

Diversion From Reality Through Quantum Theory

Abstract

1. After the discovery of the electron, researches on atomic- structure as ether vortex and electron too as ether vortex were on. Property of the ether was not pinpointed. Structure of the electron was not known in detail o the genesis of mass and charge . So the concept of Maxwell-Hertz that the electron under acceleration will radiate off energy was the first step to diversion from reality.
2. Non acceptance of the electrons orbiting the nucleus in the atom after Rutherford experiment fizzled out this great discovery due to 1, above.
3. Ultraviolet - catastrophe is shown further to be a natural process. Planck's experiment and his energy equation do not solve this problem. Planck's conclusion: Light- energy can be absorbed or emitted in an indivisible quantum of magnitude ($h f$) is proved wrong further below by deriving h from the first principles.
4. The above led to a faulty explanation in photo electric effect by Einstein.

Electron Structure

Rutherford studied scattering of alpha particles by atoms. He discovered the positively charged nucleolus of the atom. It was likened to the solar system with the nucleolus as the sun and planets as the revolving electrons. Had the then science philosophy believed in the uniformity of design in nature's creations, more than a century of research time would have been saved by not getting diverted to Quantum theory that is now proved to be a misconception with the advent of the Space Vortex Theory (SVT) formulated in the last quarter of the 20 the century:

It was believed that as per the classical theory, an orbital electron will be accelerating and due to this it will radiate off some of its energy corresponding to the frequency of its circulation. The electron structure was not known then. But

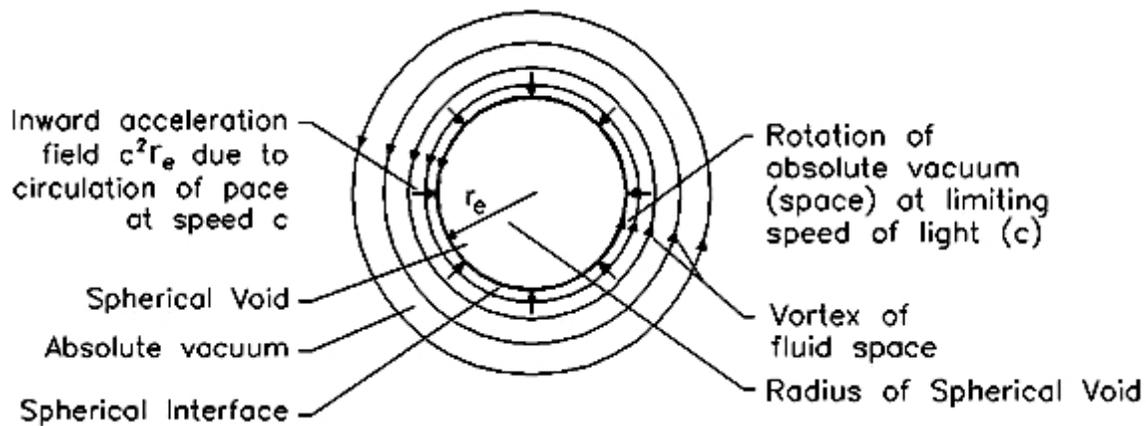
now with the new principles of SVT, vacuum-vortex- structure of the electron has been discovered. It does not permit any loss of the structural energy of the electron due to radiation as seen further below.

Postulates of the Space Vortex Theory

1. The medium of space, throughout the universe, is an eternally existing, nonmaterial, continuous, isotropic, fluid substratum.
2. The medium of space has a limiting flow speed equal to the speed of light relative to the absolute vacuum, and a limiting angular velocity, when in a state of circulating motion.
3. The medium of universal space is eternal and inherent with motion.

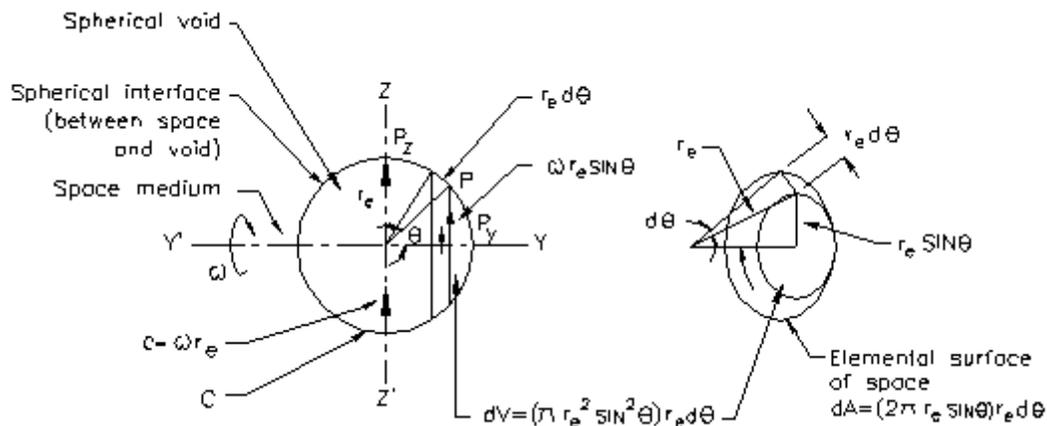
The following fig. 2-3 shows the cross section of the vacuum-vortex -electron. A spherical void is enclosed within an interface between the vacuum and the void circulating at light speed. The next sketch shows derivation of the mass and the charge of the electron. For details explanation, refer to the articles and books at www.tewari.org

The electron vortex cannot lose any of the velocity field (energy) in its structure when in acceleration relative to vacuum. ***Hence to suppose that electrons if in atomic orbit will lose part of their energy was a totally misconceived concept.***



Absolute vacuum possesses non-material properties of incompressibility, zero-viscosity, continuity & mass-lessness of an ideal fluid; fieldless & energyless spherical-void is created due to limiting rotation & breakdown of absolute vacuum.

