

Exercise 9.4.5

An atomic (quantum mechanical) particle is confined inside a rectangular box of sides a , b , and c . The particle is described by a wave function ψ that satisfies the Schrödinger wave equation

$$-\frac{\hbar^2}{2m}\nabla^2\psi = E\psi.$$

The wave function is required to vanish at each surface of the box (but not to be identically zero). This condition imposes constraints on the separation constants and therefore on the energy E . What is the smallest value of E for which such a solution can be obtained?

$$\text{ANS. } E = \frac{\pi^2\hbar^2}{2m} \left(\frac{1}{a^2} + \frac{1}{b^2} + \frac{1}{c^2} \right).$$