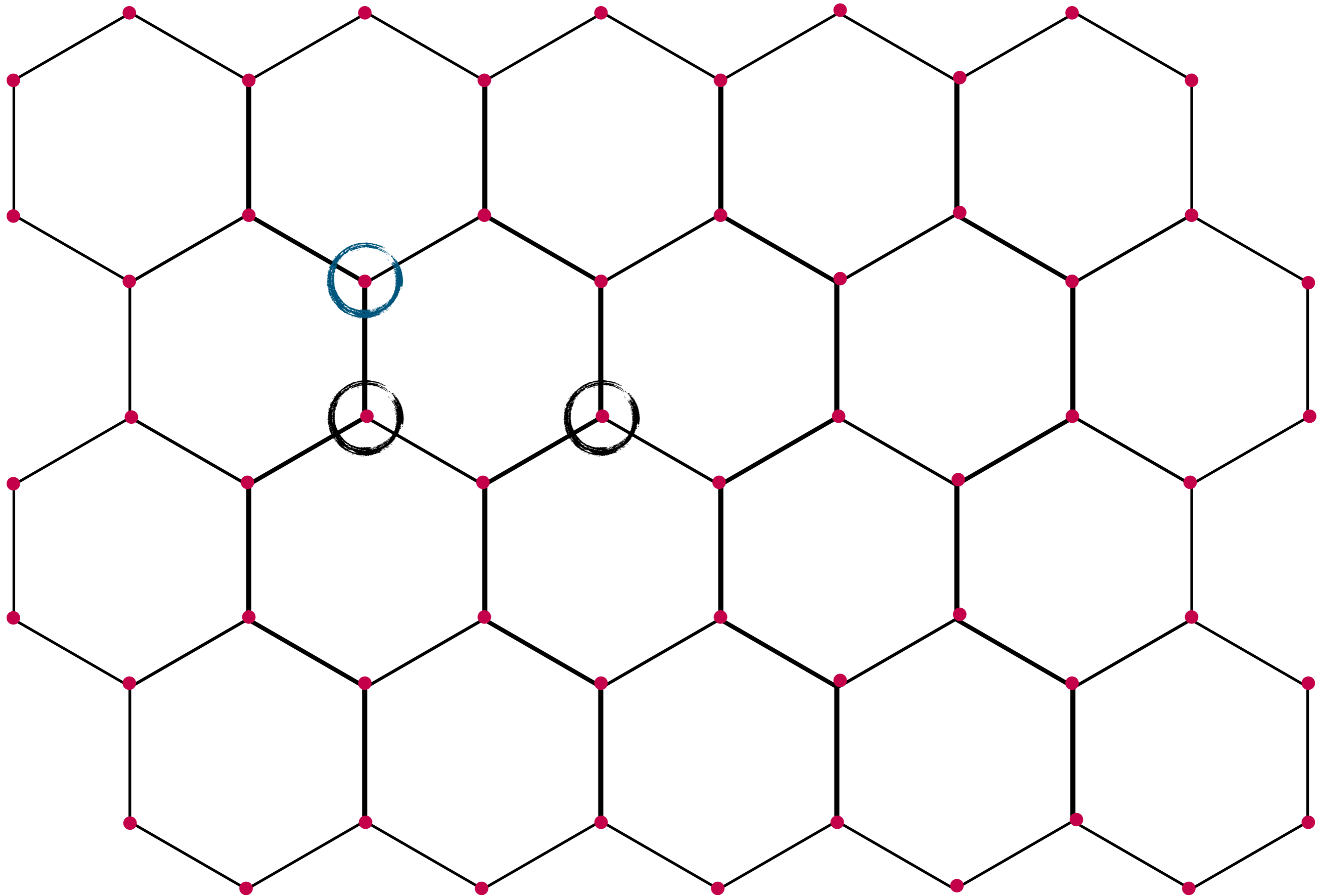
# Arreglo

1. Es un conjunto infinito de puntos definidos por la SUMA ENTERA de vectores primitivos linealmente independientes.
2. Es un conjunto infinito DISCRETO de vectores donde la suma de cualesquiera dos de ellos es también un vector del conjunto.
3. Es un conjunto infinito DISCRETO de puntos donde el entorno de cualesquiera de ellos es el mismo.

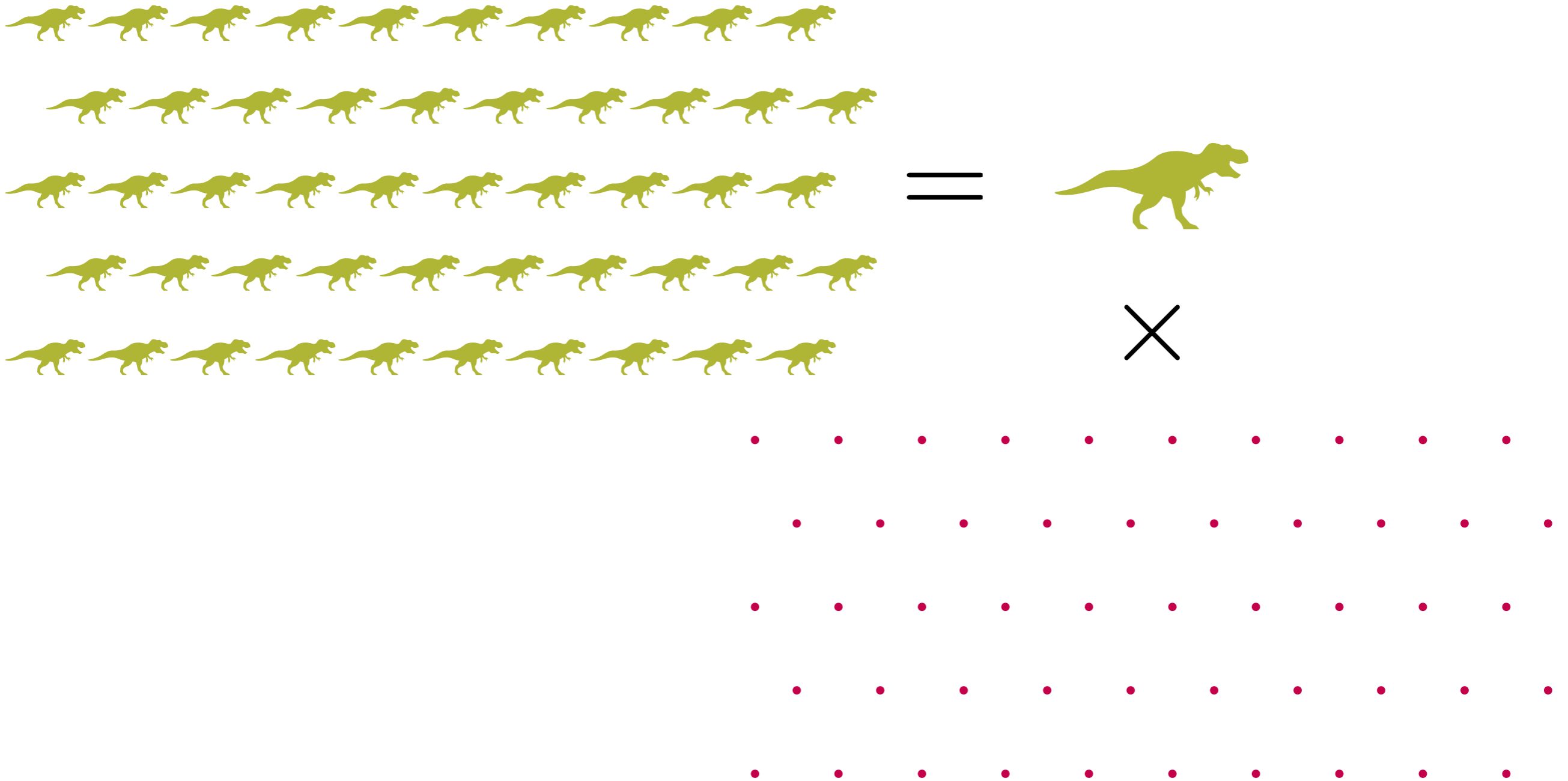
# Vector primitivo

$$\mathbf{R}_{[n_1, n_2, n_3]} = n_1 \mathbf{a}_1 + n_2 \mathbf{a}_2 + n_3 \mathbf{a}_3$$





