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Relation between Wave Energy and Field Strength by Reconciliation of Energy equations

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Abstract:*There are three famous equations related to energy namely kinetic theory of gases by Kelvin, Energy Mass equivalence by Einstein and Energy Frequency relation by Max Planck.*
Conservation of energy is an established law.In such a scenario, all three relations must be consistent with each other. This paper establishes Higgs Boson as the primitive source of energy. The author provesHiggs Boson is the reason for existence of dark matter or dark energywhichis alsothe common thread between different forms of energy.As an extension it can be shown that each wave is associated with a field proportional to its frequency. The author also provides anew mathematical model to compute the field strength of a wave of a given frequency.
Keywords:*Primitive energy, Fundamental particle, Fundamental Field, Dark Energy, Dark Matter, Laser drilling*

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I. Importance Of Article

With the quantification of field strength associated with a wave, it will lead to new research to quantify the effects on flora and fauna, if exposed to high frequency waves for longer duration. This is in connection with use of higher bandwidth e.g. 4G, 5G etc for mobile phones. The towers erected to transmit and receive such waves will be perpetually impinging on flora and fauna. Such studies will help Environmental Scientists to assess the effect.

Higgs Boson is identified as the fundamental particle and Higgs field is the fundamental field. This will lead to further research to understand the evolutionary process of Universe: space and time relationship, conversion of energy (point particles) into mass particles (particles with size and shape like electrons and protons) so on and so forth.

Lot of research has taken place on the use of Laser in Mining and deep drilling. The author uses the energy theory developed in this paper to provide a clue to minimize energy consumption in deep drilling application.

II. Introduction

In the article on magnetic field [1], it has been demonstrated that various laws of Nature appear to be different from each other but the intent remains same. The similarity in intention of seemingly different laws provides consistency among them.

In this paper, three laws pertaining to energy are scrutinized namely Kinetic theory of gases by Kelvin, Energy Mass equivalence by Einstein and Energy Frequency relation by Max Planck.These laws were discovered in different contexts.Butconservation of energy is an established conclusion. Hence conversion of energy of one form into another form is possible only when they have a common thread in all forms of energy. In such a scenario, it is intended to find the common thread among all three relations,so thatthey become consistent with each other.

This article has two parts. In the first part Clause 2 and 3), the author will establish that the common thread in all three equation is Higgs Bosons associated with field; and the strength of field is proportional to frequency of energy wave.In the second part (Clause 5), a mathematical model is developed to compute the field strength of a wave of given frequency.

III. Derivation Of Relation Between Frequency And Field Strength

3.1Energy-Frequency Equivalence Relation (Max Planck)

We know E = hv ……..(1)
where E = energy associated with a wave, h = Planck's constant, v= frequency
Frequency implies vibration and vibration implies Simple Harmonic Motion (SHM). In SHM, acceleration is directly proportional to displacement. The direction of acceleration is opposite to that of displacement.

Acceleration and displacement are relevant only in the context of a particle. It implies that wave of any type exists only because of a particle, whatever may be the attributes of that particle. The acceleration on the particle is due to some force as per Newton's second law of motion. It remains to be ascertained: the nature of particle and its field.

3.2 Energy-Mass Equivalence Relation(Albert Einstein)

We know $E = Mc^2$ ……(2)

At a macro level, this equation suggests a body with mass M can be converted to specific amount of energy E equal to Mc^2 and vice-versa. If a body loses mass while getting convertedinto energy,it will be difficult to know how it picks up mass when energy gets converted into a body of mass. It will be extremely difficult to explain how the Nature is able to do the energy-mass conversion with suchmathematical precision. We should look at the quantum level at the particle that defines and provides mass, Higgs Boson.

If each Higgs boson has a mass (m), body of mass M = Nm where N = number of Higgs Bosons. The body of Mass M can be treated as made up of N Higgs Bosons.

Equation (2) can be written as $E = Nmc^2$ ……..(3)

The body of Mass M can be treated as made up of N Higgs Bosons. Higgs Bosons exist in the body of Mass M in a bonded state within a defined contour of volume. In the state of energy, Higgs Bosons exist in free state where contour of volume is not defined.