Fig. 2-3 Vortex in electron structure



ω = Angular velocity of spherical interface around $y-y'$

Void = Fieldless spherical hole in space

Void-radius $r_e \approx 4 \times 10^{-11}$ Cm

Fig. 4.3 Velocity Field on Interface

Source of light

In atoms, orbital electrons are not the source of light as believed even today. Light originates from the structure of oscillating atoms and electrons as analysed further below. Light effect is due to a time varying potentials produced at the nucleus of the atom and the interface of electron (www.tewari.org)

Based on the concepts of Maxwell-Hertz, that electromagnetic (light) energy is *given off* from electrical oscillators; Plank believed that the orbiting electrons inside the atoms of a glowing solid-emitter radiated electromagnetic waves in different quantities, the frequency being determined by the vibration of the oscillator. The classical picture was revised by Plank based on his observed experimental fact when he assumed that an oscillator, *at any instant*, could have its total energy (potential, kinetic) only as an integral multiple of the energy quantity $h f$, where h is a universal constant (experimentally determined) and f is the frequency of vibration of the oscillator. Thus, the light energy can be absorbed or emitted in an *indivisible* quantum of magnitude hf . Planck energy equation is:

$$E = h f. \quad (1)$$

It can be also written as

$$E / f = h. \quad (2)$$

It is seen from (2) that “ h ” is the energy associated with one oscillation of the vibrator, on the following basis.

It has been shown (SVT) that one shell of light produced due to atomic vibration of an atom of average mass does have energy of:

$$= 5.36 \times 10^{-27} \text{erg} . \quad (3)$$

which is close to the experimentally determined value of:

$$h = 6.62 \times 10^{-27} \text{erg s}. \quad (4)$$

It is also derived in SVT that:

$$\text{Angular momentum of electron} = \frac{4}{5} m_e c r_e$$

Substituting

$$L = \left(\frac{4}{5}\right)(9.108 \times 10^{-28} (3 \times 10^{10} \text{ cm/s}) 4 \times 10^{-11} \text{ cm}$$

$$= 0.88 \times 10^{-27} \text{ erg s.} \quad (6)$$

Energy in (3) and in (6) are derived theoretically from the first principle. these are not far from the present value (4).

To conclude :

In Planck energy equation “ h ” is the angular momentum of the electron. It is also proportional to the gravitational potential of one shell of light produced by an oscillating atom.

The ultraviolet catastrophe,

Also called the Rayleigh–Jeans **catastrophe**, was the prediction of late 19th century/early 20th century classical physics that an ideal black body at thermal equilibrium will emit radiation in all frequency ranges, emitting more energy as the frequency increases. In Newtonian space of nothingness, an oscillating atom will have no reaction from space and the frequency of oscillations can continue to increase emitting infinite electromagnetic energy. Through black body experiment Planck is credited to find solution to the puzzle

Such is not the case with the SVT principles: As seen in the electron structure the interface is subjected to inward force fields; So also the nuclei within a vortex have inward force fields of gravity and electrical. Since the vacuum (space) has a limit to flow velocity up to the speed [Principle 3] of light a oscillating atom is reacted by space at higher frequencies.

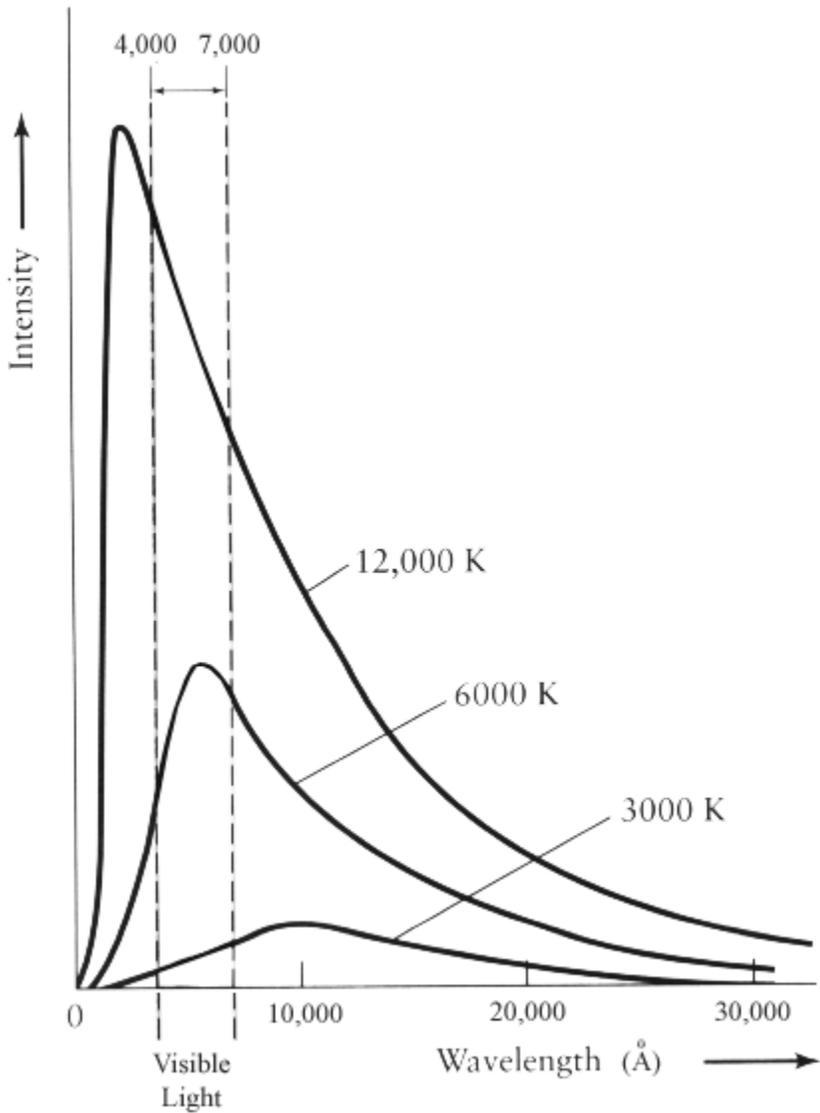
In the sketch (4-4) below, as the atom moves from the mean position to the left, space flows to it from the right; and when it moves to the right, space flows to it from the left. In each oscillation space flows in opposite directions. The space volume around the oscillating atom has a highly disturbed flow.