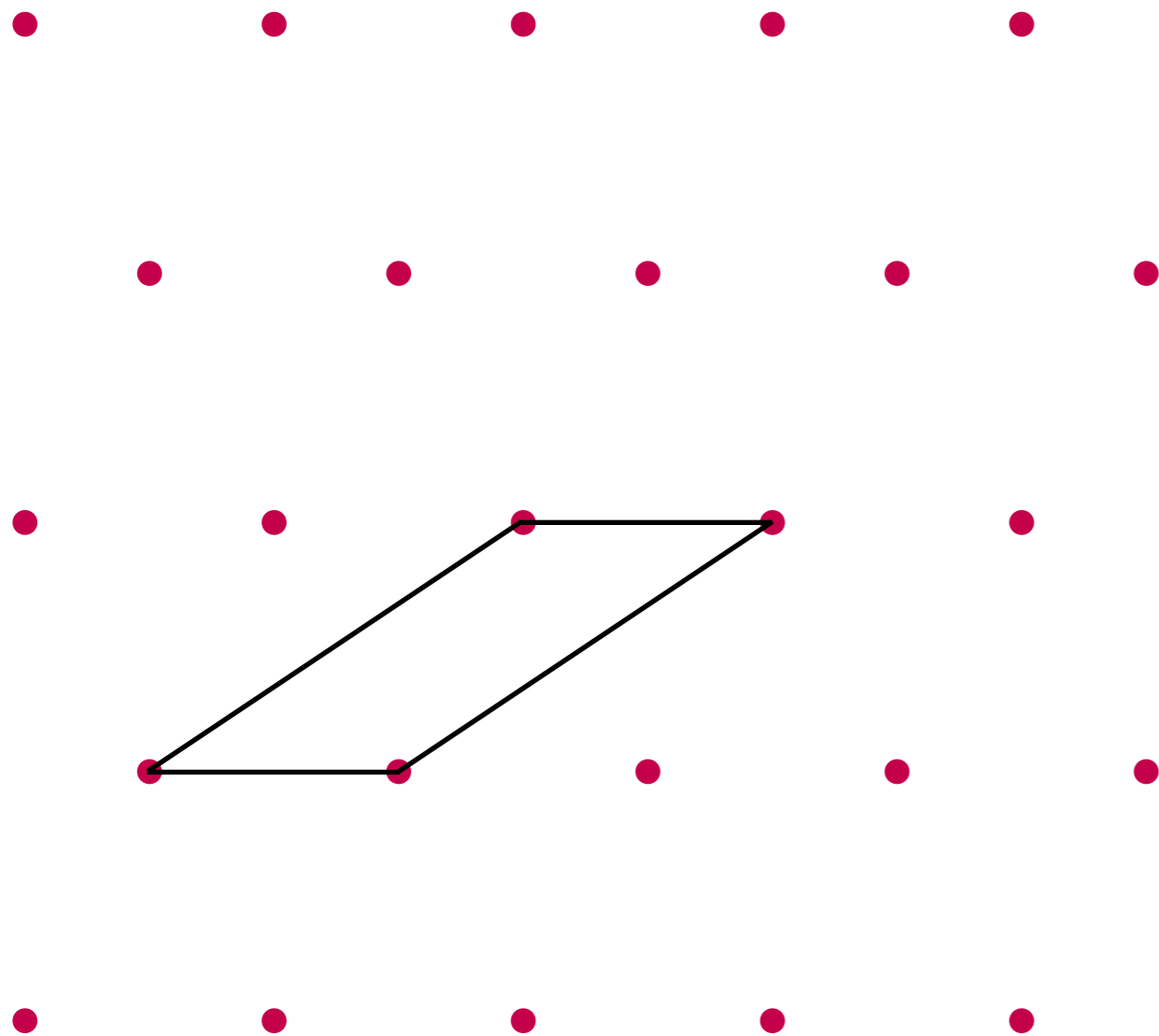
Cualquier estructura periódica puede ser representada como un arreglo de objetos (“adornos”) repetidos.



# Celda unitaria

1. Es una región del espacio tal que cuando muchas unidades idénticas son apiladas juntas cubren (llenan completamente) todo el espacio y reconstruyen la estructura periódica completa (cristal).
2. Es el azulejo (“adorno”) repetido que resulta ser el bloque que construye toda la estructura periódica.

# Celda primitiva

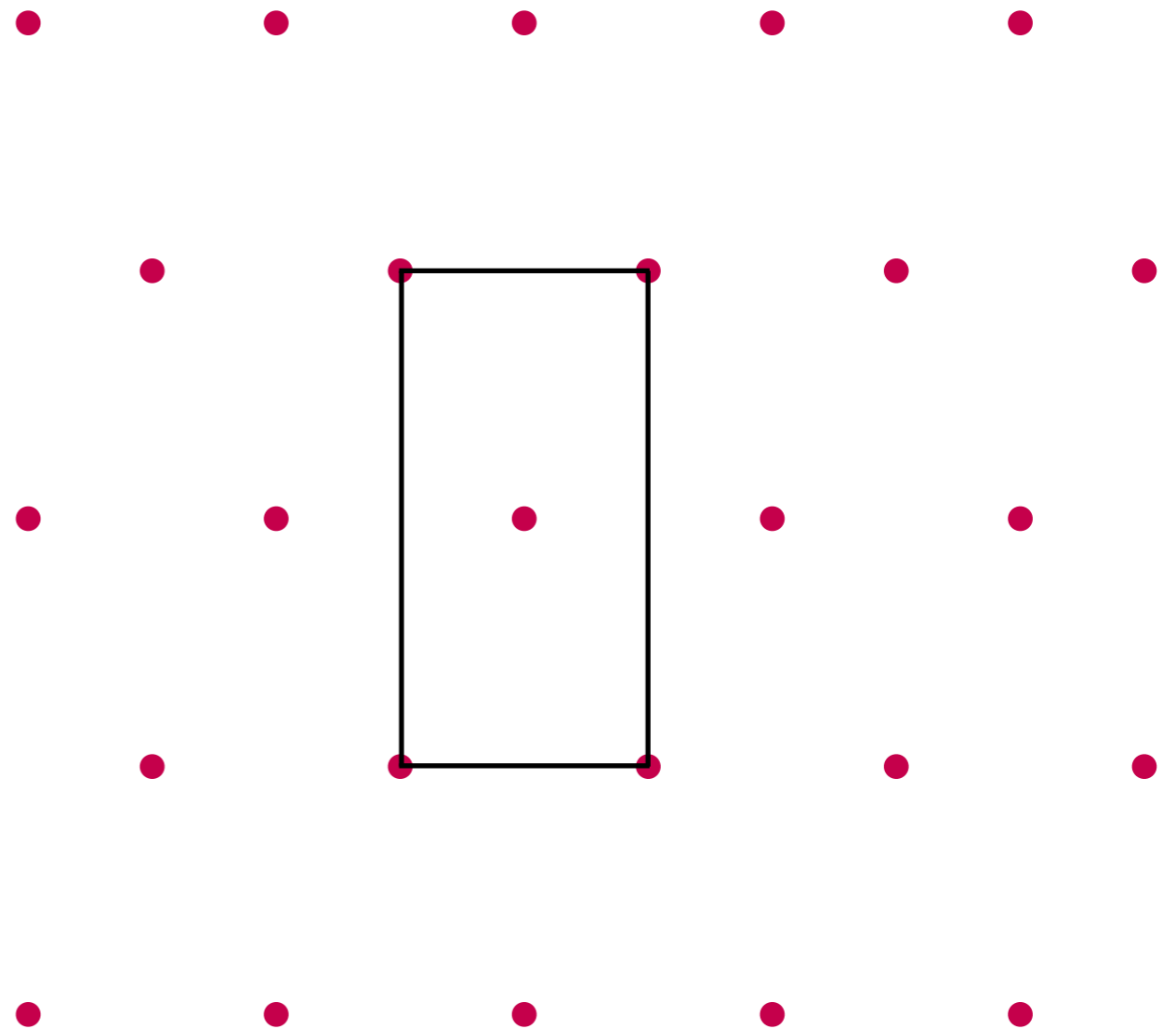


Para un cristal periódico es una celda unitaria que contiene exactamente un solo punto del arreglo.

