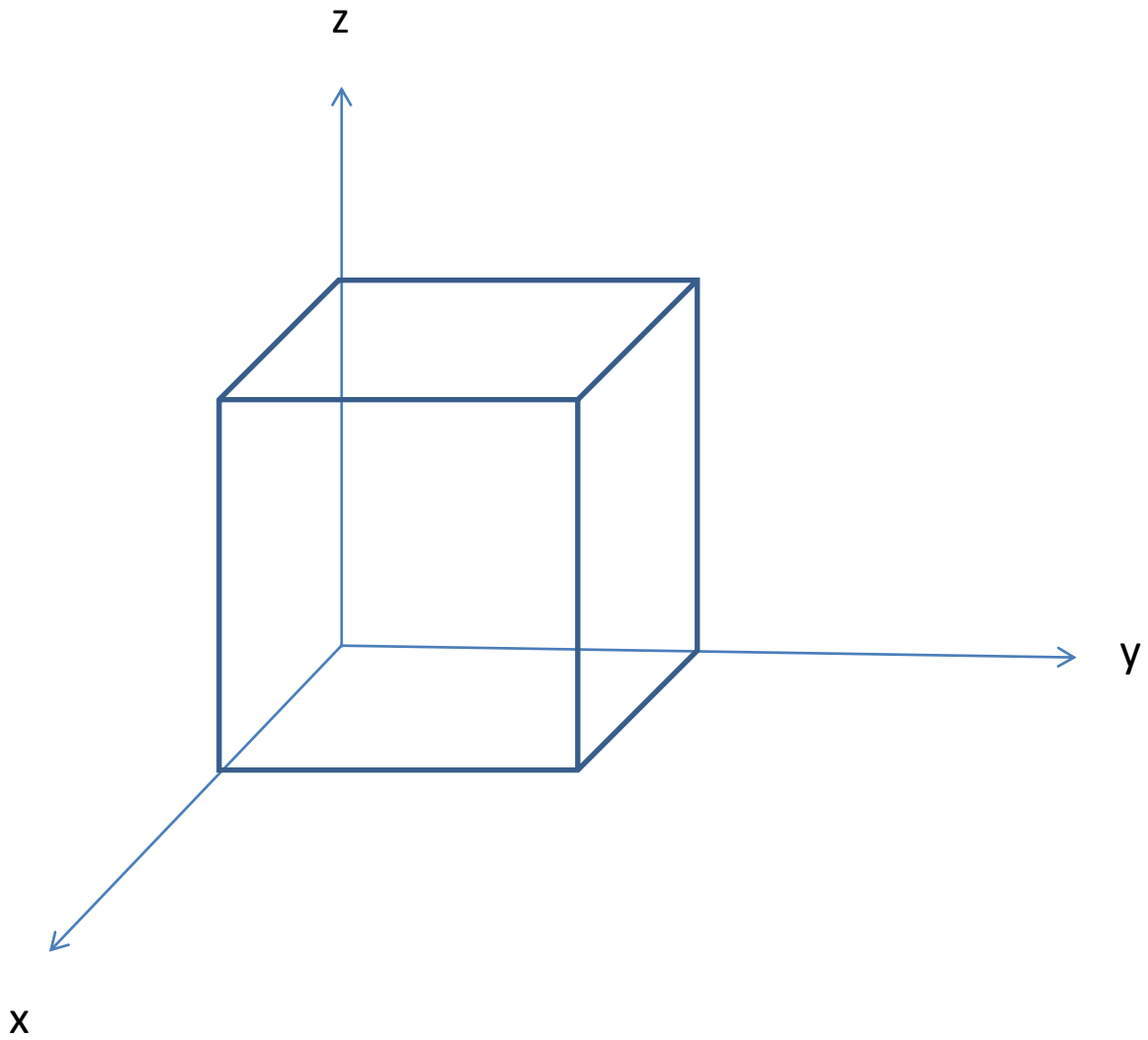
Crystal Structures in Practice

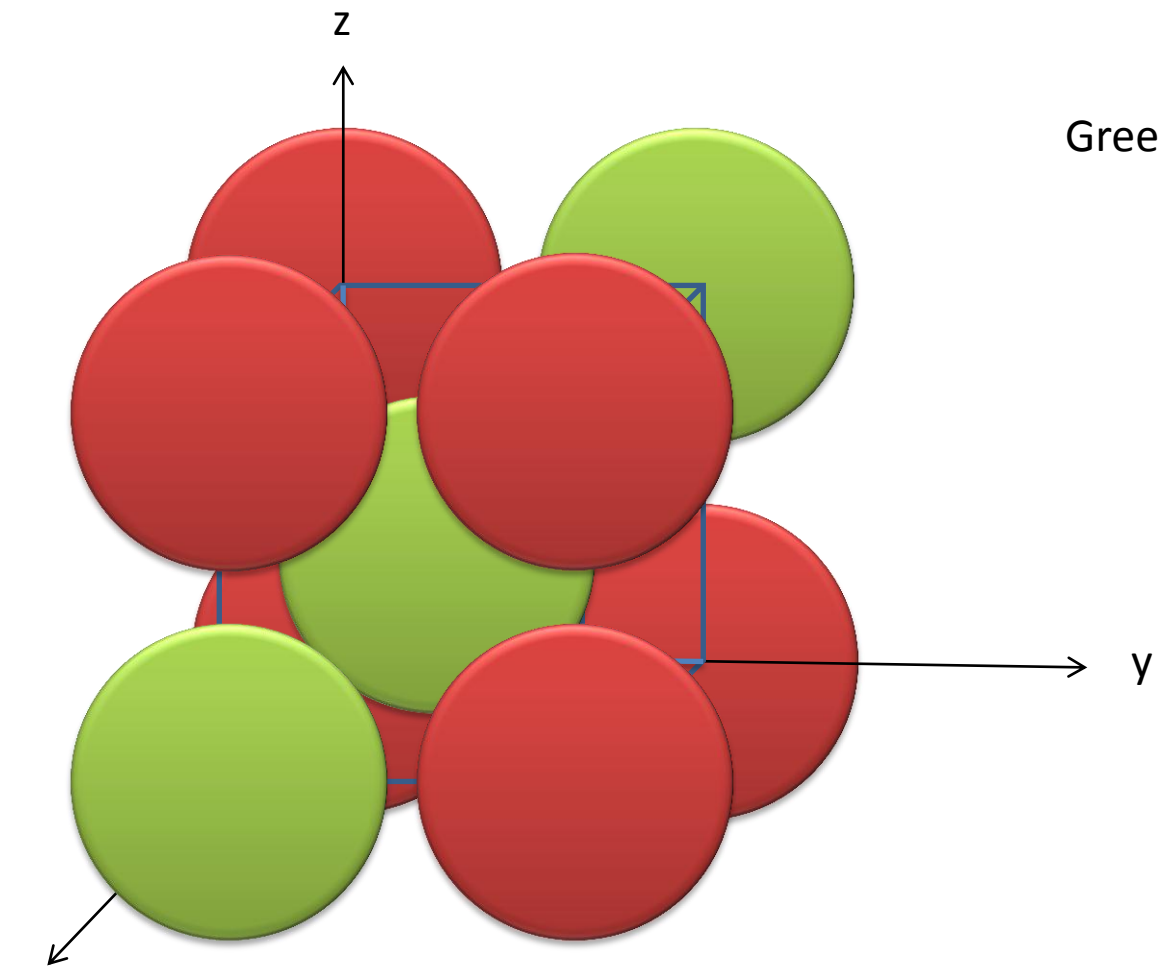
Linear Density and Planar Density



Example solutions for BCC