From equation (3) we observe each Higgs Boson is associated with Kinetic energy equal to mc^2. If Energy cannot be created or destroyed, then Higgs bosons cannot be created or destroyed. It demonstrates conservation of mass is a law.

This law of conversation of mass implies Higgs Boson should be a fundamental particle. Higgs field, being the field of a fundamental particle, should be a fundamental field. Higgs Boson meets the requirement of Equation (1) as mentioned above. The kinetic energy of Higgs boson is due to its vibration. It is the primitive source of energy.

Higgs boson cannot be detected for following reasons:

i) It is a point particle hence its size is zero. Mathematically the product of zero multiplied by any number is zero. Therefore, it is technically impossible see through any microscope having a magnifying power as large as possible to conceive.

ii) The field is also so weak that its impact on other bodies cannot be experienced and measured. Electric field is a very strong filed and its effects can be seen in simple experiments conducted in the lab. Gravitational field is very weak in comparison to Electric field. The effect of gravitational field between two small objects is invisible. Effects of gravitational field on small masses is visible only when the other body of mass is as big as planet. In such a scenario, detecting a negligible field around a point particle is next to impossibility.

But there are indirect ways to detect the Higgs Boson and its impacts:

iii) Existence of Brownian Motion proves beyond doubt that existence of Higgs Bosons and impact on other particles. In the absence of Higgs Bosons, Brownian Motion would not exist.

iv) Existence of magnetic field around a current carrying conductor [1] proves existence of particles with force, which are none else but Higgs Bosons.

As Higgs Bosons and its field cannot be detected, its mass appears as dark matter. For the same reason, its kinetic energy appears as dark energy. In fact, dark and dark energy are synonym for Higgs Boson.

3.3 Energy-Temperature Equivalence Relation (Kelvin)

From Kinetic theory of gases, we know that

$K_e = pV = nRT$ ---------- (4)

where K_e = kinetic energy of gas molecules, p = pressure of gas, V = volume of gas, n = Number of molecules of given mass of gas, R = gas constant, T = Absolute temperature of gas.

The equation (4) can be rewritten as

$K_e / V = p = (n/V) R T$ ----------(5)

K_e / V = energy density per unit volume, n/V= Density of molecules per unit volume.

Pressure p is force per unit area across any cross section of the container of gas.

We consider a gas of given mass M in a container of volume V. Here number of molecules of gas is constant as mass is not changing. Volume of container is fixed and cannot change.

If temperature is increased, pressure of gas as well as energy density will increase. Increase in Kinetic energy implies increase in velocity of molecules. Increase in velocity indicates application of force as per Newton's Second Law of motion. The question is:who applies the forceon molecules when heat is supplied to gas at higher temperature.

To understand this, we have to understand the concept of volume of gas. Volume of gas is the sum of volume of molecules of gas and the volume of inter-molecular space. The inter-molecular space is not vacuum [(1)]. The

particles in inter-molecular space are responsible for the kinetic energy of molecules. We have identified the particles as Higgs bosons in the observations of equation 3. When heat supplied,more and more Higgs bosons from heat source enter into inter-molecular space causing the increase in kinetic energy of molecules. The equation (5) need to be rewritten as given below:

$(E_1 + E_2)/ (V_1 + V_2) = p = \{ (N_1 + N_2)/(V_1 + V_2) \} R T$ ----------(6)

$K_e = E_1 + E_2$, E_1 = Kinetic energy of Molecules, E_2 = Energy of Higgs bosons in intermolecular space

$V = V_1 + V_2$, V_1 = volume of molecules, V_2 = volume of inter-molecular space

$n = N_1 + N_2$, N_1 = Number of molecules, N_2 = number of Higgs bosons in inter-molecular space

In the equation 6, volume of molecules (V_1) and number of molecules (N_1) do not change whatever may be the temperature. The variables, which change with temperature, are E_2, V_2, p and N_2 as these are related to Higgs bosons.