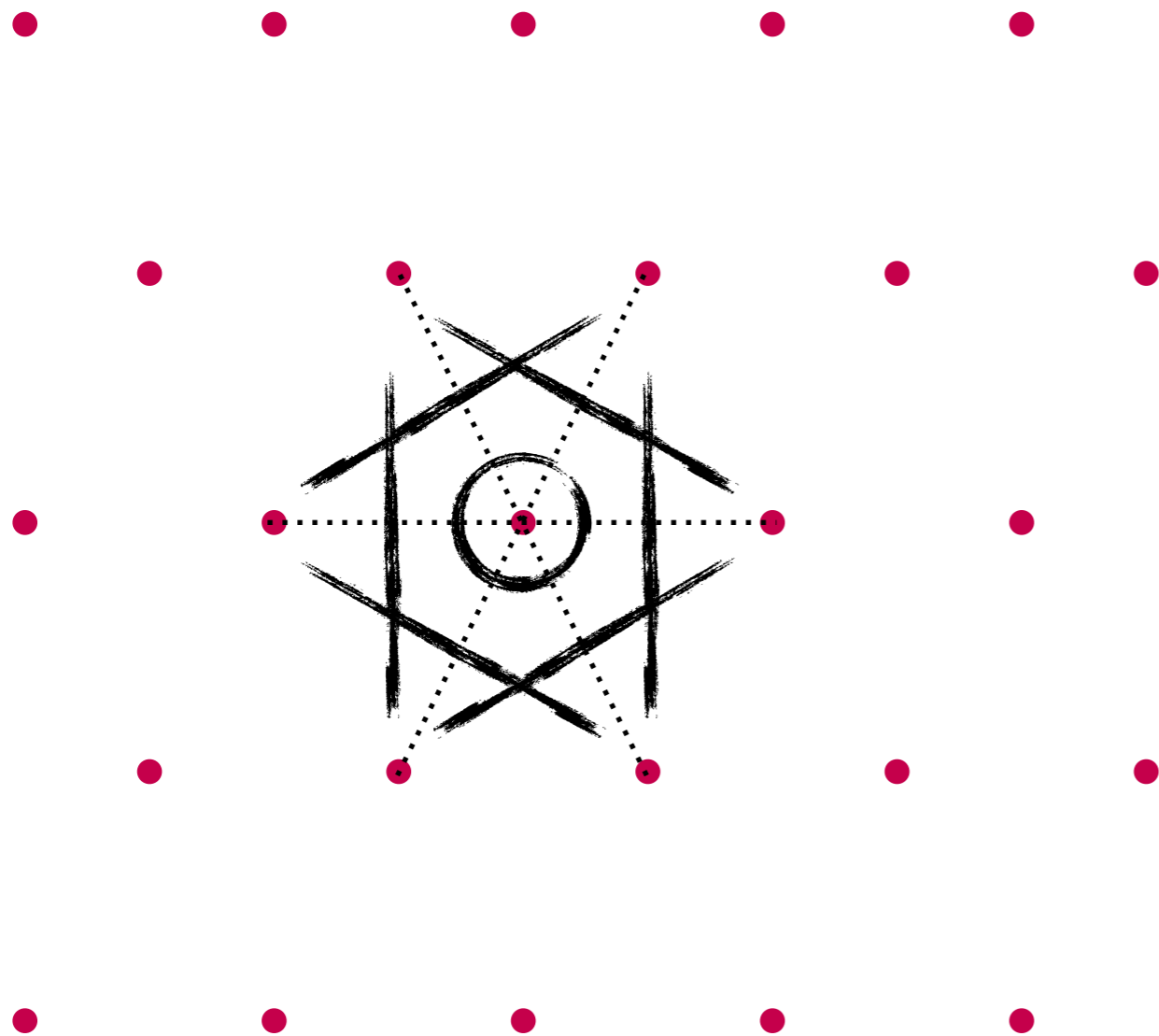


# Celda convencional

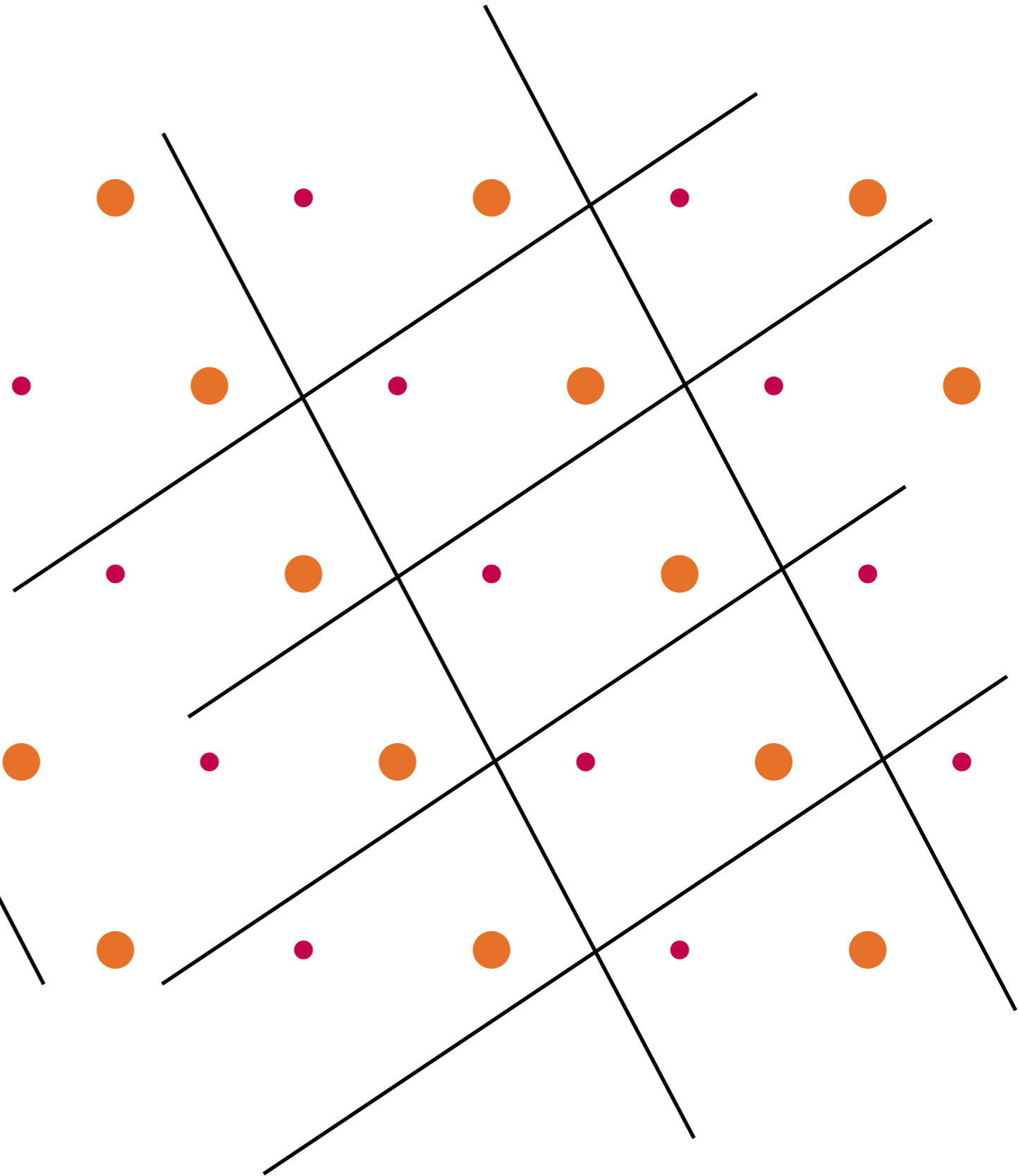
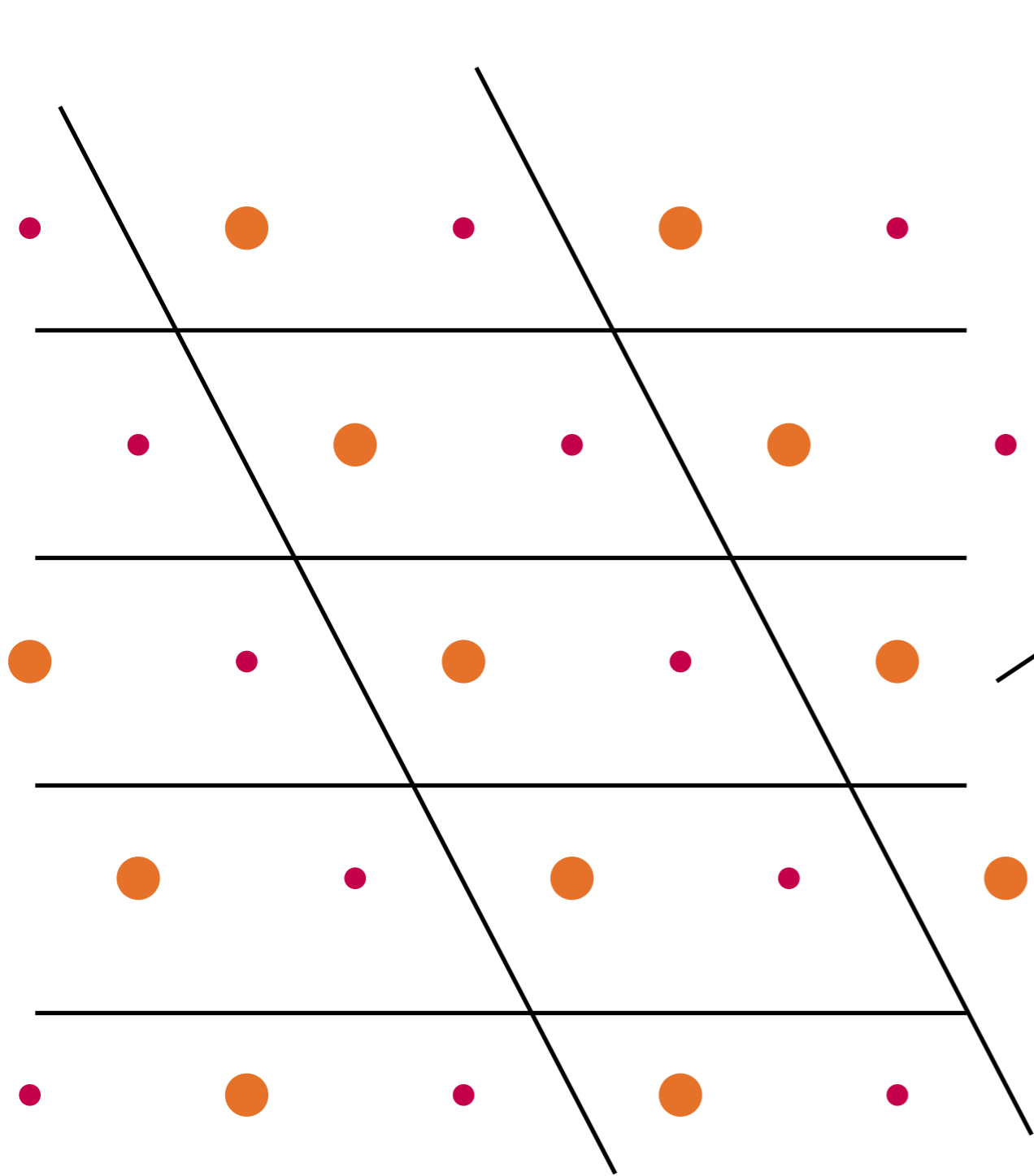
Es una celda que no es primitiva y que tiene ejes ortogonales.