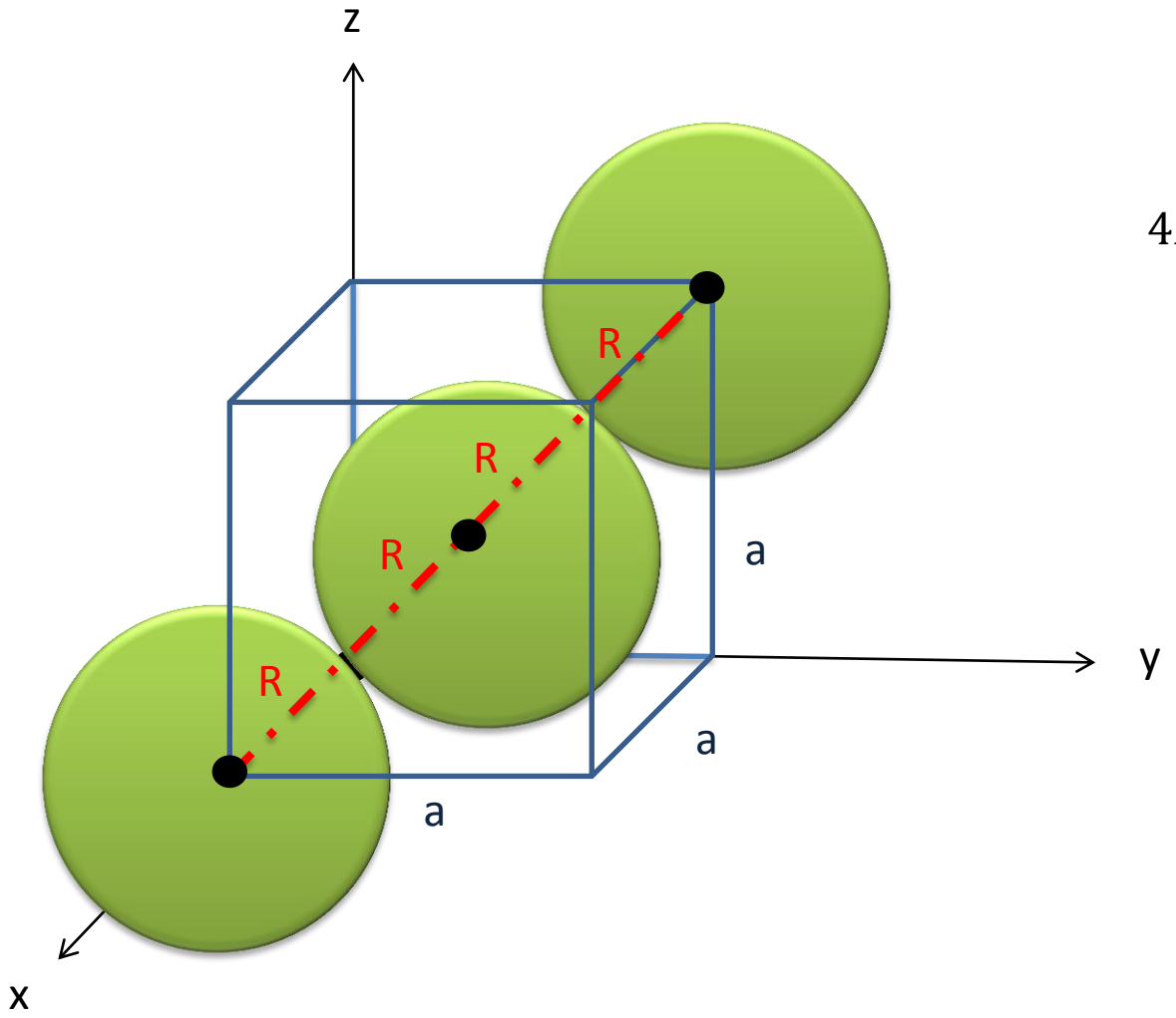
- Find Lattice Parameter
- Find Directions or Planes
- Calculate Linear or Planar Density

First, we should find the lattice parameter(a) in terms of atomic radius(R). Then, we can find linear density or planar density.



Green ones touches each other.

Body-centered Cubic Crystal Structure (BCC)