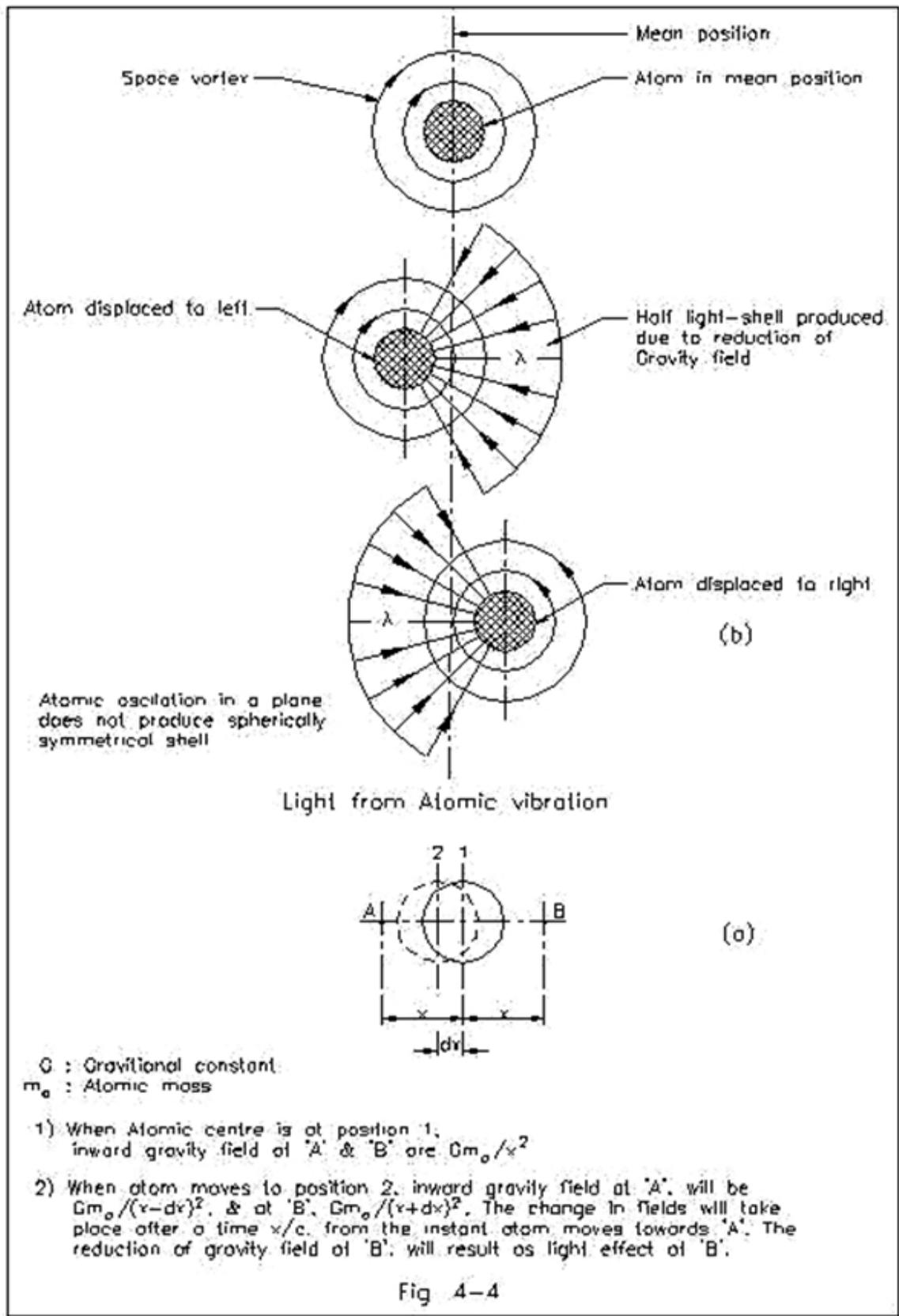
An atom of the average diameter of 10^{-8} mm can displace space at the maximum speed of light For one oscillation time required will be $[(10^{-8} \text{ mm}) / (3 \times 10^{10} \text{ cm / s})] = 0.33 / \times 10^{-18} \text{ sec}$. The frequency will be about $3 \times 10^{18} / \text{sec}$.