# Celda Wigner-Seitz

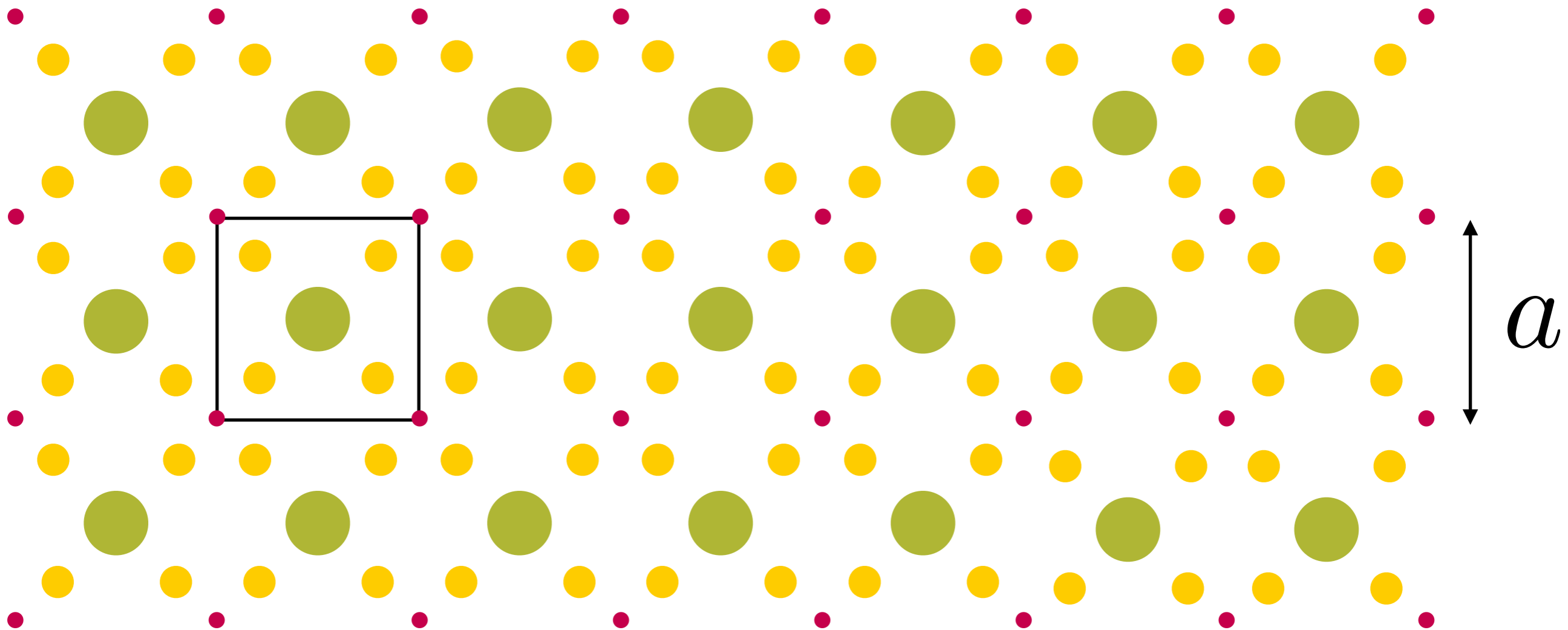


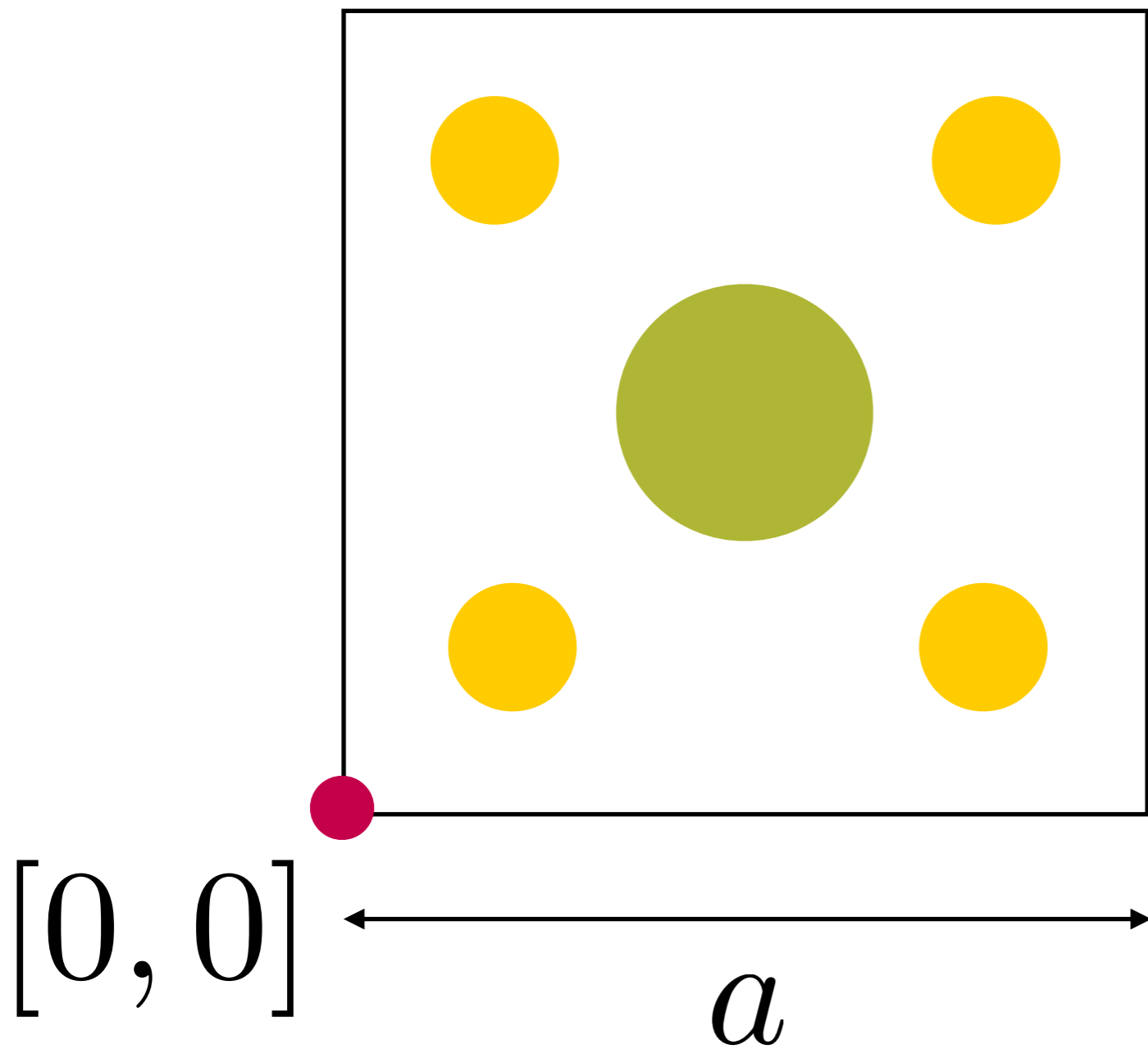
Dado un punto del arreglo, el conjunto de todos los puntos en el espacio que están más cerca del punto dado que cualquier otro constituyen la celda Wigner-Seitz del punto dado.



