

Workshop 1

1. Tennis balls and argon atoms

How many tennis balls can you fit in a shipping container?

Tennis ball diameter 67mm. Internal dimensions of a shipping container: 5.867 m × 2.352 m × 2.385 m.

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The density of frozen argon (atomic mass 40) is $\rho = 1623 \text{ kg/m}^3$.

Close-packed spheres is a good model of a frozen noble gas, and it crystallizes as FCC.

Estimate the lattice constant (conventional unit cell size) and the effective radius of an argon atom.

Atomic mass unit $u = 1.66 \times 10^{-27} \text{ kg}$.

2. X-ray diffraction

A crystal is illuminated with x-rays of wavelength $\lambda = 1 \text{ \AA}$. The first few observed diffraction orders are at

$$\sin\left(\frac{\theta}{2}\right) = (0.289, 0.333, 0.471).$$

Using

$$\sin\left(\frac{\theta}{2}\right) = \frac{\lambda}{2a} \sqrt{h^2 + k^2 + l^2}$$

and the geometric structure factor (given below), find the crystal structure (SC, FCC, or BCC) and the lattice constant a .

(h,k,l)	$h^2 + k^2 + l^2$	SC	BCC	FCC
(1, 0, 0)	1	1	0	0
(1, 1, 0)	2	1	2	0
(1, 1, 1)	3	1	0	4
(2, 0, 0)	4	1	2	4
(2, 1, 0)	5	1	0	0
(2, 1, 1)	6	1	2	0
(2, 2, 0)	8	1	2	4