1.1.B Radiation in a cavity

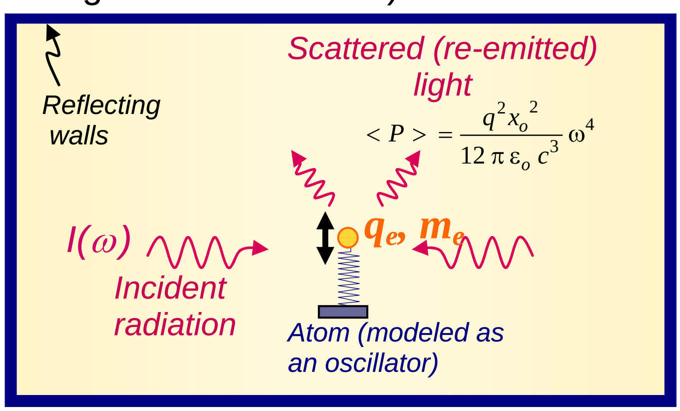
Our objective is to characterize the bath of electromagnetic radiation existent inside a blackbody radiator cavity. We would like to know,

> *How much light energy of angular frequency* ω *(across the electromagnetic spectrum) does exist inside the cavity at equilibrium conditions at a given temperature T?* (1)

Two approaches for answering this question, each arriving to the same general result, are worth mentioning:

APPROACH -1: The first follows a Feynman's description (very rich in physics content) that models an atom as an electrical oscillator. The equilibrium inside the cavity is obtained by a balance between:

- the energy absorbed by the atoms from the light energy existent in the cavity, and
- the amount of energy that these atoms scatter (accelerated charges emit radiation.)



x_o is the electron's amplitude of oscillation

c: speed of light

w: angular freq of oscillation (electron and light)

An expression will be obtained for the required Light Intensity Spectral Density *I*(ω) that must exist inside the cavity (if equilibrium were to prevail.)

APPROACH-2: The second approach is a bit more abstract; it considers the energy-interchange equilibrium reached between the electromagnetic-modes inside the cavity and the cavity's walls.

It involves the counting of electromagnetic modes. An expression for the Light Energy Density $U(\omega)$ at equilibrium will be obtained. Here $I(\omega) = c\,U(\omega)$ where c is the speed of light.

It turns out that the procedure followed by these two approaches (leading to an expression for $I(\omega)$ and $U(\omega)$) have survived the new wave of quantum concepts; that is they are still considered valid. **What has changed?** It is the way of how to specifically calculate the average-energy of an atom or the average energy of an electromagnetic mode what has suffered drastic modifications due to the advent of the quantum ideas. A detail description of these quantum modifications constitutes the essence of Section 1.1.B.

In what follows, we will mainly concentrate on a detailed account of the approach-1 referred above. A description of the approach-2 is given in the appendix.