# Base

Es la descripción de objetos en la celda unitaria con respecto a un punto de referencia del arreglo en la celda unitaria.





● Átomo verde

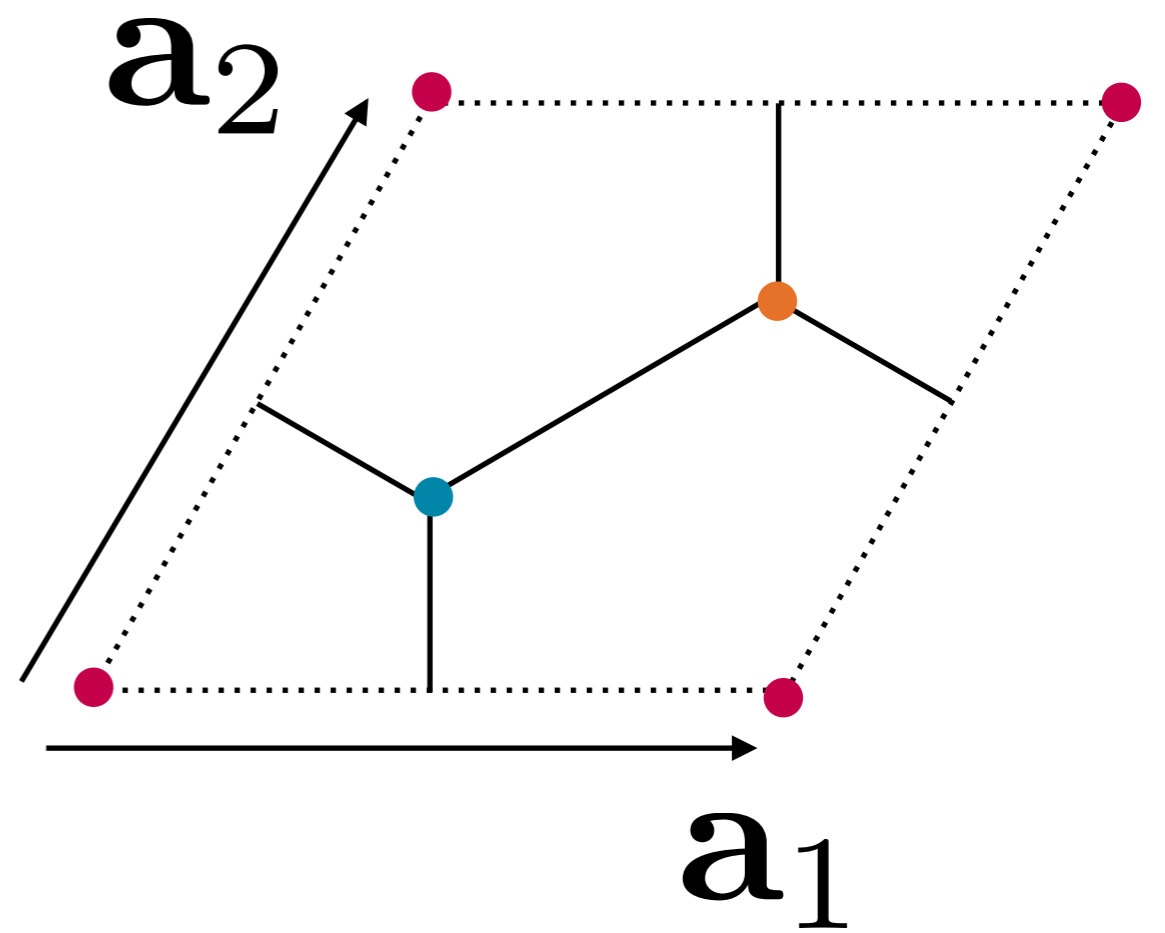
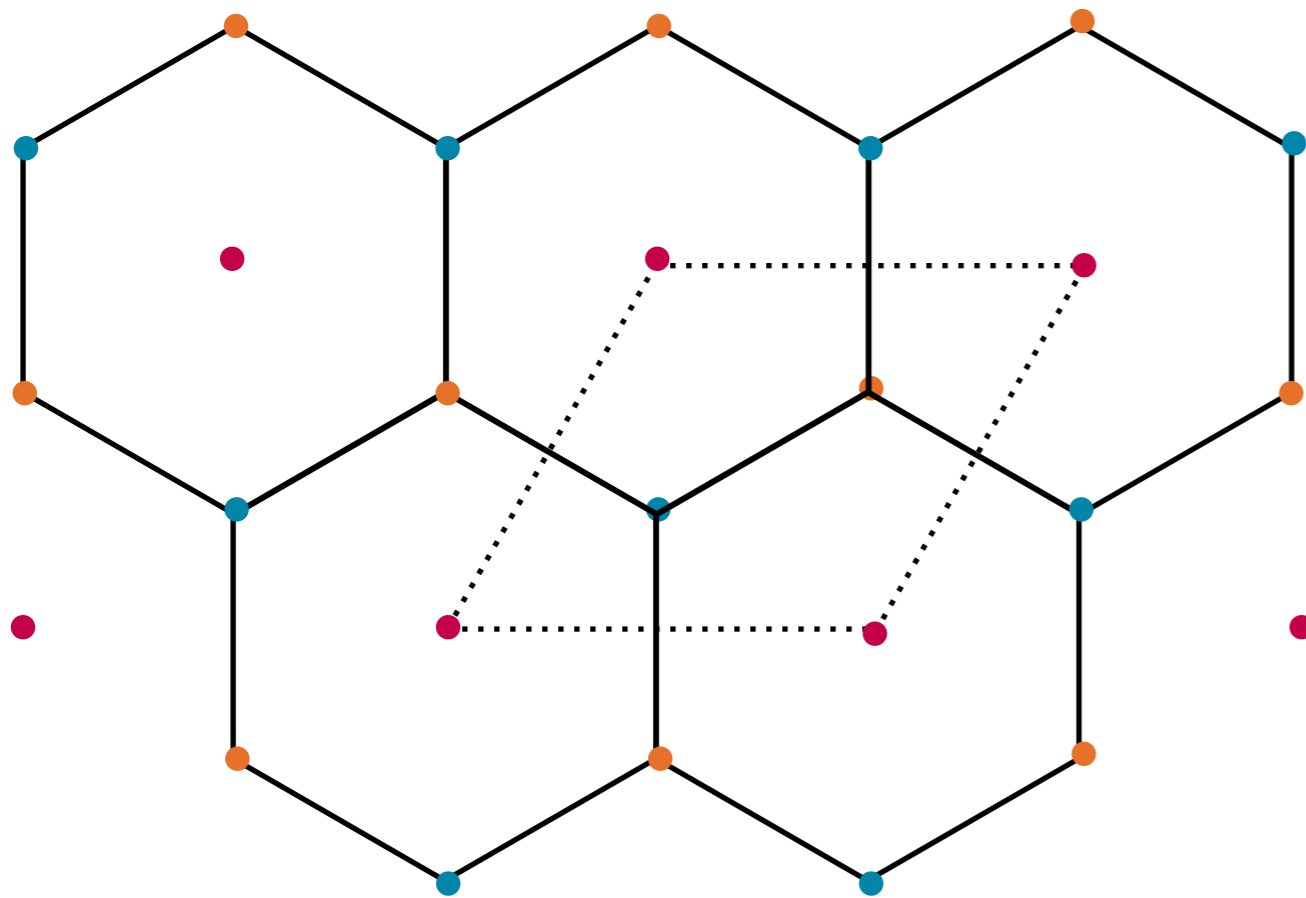
$$\left[ \frac{a}{2}, \frac{a}{2} \right]$$