As seen in the graph on back body radiation, the luminosity curve rises steeply at low frequency and then falls due to space reaction against the oscillating atoms.

This a natural process that has been misconceived as Ultraviolet catastrophe,

Black body radiation





Planck Energy Equation

Based on the concepts of Maxwell-Hertz, that electromagnetic (light) energy is *given off* from electrical oscillators, Plank believed that the orbiting electrons inside the atoms of a glowing solid-emitter radiated electromagnetic waves in different quantities, the frequency being determined by the vibration of the oscillator. The classical picture was revised by Plank based on his observed experimental fact when he assumed that an oscillator, *at any instant*, could have its total energy (potential, kinetic) only as an integral multiple of the energy quantity hf , where h is a universal constant (experimentally determined) and f is the frequency of vibration of the oscillator. Thus, the light energy can be absorbed or emitted in an *indivisible* quantum of magnitude hf . Planck energy equation is:

$$E = h f. \quad (8.1)$$

It can be also written as

$$E / f = h. \quad (8.2)$$

It is seen from (8.2) that “ h ” is the energy associated with one oscillation of the vibrator, on the following basis. It has been shown UPSM (4.27) that one shell of light produced due to atomic vibration does have energy close to the experimentally determined value of h . Though Planck believed that the oscillator emits its own energy (kinetic, potential) that it possesses structurally, by deriving h from the gravitational potential in space external to the oscillating atom, a new fact has been brought to light that the “least energy” produced (in each shell of light) is “ E / f ”. Therefore, the quantity “ $h f$ ” is, actually, the energy contained in f numbers of *successive* light- shells produced by the oscillator in unit time, and can no more be an “indivisible quantum” available at *an instant*, which Planck assumed.

Further, as stated earlier, the structures of the oscillators, either electrons or atoms, are not suited to *absorb* or *emit* energy—a serious misconception continuing since Maxwell’s theoretical conclusion that oscillations of electric current leads to a *loss* of energy from the system in the form of electromagnetic waves. The concept that heat and light energy get *detached* from the oscillating atoms is corroborated in the following: “¹...the collisions between atoms and molecules in a gas are said to be perfectly elastic. Although this is an excellent

¹ The Feynman Lectures on physics, Feynman, Leighton, Sands; Vol. 1, page 10-9

approximation, even such collisions are not *perfectly* elastic; otherwise one could not understand how energy in the form of light or heat radiation could come out of gas.” But such a concept is basically wrong and, as seen later, has misdirected the postulation at the very basic principles of quantum physics. Even in an oscillating electric current the electrons cannot part with their structural energy (the velocity field in the vortex), barring the phenomenon of annihilation.

An expression similar to Planck energy equation was derived UPSM (2.15) from the vortex structure of electron. The Planck constant for electron was shown to be different UPSM (Sec.4.4) from the Planck constant for the atoms UPSM (Sec.4.5). Its value from the relationship: $h = (4/5) m_e c r_e$, was found to be 7.5 times less than the Planck constant. However, for an average atom, Planck constant computed UPSM (4.27) was close to the experimental value determined by Planck.

The dimensions of h determined by Planck are that of angular momentum—same as the angular momentum of electron derived above. Though the angular momentum of electron UPSM (2.15) is 7.5 times smaller than the accepted value of the Planck constant, the nearness of the two values may lead to a guess that the orbital electrons in the atoms are indeed the electric oscillators that produce light, as imagined by Planck and others, and as is also the prevalent concept. In this conjecture, however, following difficulty arises. An atom shows overall electrical neutrality in the region beyond the orbital electrons, where only the gravitational field of the atom should exist. On account of this, h has been computed UPSM (4.27) theoretically with the considerations of the time-varying potential of gravitation alone. This is not to say that a charged atom will not produce light; rather the value of h obtained from an assembly of charged oscillating atoms should be different, and so also the nature of light (frequency, wavelength) produced.

Since the structure of light consists of successive shells, it can be said that light energy exists in quanta, where quanta is defined as “energy in each shell”; whereas, the kinetic energy of a moving body, which is proportional to the velocity of the body that can continuously vary, cannot have quanta of energy. Any generalization coming out of Planck energy equation, and leading to the concept that all forms of energy occur in quanta, is therefore erroneous.

8.3 *Explaining Photoelectric Effect – Einstein’s Error*

In the vortex structure of atom (Fig.7-5, UPSM), the vortices of the orbital electrons, interlocked with the velocity fields of the atomic vortex, are carried round the nucleus as explained earlier. As is well known, the outer orbital electrons, if interacted with light of appropriate wavelength, are released in

photoelectric effect. It is now believed that the photo- electrons *absorb* energy from the incident light for their release, and also for the kinetic energy that they possess. On this phenomenon, the following new aspects are to be taken into account.