$$4R = \sqrt{a^2 + a^2 + a^2}$$

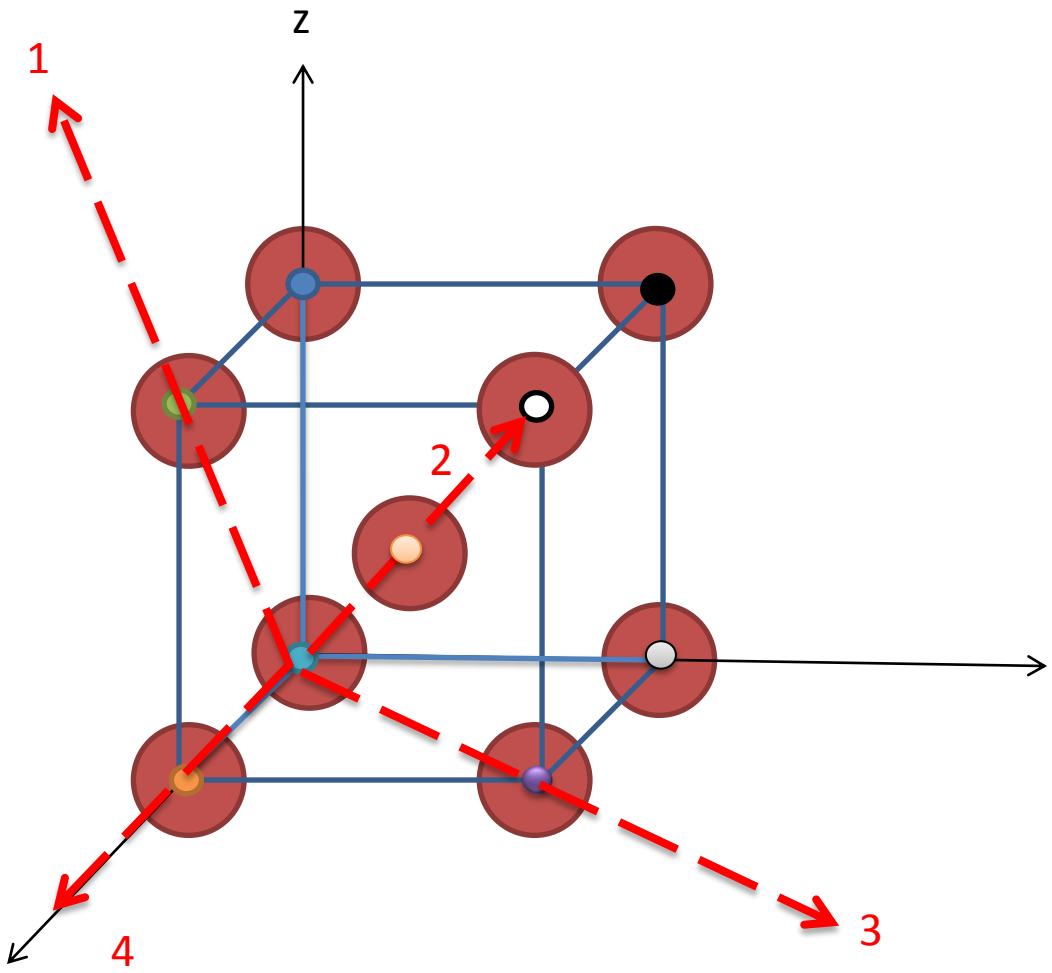
$$\rightarrow \; a = \frac{4R}{\sqrt{3}}$$

We found the lattice parameter in terms of atomic radius.

Linear Density

1. Draw the atoms on the direction, and use the formula;

$$LD = \frac{\#\ of\ atoms\ on\ the\ line}{the\ length\ of\ the\ line}$$



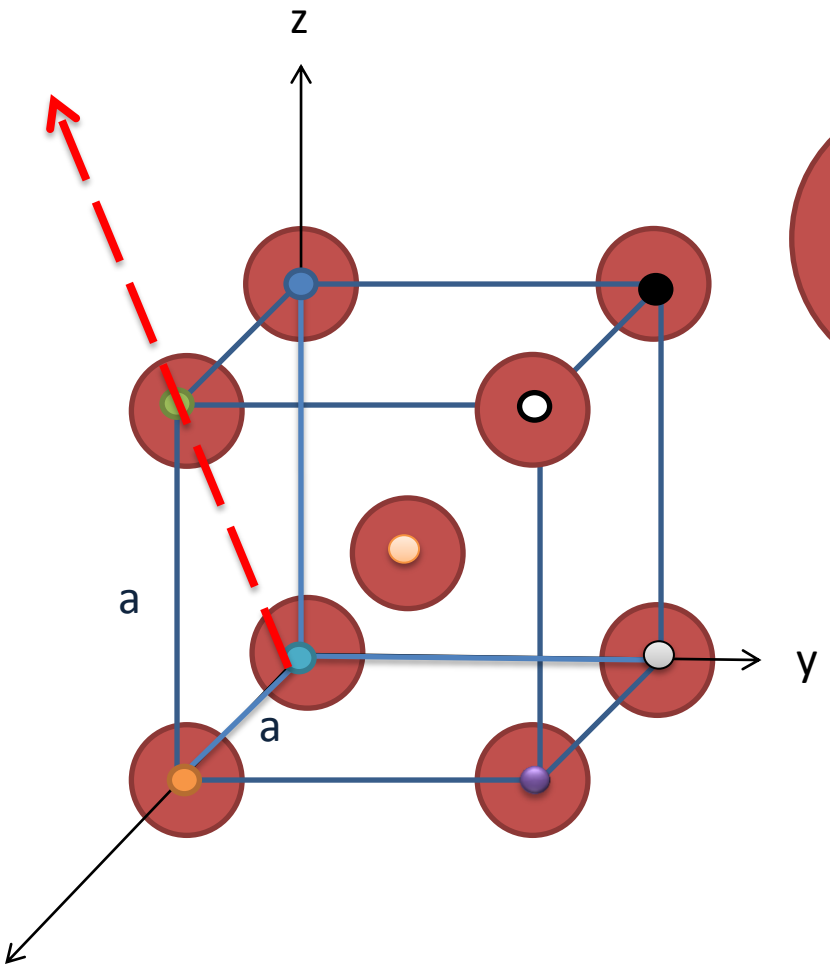
Body-centered Cubic Crystal Structure (BCC)