● Átomos amarillos

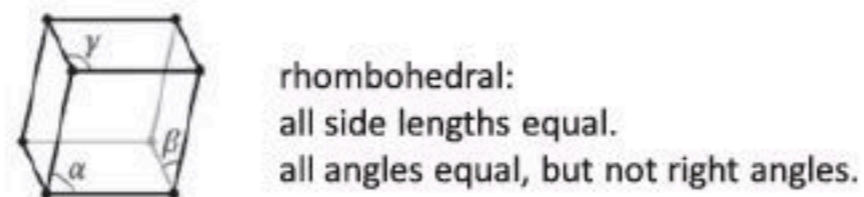
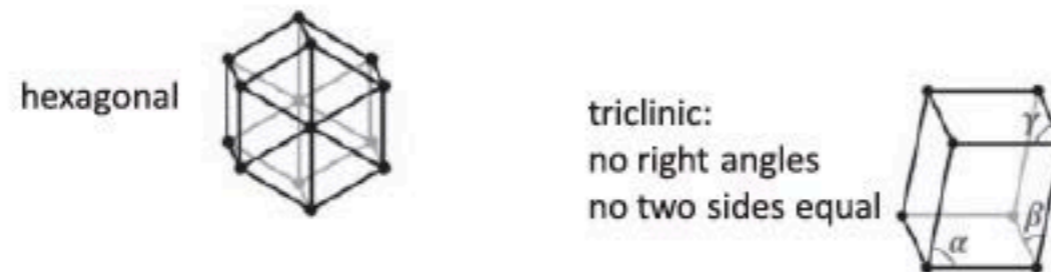
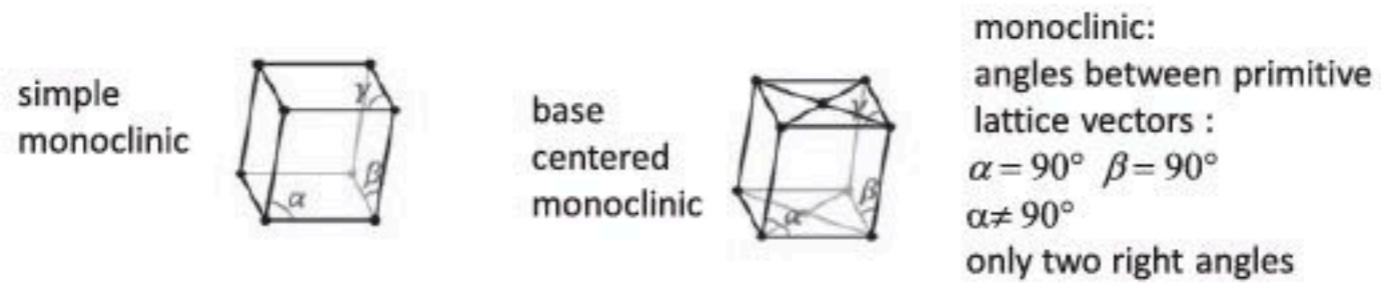
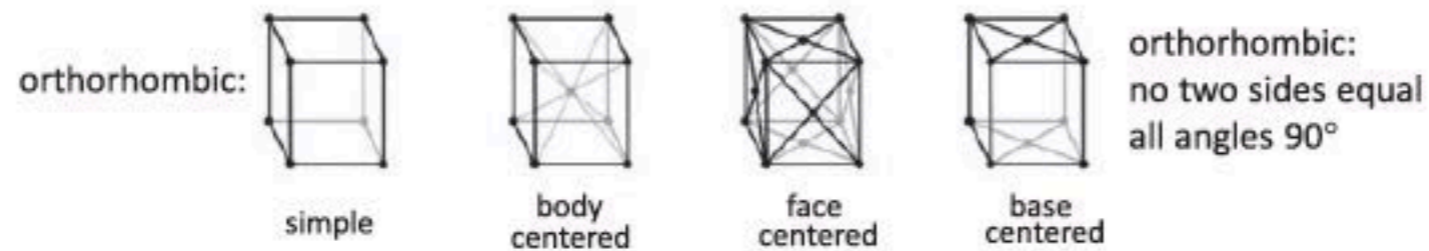
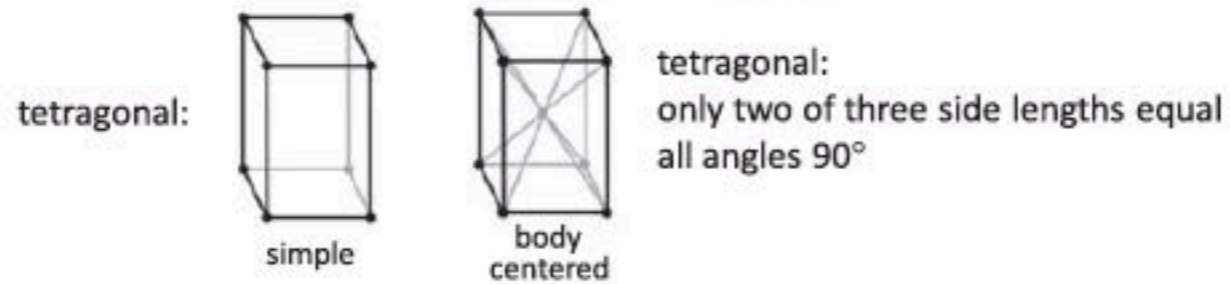
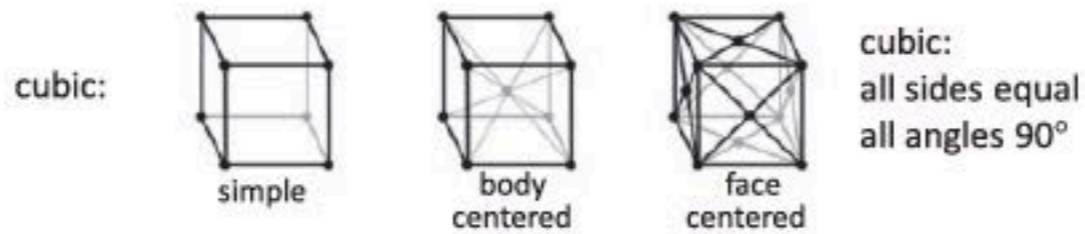
$$\left[ \frac{a}{4}, \frac{3a}{4} \right] \left[ \frac{3a}{4}, \frac{3a}{4} \right]$$

$$\left[ \frac{a}{4}, \frac{a}{4} \right] \left[ \frac{3a}{4}, \frac{a}{4} \right]$$