Absorption of energy by an electron is, structurally, impossible. The orbital electron, already in circulating motion, possesses kinetic energy due to the velocity field of the atomic vortex. This energy is computed: The nuclear radius of an average atom UPSM (4.24) is, $r_n = 2.37 \times 10^{-9}$ cm. Like an electron, the nucleus too has its axis of rotation and, hence, the maximum electrostatic field is confined in a circular vortex in a plane (more or less), at right angles to the axis of rotation. In the irrotational vortex, space-circulation velocity falls inversely as the radius of rotation. From UPSM (2.2), in the electron vortex, $c r_e = \text{constant}$. Applying this relationship also on the nuclear surface,

$$c r_e = u_n r_n \quad (8.3)$$

where u_n is the maximum tangential velocity of space on the nuclear surface in the diametrical plane at right angles to the axis of rotation. Substituting in (8.3) the known values of c , r_e , and $r_n = 2.37 \times 10^{-9}$ cm, we have

$$\begin{aligned} u_n &= (3 \times 10^{10}) 4 \times 10^{-11} / 2.37 \times 10^{-9} \\ &= 5 \times 10^8 \text{ cm/s.} \end{aligned} \quad (8.4)$$

This velocity falls in the atomic vortex (around the nucleus) inversely as the radius of space rotation. Assuming the radius of rotation of the outermost orbital electron to be 10^{-8} cm, the space circulation-speed, which is also the tangential-velocity of the orbital electron, will be

$$\begin{aligned} v &= u_n (2.37 \times 10^{-9} \text{ cm}) / 10^{-8} \text{ cm} \\ &= (5 \times 10^8 \text{ cm/s}) 2.37 \times 10^{-1} = 1.2 \times 10^8 \text{ cm/s.} \end{aligned} \quad (8.5)$$

The kinetic energy of the orbital electron is

$$\begin{aligned} E_{\text{kin}} &= (1/2) m_e v^2 \\ &= (1/2) 10^{-27} (1.2 \times 10^8)^2 \\ &= 7.2 \times 10^{-12} \text{ erg.} \end{aligned} \quad (8.6)$$

The experiments show that the kinetic energy of the photoelectrons is about 8×10^{-12} ergs, which is so very close to the value obtained above (8.6). It is thus seen that Einstein mistook the *source* of the kinetic energy of the photoelectron, thinking that it came from the incident light source; whereas, the reality is that the *velocity field in the atomic vortex projects the electron after the incident light has triggered its release*, as explained below.

Production of light due to oscillation of an atom has been discussed before UPSM (Sec.4.4, 4.5). We shall analyze here the displacement of an atom during its oscillation, and the radial flow of the surrounding space UPSM (Fig.4-4). An atomic nucleus, composed of independent electronic voids, closely packed, approximates to a “spherical hole” in space, central with the atom. The atom, during displacement equal to its diameter, leaves a “hole” in its previous location. This “hole” is filled due to the flow of space at speed c , radial through the light’s first wavelength λ , which gets formed as discussed earlier. The time taken for this flow across the wavelength is λ/c ; and the acceleration of space is $c / (\lambda/c)$, which is c^2/λ . Each successive wave-length, formed due to the oscillations of the atom, possesses the above acceleration field across it (radial). Now suppose that the spherical wave front of one of these shells, during its transmission, meets an orbital electron of an atom. The orbital velocity v of this electron, is derived from the atomic vortex which subjects it to an inward acceleration v^2 / r , where r is the radius of its rotation. The electron is held by electrical force, created by the above inward acceleration towards the nuclear center. The acceleration field c^2/λ , within the wavelength of the light-shell that meets the orbital electron of the atom, is also inward, that is, towards the light source. For the electron to be released from the atomic vortex, the above two acceleration fields must be equal and opposite. Thus,

$$c^2 / \lambda = v^2 / r \quad (8.7)$$

Or, $\lambda = c^2 r / v^2 \quad (8.8)$

Substituting the values: $v = 1.2 \times 10^8$ cm/s obtained above (8.5); $r = 10^{-8}$ cm; $c = 3 \times 10^{10}$ cm, the value of λ comes to, 6.25×10^{-4} cm, which corresponds to the cut off frequency of, $3 \times 10^{10} / 6.25 \times 10^{-4}$, that is, 0.48×10^{14} cycles/s. (For metallic sodium, the threshold frequency is about 5×10^{14} sec⁻¹). Considering the approximate nature of the assumptions on the orbital radius of electron, and the radius of an *average size* of nucleus, with which the space-circulation velocity around the nucleus and the orbital velocity of the electron were calculated; any better result from (8.8) to conform to the experimentally obtained value of threshold frequency is unlikely. For, the orbital radius of the electron, if supposed to be 10^{-9} cm, rather than 10^{-8} cm, the thresh-hold frequency calculated from (8.8) will be closer to the experimental value.

The additional information given by Eq.8.8 is as follows. In atomic vortex, the velocity field falls inversely from the nucleus centre; and therefore, the inner orbital electrons will have higher speed of rotation. On release by the incident light shell, these electrons will possess higher kinetic energy. It is seen from (8.8) that for higher value of the electron’s speed v , the wavelength λ is smaller. It is thus concluded that with higher frequency of the incident light, the photoelectrons released will show higher kinetic energy. This is an experimentally observed fact.