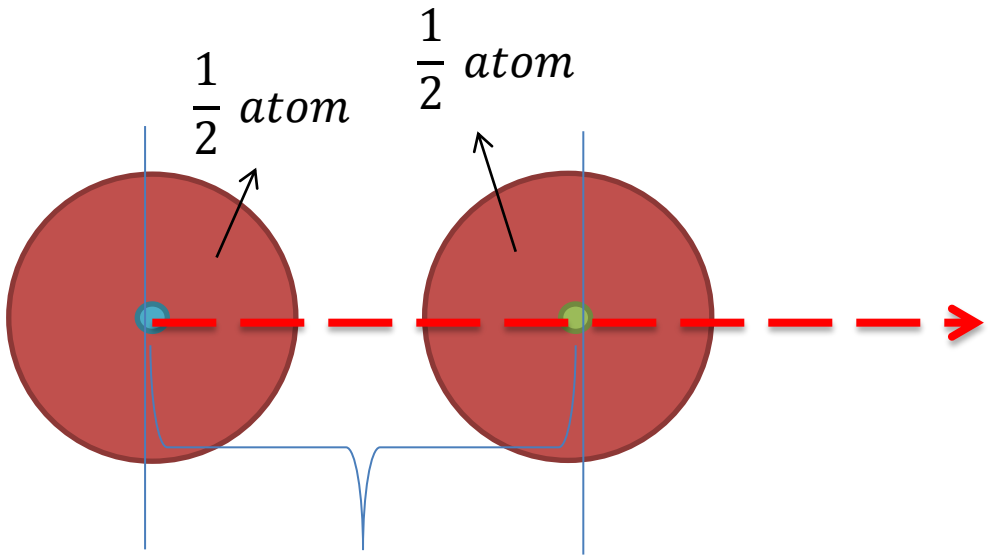
Directions
1 [1 0 1]
2 [1 1 1]
3 [1 1 0]
4 [1 0 0]

Let's apply the formula below for [101] and [111].