When Temperature increases, the increase in number of Higgs bosons in volume V_2 , leads to increase in density of Higgs bosons. The additional Higgs bosons apply force on Gas molecules increasing their velocity hence kinetic energy.

The above explanation is for the gas law pertaining to it pressure and temperature when volume is constant. Similarly, Boyle's law and Charles's Law also can be explained in terms of behaviour of Higgs Bosons in intermolecular space.

3.4 When Temperature attains absolute zero:

We know from Charles's Law that when temperature is zero, Volume of gas becomes zero. Volume of gas can become zero only when volume of gas molecules becomes zero. It implies that Higgs bosons are drained out NOT only from inter-molecular space but they are drained out from intra-atomic space. This leads to crumbling of atoms and they convert into Higgs Bosons as per energy-mass equivalence relation.

The equation reduces to

$E_1 / V_3 = p = N_3 mc^2 / V_3$ ----------(7)

E_1 = Kinetic Energy of Higgs bosons contained in gas molecules

V_3 = New volume of Higgs bosons contained in gas molecules

N_3 = number of Higgs bosons contained in gas molecules

As per Max Planck equation Energy is proportional to frequency of wave. Hence equation (7) can be written as

$E_1 / V_3 = p = N_3 mc^2 / V_3 = hv$----------(8)

IV. Observations:

4.1Fundamental Particle and Fundamental field

From the interpretation of equation (2), we conclude Higgs field is a tensor of rank one hence it is fundamental field. Higgs boson is fundamental particle.

4.2Context of relevance – Temperature and Frequency

From equation (4) we observe: temperature is relevant in case of atoms and molecules which have characteristic attributes like size and shape. Because atoms have a stable volume (size), mass is visible. Stability of size (*volume V_1 in equation (6)*) provides stability to mass. When an electron moves from one point to another point, it carries its entire mass with it.

From equation (8) we observe frequency is the characteristic attribute in case of waves as they are made up of point particles. Since energy radiates out, volume V_3 (equation (8)) is perpetually increasing.Hence in case of point particles, the existence is instantaneous. Instability in volume causes instability in mass. This is the reason mass of point particles cannot be ascertained. In case of light, when a photon moves from one point to another point, it does not carry the same mass.

4.3Redefining Max Planck Energy-Frequency Equivalence relation:

From equation (8), we observe frequency of a wave is directly proportional to Energy density and NOT to quantum of energy alone. We also observe that every wave carries a field strength "p" force per unit area.

4.4Photo-electric effect:

Voltage generated in photo-electric effect is directly proportional to frequency of light. If frequency is related to quantum of energy only, then quantum of energy is responsible for voltage generated. In such case, a bright red light, emitting more energy, should generatemore voltage as compared to a dull blue light emitting less energy. But it is the dull blue light having higher frequency is generating higher voltage than the bright red light having lower frequency. This shows frequency is not related to quantum of energy alone but to quantum of energy per unit volume. It is the associated field per unit area with a given frequency is responsible for ejecting more electrons and generating higher voltage.

Note: Reason for brightness / dullness:
The question is: How does a bright red light (low frequency) is different from a dull blue light (high frequency)? Brightness or dullness is a property of surface. Brightness of a surface depends on the amount of energy released per unit area. It does not depend on frequency.

4.5Behavior of x-ray, laser and ultra-violet rays and ordinary light:

Strength of a field around a particle defines the potential on the particle. We have already seen (refer equation 6) that inter atomic space as well as intra-atomic space is filled with Higgs bosons. Atoms and/or groups of atoms are held by forces provided by Higgs bosons in matter. Because these forces, the inter-atomic space or inter-molecular space attains potential. This potential appears as strength of materials. Anything, which cuts through or passes through the matter, must address this potential.

When light falls on an object, it will reflect or refract will depend on potential of photons compared to potential of inter-atomic space. If potential on photons is more, it will pass through otherwise it will get reflected. A similar phenomenon takes place with other rays also. In case of X-rays and ultra-violet rays, bio cells are getting damaged, hence adverse effects are observed when flora and fauna are subjected to prolonged exposure of such rays.

