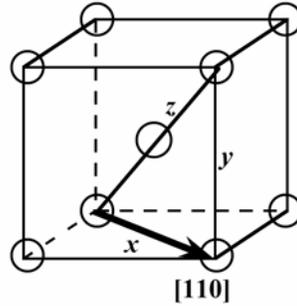


3.52 (a) In the figure below is shown a $[110]$ direction within a BCC unit cell.



For this $[110]$ direction there is one atom at each of the two unit cell corners, and, thus, there is the equivalence of 1 atom that is centered on the direction vector. The length of this direction vector is denoted by x in this figure, which is equal to

$$x = \sqrt{z^2 - y^2}$$

where y is the unit cell edge length, which, from Equation 3.3 is equal to $\frac{4R}{\sqrt{3}}$. Furthermore, z is the length of the unit cell diagonal, which is equal to $4R$. Thus, using the above equation, the length x may be calculated as follows:

$$x = \sqrt{(4R)^2 - \left(\frac{4R}{\sqrt{3}}\right)^2} = \sqrt{\frac{32R^2}{3}} = 4R\sqrt{\frac{2}{3}}$$

Therefore, the expression for the linear density of this direction is

$$\begin{aligned} LD_{110} &= \frac{\text{number of atoms centered on } [110] \text{ direction vector}}{\text{length of } [110] \text{ direction vector}} \\ &= \frac{1 \text{ atom}}{4R\sqrt{\frac{2}{3}}} = \frac{\sqrt{3}}{4R\sqrt{2}} \end{aligned}$$

A BCC unit cell within which is drawn a $[111]$ direction is shown below.