$$LD = \frac{\#\ of\ atoms\ on\ the\ line}{the\ length\ of\ the\ line}$$

[1 0 1] direction for BCC and Linear Density



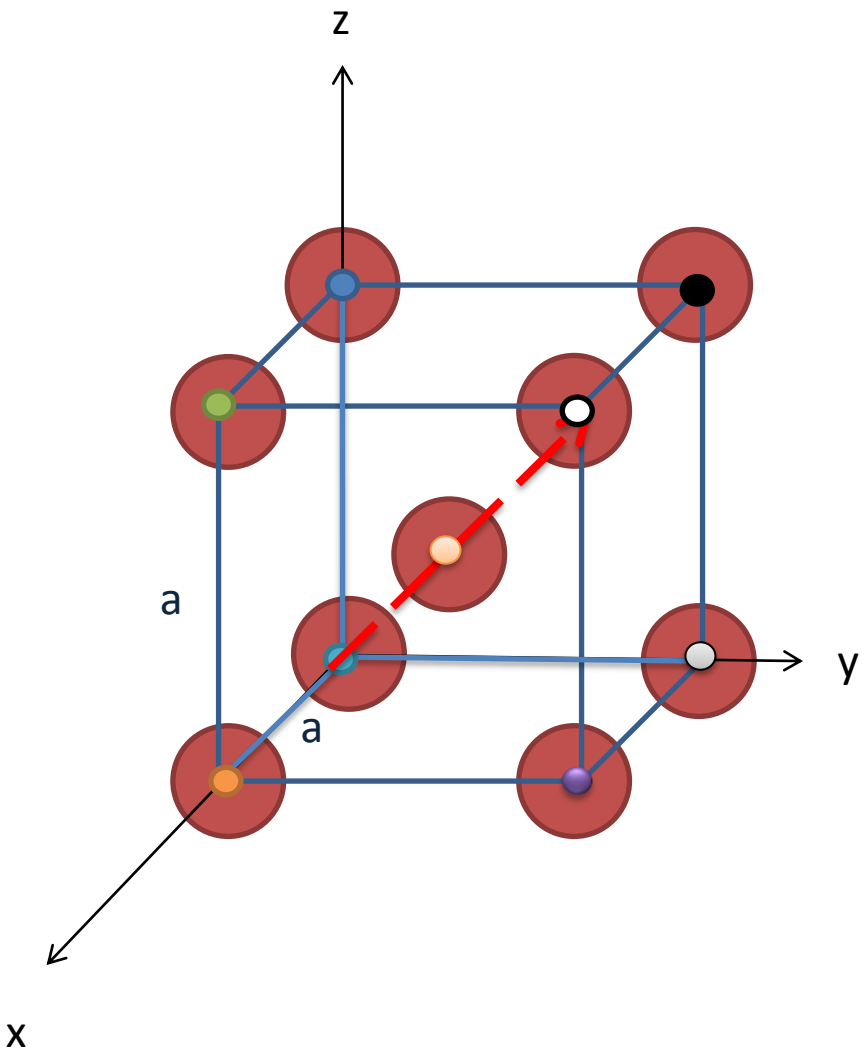


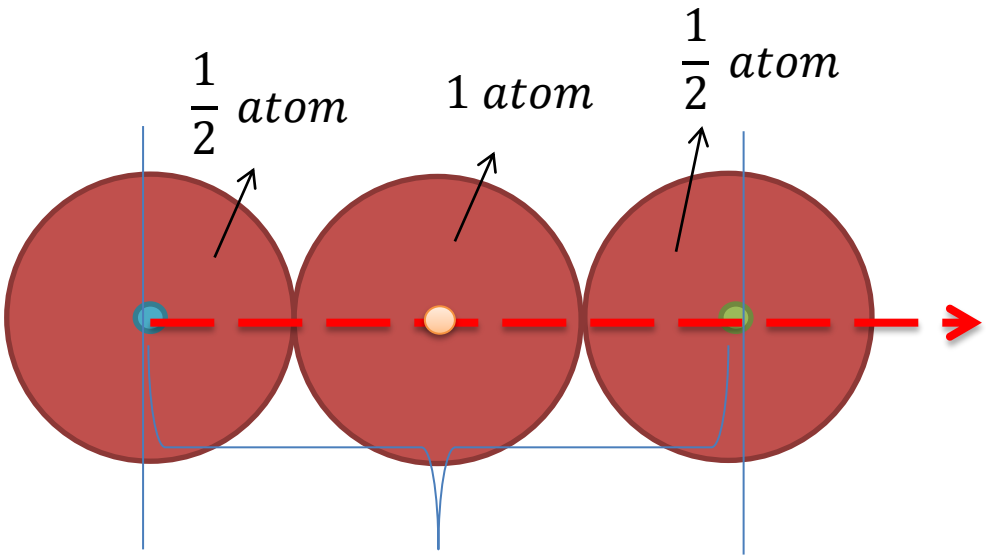
$$L = a\sqrt{2} = \frac{4\sqrt{2}R}{\sqrt{3}}$$

$$LD = \frac{\#\ of\ atoms\ on\ the\ line}{the\ length\ of\ the\ line}$$

$$LD = \frac{\frac{1}{2} + \frac{1}{2}}{\frac{4\sqrt{2}R}{\sqrt{3}}} = \frac{\sqrt{3}}{4\sqrt{2}R}$$