# E1 panel



# Las 14 redes de Bravais

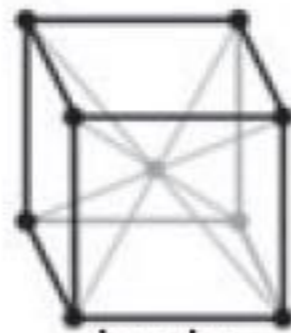




# Arreglos cúbicos



simple



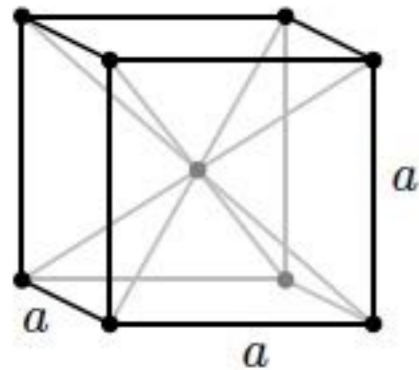
body  
centered



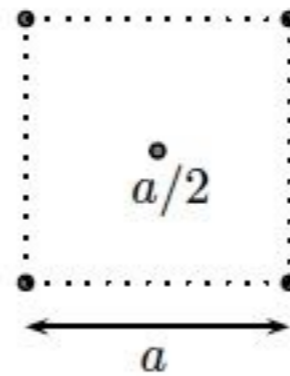
face  
centered

cubic:  
all sides equal  
all angles  $90^\circ$

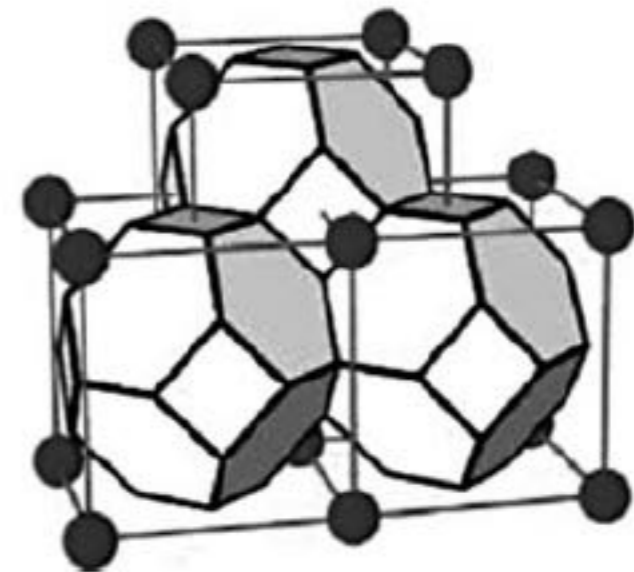
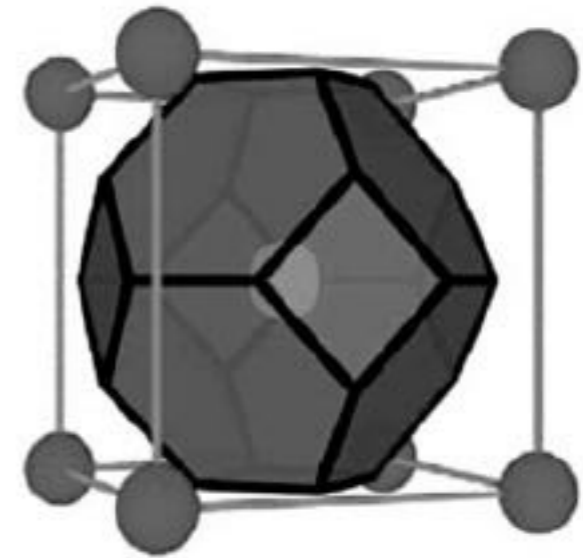
# Cúbico centrado en el cuerpo (BCC)



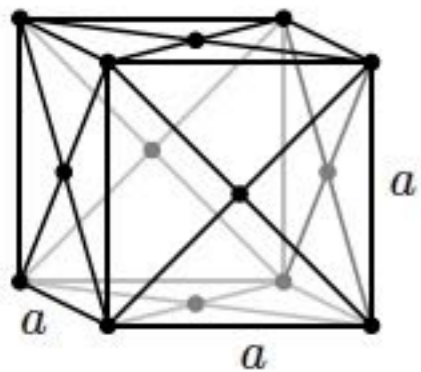
Body-centered cubic  
unit cell



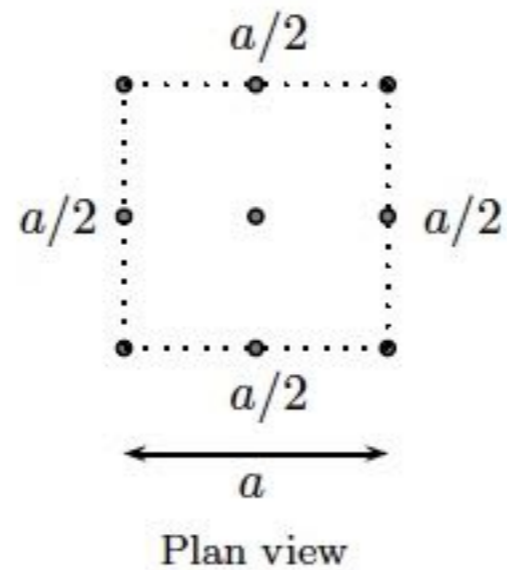
Plan view



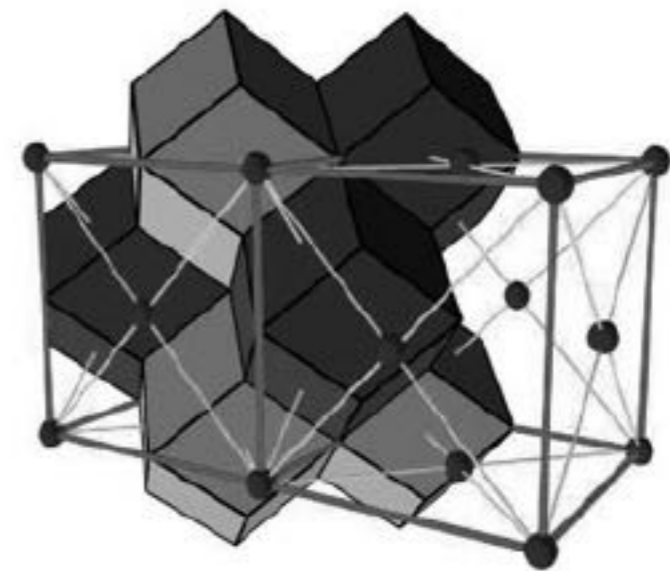
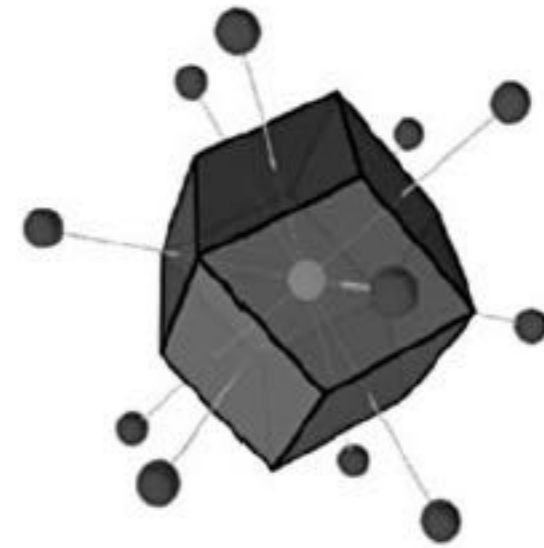
# Cúbico centrado en la cara (FCC)