The above analysis shows that the concept of the photon-nature of light, with the *indivisible quanta* of energy possessed by each photon, is a case of the most serious *misconception*, which led Einstein (who was a believer in the *emptiness* of space, as evident from the formulation of special theory of relativity) to wrongly treat light-energy, hf , as the *instantaneous* value (when in reality, this energy is produced and accumulated in *unit time*); because this way, the kinetic energy of the photoelectrons, as observed experimentally, could be explained without going deeper into the structure of the atom (that became known later about 1912 through Rutherford's experiments) to determine whether the photoelectrons have any other source in the atomic structure that imparts kinetic energy to them at the time of their ejection from the atoms.

Though, Planck *integrated* together the energy of f nos. of shells erroneously, he still believed that light energy is distributed uniformly over an expanding set of wave fronts. In contrast, Einstein conceptualized that the energy of light is not distributed evenly over the whole wave front, as the classical picture assumed; rather it is *concentrated* or localized in discrete small regions. With the help of both these energy integration and concentration operations, the right order of magnitude of the kinetic energy of the photoelectrons, as observed experimentally, could be achieved in the quantity hf .

Without any physical picture, clarity and meaningful explanations, some of these ambiguous conceptions on the fundamental nature of light laid foundation to the quantum physics.

Gravitation

Gravitational constant for the electron and atoms

Gravitational Field

The origin of free-fall acceleration is given in Universal Principle of Space and Matter (UPSM), Chapter 3 (www.tewari.org). This is due to the existence of the *acceleration field* in the space vortices surrounding the cosmic bodies with axial rotation. The *gravitational field*, basically, has been traced to arise from the very structure of the electron and atoms. (UPSM, Chapter 4).

Consequent to the creation of the spherical void at the electron center due to limiting speed of space-circulation, the universal space is gravitationally energized (Fig.4.1c) by transmission of the gravitational potential—a process starting from the interface of the electron and proceeding outwards at speed c , which is also the

limiting speed for the transmission of potential in space. In this figure, the volume of space in the annular zone, marked Z, has already been gravitationally energized since the spherical front has passed over it. Till the existence of the void—a zero-potential zone—the universal space will maintain its positive gravitational potential. The creation of matter means creation of independent stable voids (electrons); which leads to higher gravitational and electrostatic potential in space. The energy used for creation of each electron is retained in space as gravitational/electrostatic potential—there being no reduction in the overall content of universal energy due to creation of electron because from the electron’s void-center, it is transferred to the gravitational /electrostatic potential in the fields of the electron. The gravitational process is discussed below.

The creation of electron-void requires energy (Eq.2.14) UPSM) of the magnitude, $(4/5) m_e c^2$, out of which as seen from UPSM (3.1.2.2), $(\pi/10) m_e c^2$, is distributed in space as electrostatic energy; whereas, the remaining, about $(1/2) m_e c^2$, stays in space as gravitational potential.

In the continuous medium of the fluid-space, which is also incompressible, the volume of space equal to the volume of void is pushed out spherically beyond the interface during void creation.