[1 1 1] direction for BCC and Linear Density





$$L = a\sqrt{3} = 4R$$

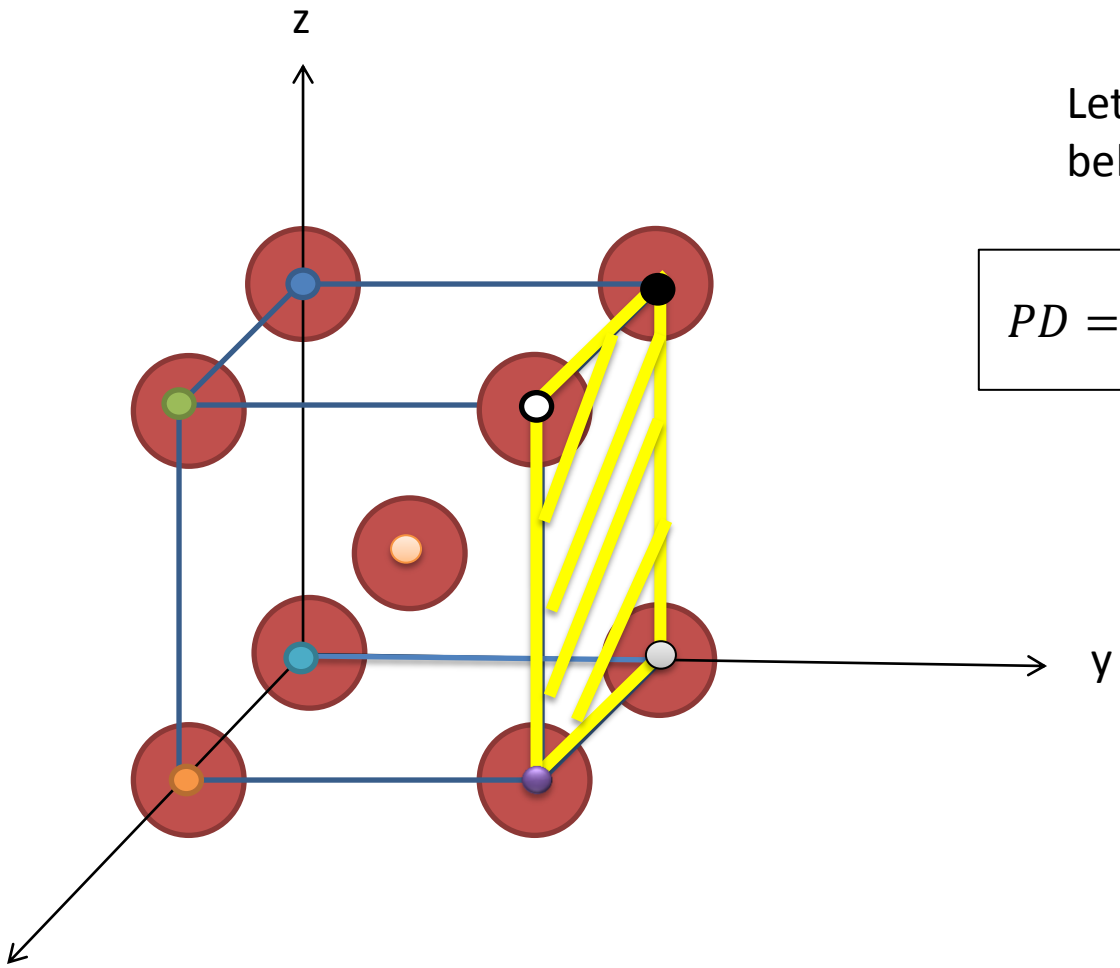
$$LD = \frac{\#\ of\ atoms\ on\ the\ line}{the\ length\ of\ the\ line}$$