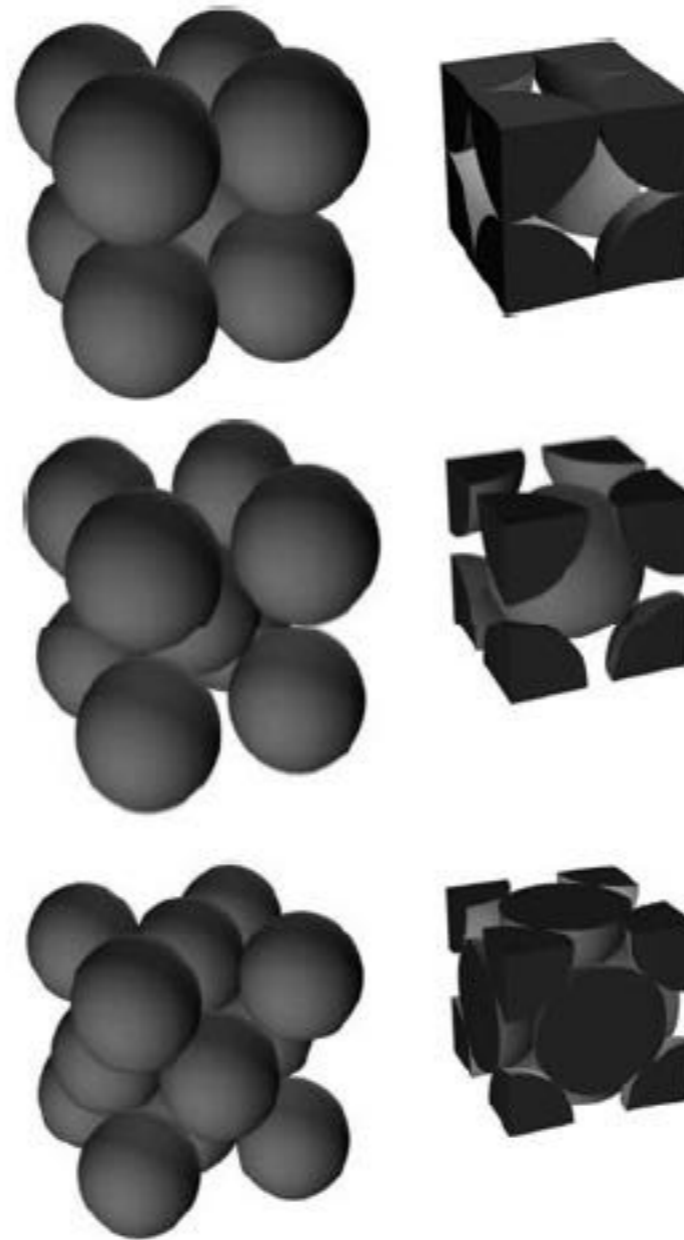
Face-centered cubic  
unit cell



Plan view




# Empaquetamiento de átomos

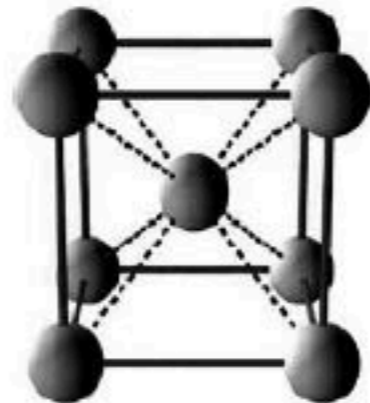


Cristales reales

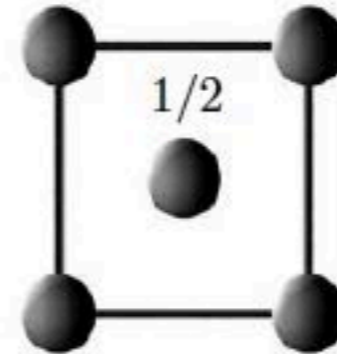
Sodium (Na)

Lattice = Cubic-I (bcc)

Basis = Na at [000] 




Plan view  
unlabeled points at  $z = 0, 1$




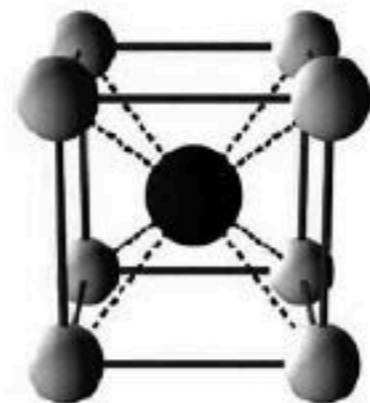
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Caesium chloride (CsCl)

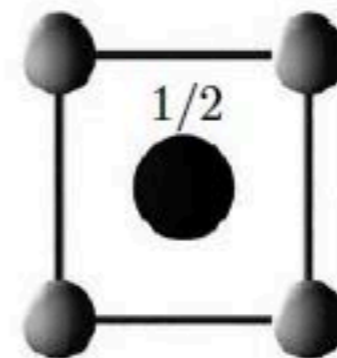
Lattice = Cubic-P

Basis = Cs at [000] 

and Cl at  $[\frac{1}{2} \frac{1}{2} \frac{1}{2}]$  




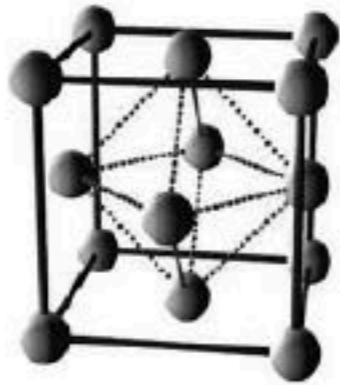
Plan view  
unlabeled points at  $z = 0, 1$



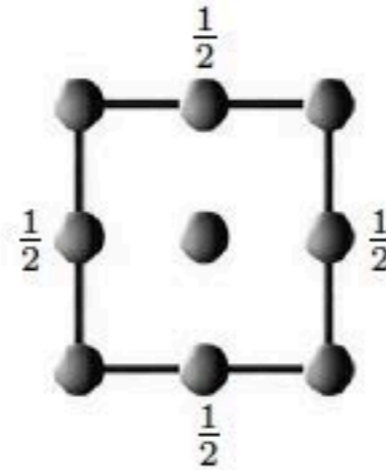
Copper(Cu)

Lattice = Cubic-F (fcc)

Basis = Cu at [000] 





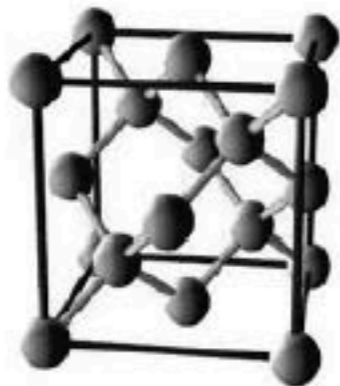
Plan view  
unlabeled points at  $z = 0, 1$



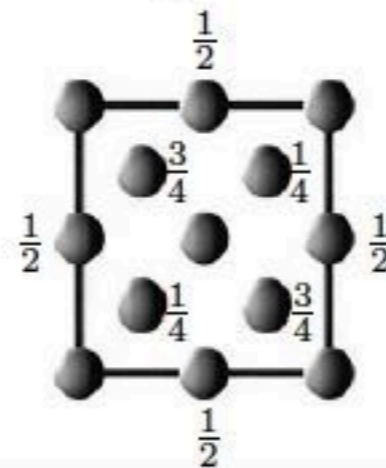
Diamond (C); also Si and Ge

Lattice = Cubic-F (fcc)

Basis = C at [000]   
and C at  $[\frac{1}{4} \frac{1}{4} \frac{1}{4}]$  





Plan view  
unlabeled points at  $z = 0, 1$

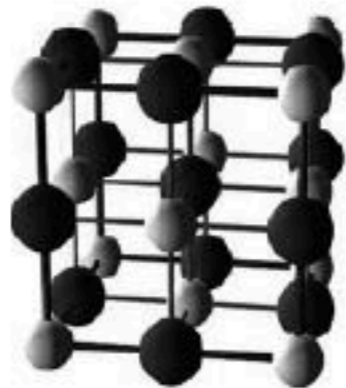


Sodium Chloride (NaCl)

Lattice = Cubic-F (fcc)

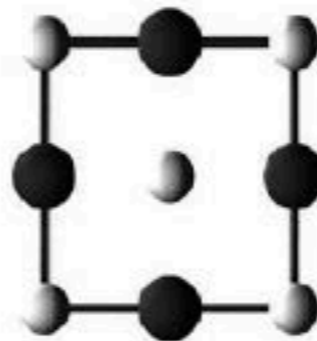
Basis = Na at  $[000]$  

and Cl at  $[\frac{1}{2} \frac{1}{2} \frac{1}{2}]$  



Plan view

$z = 0, 1$  layer



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