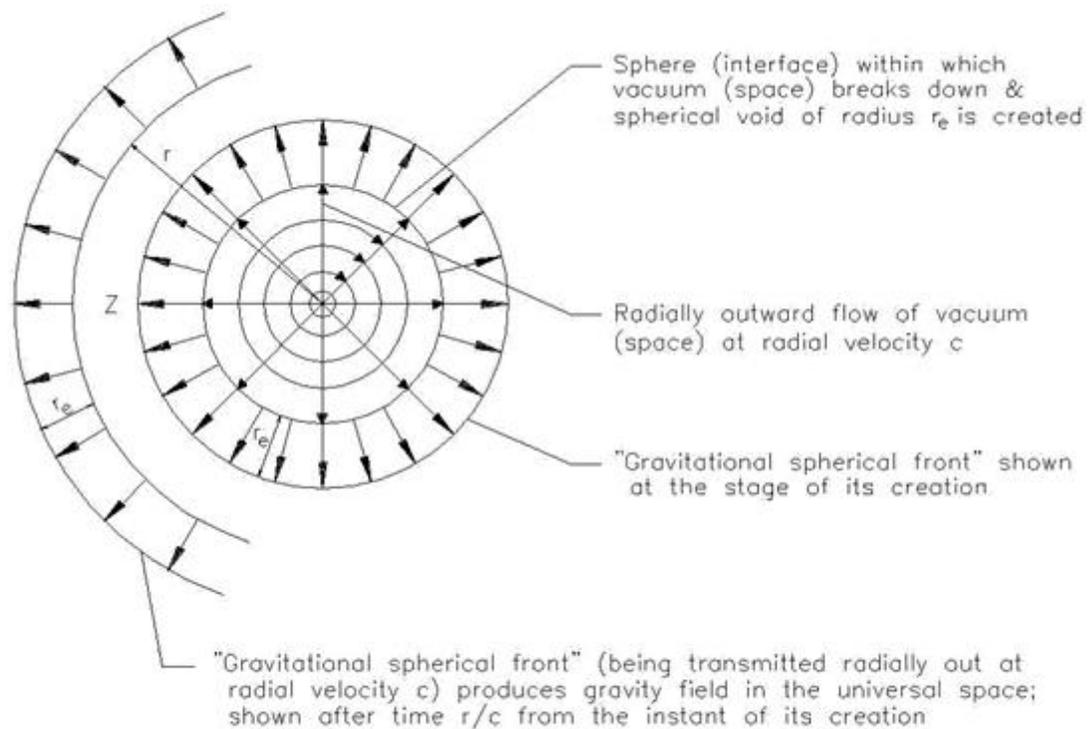


Fig. 4-1a Creation of Electron

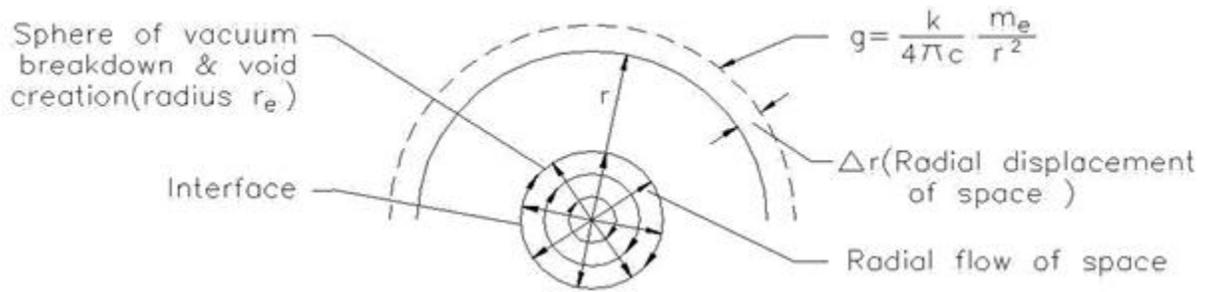


Fig. 4-1b Gravitation

Had the medium of space been a material fluid with certain compressibility, the displaced fluid would have formed a compressed-fluid-shell enclosing the interface and having a radial-width: $V/4\pi r_e^2$, where V is the volume of the void. However, the incompressible space cannot retain a compressed-shell around the interface; due to which the displaced volume V of space continues flowing out at speed c as a compressive-shell with diminishing shell-width, and pushing space-points outward at each spherical space surface (Fig.4.1b), such that at a radius r from the void center, the radial length of displacement of a space-point is:

$$\Delta r = V / 4 \pi r^2 \quad (4.1)$$

Thus, the process of creation of electron displaces outwards each point of the universal space in due course; and this displacement remains a permanent feature in space till the existence of the electron. The length, Δr , can be defined to be proportional to the gravity field, g_e , of the electron at a radial distance r from its center. Expressing, V , in (4.1) in terms of electron-mass from mass equation (2.6), UPSM,

$$g_e \propto \Delta r \propto (m_e / c) / 4 \pi r^2 = (k / 4 \pi c) m_e / r^2 \quad (4.2)$$

in which g_e is the gravity field of the electron and k is a 'constant of proportionality' with the dimensions of, $1/T^2$, so that the dimensions of the gravitational field, g_e , obtained from (4.2) are: $[L] / [T^2]$. Since the electron is the fundamental particle of matter, (4.2) is the expression of gravity field applicable in general, for all electrons in the constitution of matter in the universe. (For reference to equations, UPSM is to be referred.)

4.3 *Inter-relationship Between Light and Gravity*

Consider an electron oscillating about its center with displacement dR as shown in Fig.4.3. At a point P at a distance R from the electron center, where the gravitational field from UPSM (4.6) is, $[g_e m_e / R^2]$, the gravitational potential energy is:

$$U = G_e m_e^2 / R. \quad (4.3)$$

where G_e is the gravitational constant for the electron.

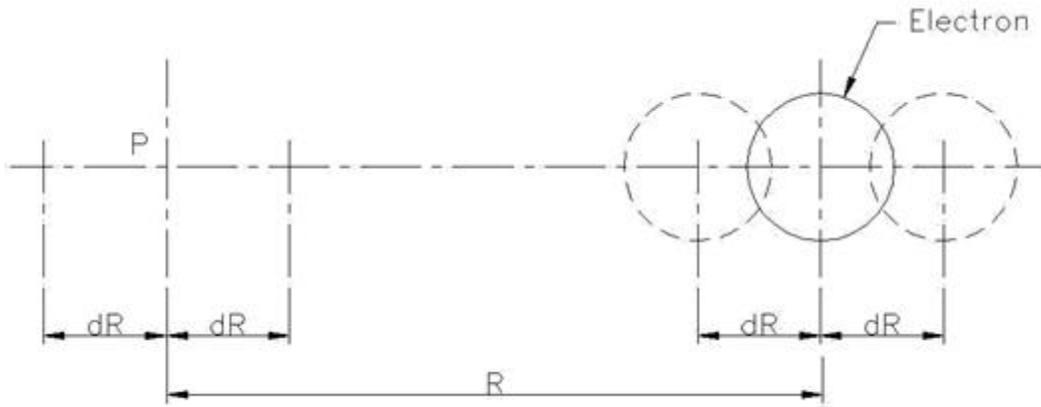


Fig. 4-3

(In the following analysis only gravitational fields have been taken into consideration. Electric potential of electron can be treated separately.)