$$LD = \frac{\frac{1}{2} + 1 + \frac{1}{2}}{4R} = \frac{1}{2R}$$

Planar Density

1. Draw the atoms on the plane, and use the formula;

$$PD = \frac{\#\ of\ atoms\ on\ the\ plane}{the\ area\ of\ the\ plane}$$

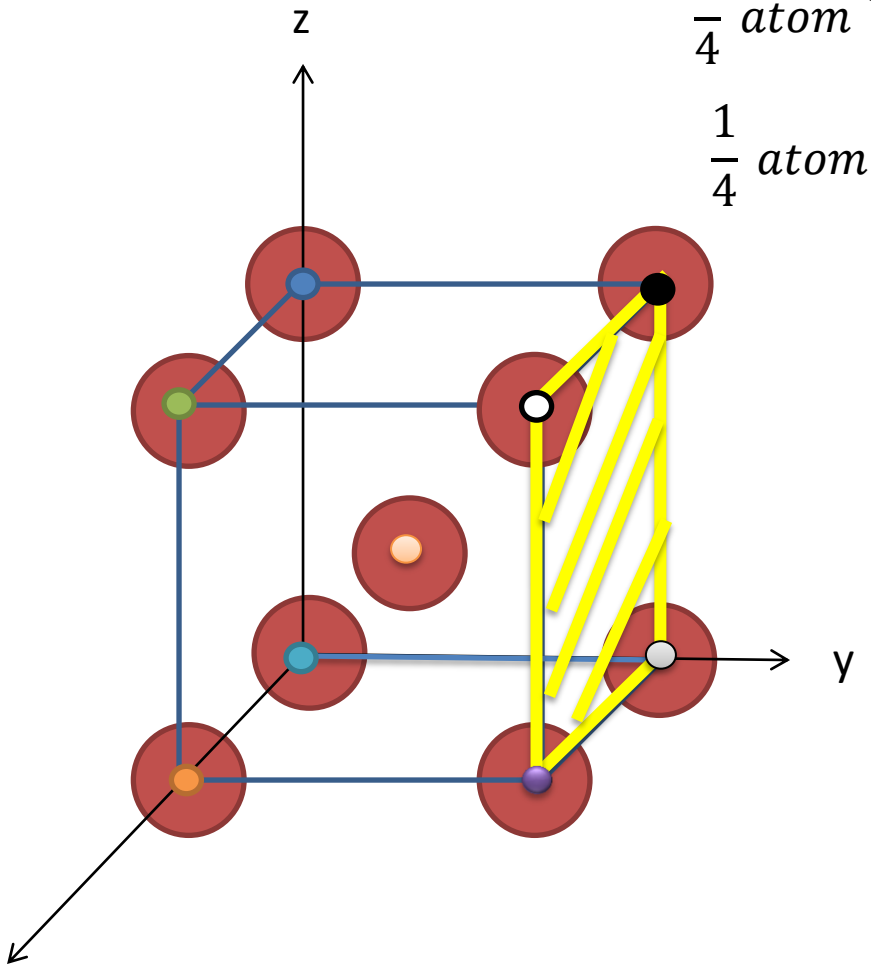


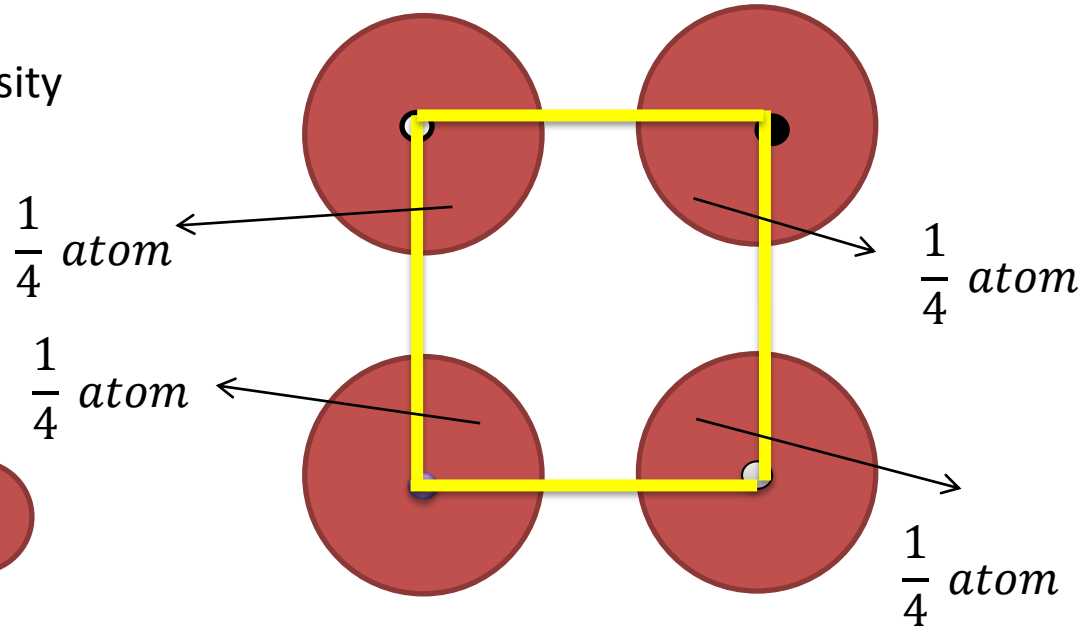
Let's apply the formula below for (0 1 0).

$$PD = \frac{\#\ of\ atoms\ on\ the\ plane}{the\ area\ of\ the\ plane}$$

Body-centered Cubic Crystal Structure (BCC)

(0 1 0) plane for BCC and Planar Density





$$PD = \frac{\#\ of\ atoms\ on\ the\ plane}{the\ area\ of\ the\ plane}$$

$$PD = \frac{\frac{1}{4}+\frac{1}{4}+\frac{1}{4}+\frac{1}{4}}{a^2}$$

$$PD = \frac{1}{\left(\frac{4R}{\sqrt{3}}\right)^2} = \frac{3}{16R^2}$$

Body-centered Cubic Crystal Structure (BCC)

Suggestion

- For the other directions and planes, also for all crystal structures (FCC,SC), you can and you should do this on your own.
- For any question, you can contact with me,

emreyilmaz@cankaya.edu.tr