The oscillation of the electron changes the distance R of P by dR on its either side, due to which the potential U undergoes cyclic changes in its magnitude. The effect of the changes (increase and decrease) of potential starts from the interface of the electron, and transmits to P at speed c . It is this process of 'time-varying potential' at a point in space, resultant due to the oscillation of electron or atom, that produces light. From UPSM (4.20),

$$dU / dR = - G_e m_e^2 / R^2 = - G_e m_e (m_e) / R^2. \quad (4.4)$$

Expressing m_e (in bracket) in terms of r_e and c from UPSM (2.6); substituting: $k / 4 \pi c$ for G_e , from (4.3); and $R = r_e$ to determine the potential gradient at the interface

$$\begin{aligned} dU / dR &= -(k / 4 \pi c) m_e [(4\pi/3) r_e^3 c] / r_e^2 \\ &= -k (m_e c r_e) / 3c. \end{aligned}$$

$$\text{Or, } dU/ (dR/c) = k (m_e c r_e)/3. \quad (4.5)$$

The quantity, dR/c , is the time duration for the transmission of the potential changes across dR , and written as, dt . Multiplying and dividing right hand side of (4.21) by $4/5$,

$$dU/ dt = k (4/5) m_e c r_e (5/4)/3. \quad (4.6)$$

The quantity, $(4/5) m_e c r_e$, is the angular momentum (L) of electron UPSM (2.15); its numerical value is found by substituting the known values of m_e , c , and r_e :
The quantity, $(4/5) m_e c r_e$, is the angular momentum (L) of electron UPSM (2.15); its numerical value is found by substituting the known values of m_e , c , and r_e :

$$\begin{aligned} L &= (4/5)(9.108 \times 10^{-28} (3 \times 10^{10} \text{ cm/s}) 4 \times 10^{-11} \text{ cm}) \\ &= 0.88 \times 10^{-27} \text{ ergs.} \end{aligned}$$

The dimensions of L are the same as that of Planck constant; also, the numerical value of L for electron, calculated also, the numerical value of L for electron, calculated above, is about 7.5 times smaller than the Planck constant,

$$h = 6.62 \times 10^{-27} \text{ erg s.}$$

Planck constant is the angular momentum of the electron. It is also proportional to the potential gravitational energy in one shell of light produced during oscillation of the electron.

The Planck constant was determined in experiment with thermal radiation produced due to atomic vibration, and not with the oscillation of free electron² being analyzed here; therefore, close numerical agreement of the values of L and h are not expected. Under these considerations, it is defined that at a point in space, “time -varying gravitational potential” due to oscillation of an electron, produces light energy in one shell proportional to the Planck constant. Substituting: $h = (4/5) m_e c r_e$, in UPSM (4.22), gives the basic equation on the inter relationship between gravity and light:

$$dU/dt = (5k/12) h. \quad (4.7)$$

² It is shown further that rotation of electron in atomic orbit is not the basic cause of radiation (production of light).

Planck Constant in Thermal Radiation

The basic-relationship UPSM - (4.23) can be checked, by analyzing the vibration of a single atom. Let us choose an atom of average atomic weight, say 120 times the proton mass.

$$\text{Its mass: } m_a = 120(1.67 \times 10^{-24} \text{ g}) = 2 \times 10^{-22} \text{ g,} \quad (4.8)$$

which from UPSM -(2.12) becomes:

$$m_a = 2 \times 10^{-22}(8.6 \times 10^6 \text{ cm}^4 / \text{s}) = 1.72 \times 10^{-15} \text{ cm}^4 / \text{s.} \quad (4.9)$$

The volume of this nucleus is: $V_a = (4\pi/3) r_n^3$

where r_n is the radius of the nucleus of the atom.

Mass-equation UPSM-(2.6), though applicable to the electron in a strict sense, can also be used for the nuclear structure because the, density of distribution of the electrons and positrons in all nuclei is the maximum. Therefore, from above

$$V_n = (4\pi/3) \cdot r_n^3 = m_a / c, \text{ and } r_n = (3 m_a / 4\pi c)^{1/3}.$$

Substituting the value of m_a (4.9) derived earlier,

$$\begin{aligned} r_n &= [3 \times 1.72 \times 10^{-15} \text{ cm}^4 / \text{s} / 4\pi \times 3 \times 10^{10}]^{1/3} \\ &= 2.39 \times 10^{-9} \text{ cm.} \end{aligned} \quad (4.10)$$

The gravitational potential energy at the surface of the nucleus

$$U = G m_a^2 / r_n. \quad (4.11)$$

Substituting the known value of G , and m_a

and r_n computed above,

$$\begin{aligned} U &= 6.67 \times 10^{-8} \text{ g}^{-1} \text{ cm}^3 \text{ s}^{-2} (2 \times 10^{-22} \text{ g})^2 / \\ &2.37 \times 10^{-9} \text{ cm} = 11.156 \times 10^{-43} \text{ erg.} \end{aligned} \quad (4.11)$$

Supposing that the average period of oscillation of an atom is 10^{-15} s, the duration (dt) of the change of the gravitational potential at the nuclear surface is $(1/2) 10^{-15}$ s.

Substituting in (4.8) the above value of dt and of U computed in UPSM (4.26)

$$\begin{aligned} dU / dt &= 11.156 \times 10^{-43} \text{ erg} / (1/2) 10^{-15} \text{ s} \\ &= (5 / 12 \text{ s}^2) h. \end{aligned}$$

$$\text{From above, } h = 5.36 \times 10^{-27} \text{ erg s.} \quad (4.12)$$

Planck constant is the angular momentum of the electron. Its energy content is the gravitational potential in one sell of light produced During atomic vibration.

The **ultraviolet catastrophe**, also called the Rayleigh–Jeans **catastrophe**, was the prediction of late 19th century/early 20th century classical physics that an ideal black body at thermal equilibrium will emit radiation in all frequency ranges, emitting more energy as the frequency increases.