Laser rays with a specific optical power have an additional capacity to drive out the Higgs Bosons in inter-atomic space, which appears as cutting or drilling.

4.6 A theoretical model needs to be developed to understand the conversions of Higgs Bosons in wave form into particles with size like electron, positron and neutrino. The validity of the model lies in its consistency in interpretation of other known accepted laws like Laws of thermodynamics, Inverse square law, electric, magnetic and gravitational field so on so forth.

V. Computation Of The Force Per Unit Area For A Known Frequency

5.1Computation of Force Per Unit Area

When a hole is drilled in a piece of metal, it has to address two constraints:

- Every metal has strength expressed as force per unit area. Any tool, whether a drill bit or laser light, must meet this condition to be able to drill a hole.
- Energy required to drill a hole of a given length.

Equation (1) meets only energy requirement but does not meet force per unit area requirement. Equation (8) addresses both the constraints. In a laser drilling, the beam must have a minimum optical power to be able to drill a hole. Power is energy required per unit time. It implies quantum of energy required any instant. Quantum of energy at any instant entails number of particles at that instant.Number of particles at any instant essentially addresses the strength (force per unit area) of material.

A laser beam of frequency "v" drills a hole of diameter "d" (equivalent cross sectional area" A") and length "l ".
Let P be the optical power of laser beam E_e be the equivalent electrical energy consumed to drill the hole.
E_e = P t where t is the time required to drill the hole.
Let " E_m" be mechanical energy equivalent ofelectrical energyE_e
E_m = F l where F = Force required to drill the hole
E_m / l = F, F can be calculated as E_m and l are known.
This force F is applied on a cross sectional area of A.
Hence force per unit area p = F / A
As d can be measured, cross-sectional Area "A" can be computed. Hence Force per unit area p can be computed.

5.2 Computation for other frequencies:

Let p_1 be field strength per unit area as computed above for a known frequency v_1. v_2 is frequency of another wave, for which field strength need to be computed.
From equation (8) $p_2 / p_1 = v_2 / v_1$ or $p_2 = (v_2 / v_1) p_1$

5.3 Computation of field strength for ordinary light:

The above computation method is for laser light. To compute field strength carried by ordinary light, we have to understand relation between ordinary light and laser light.
Let us consider a sphere of unit radius. Light is emitted from a source of light placed at the center of sphere. Light moves in all direction. The entire light is converged to a single direction to form beam of laser light.
The force per unit area p associated with laser light of frequency v now falls on entire surface area of the sphere.
The surface area of sphere of unit radius= 4Π.
The force per unit area is p/4Π for ordinary wave of frequency v.

As light or any wave follows inverse square law, the force per unit area at a distance r from a tower emitting waves of frequency v will be $p/4\Pi r^2$.

VI. Application

6.1 Effect on flora and fauna due to long exposure to radiations

We know that long exposures to ultraviolet rays, radio waves and x-rays are harmful for human body, but there is no mechanism to quantify the effect.

Now quantification of filed associated with a wave of given frequency, one can quantify the harmful effects on flora and fauna due to long exposure to such high frequency radiations. Such studies will help Environmental Scientists.

6.2 Use of Laser in Mining

In conventional cutting, the design of tools takes care of removal of materials.

In Mining, deep drilling is associated with suction pipe to remove the drilled material to increase efficiency of drilling operation. A similar approach has to be used if a laser beam is used for deep drilling. Otherwise it may lead to melting and re-melting of drilled material affecting the effectiveness and efficiency of drilling operation. Use of suction pipe will reduce energy consumption and increase drilling efficiency. The suction must withstand the temperature of removed material. As the removed material is fine powder, proper mechanism should be there to handle it.

Note: While reviewing the research papers[2][3][4][5]on Laser Drilling, it was observed that laser cutting was treated as burning rather than conventional cutting. Hence a lot of energy is used to evaporation of drilled material.

The difference between Burning and Cutting need clarification.

Any inflammable material has a characteristic temperature known as ignition point. On reaching this point only, the material starts burning. It has to be triggered once. Rest of the burning is taken care by rising temperature in the adjacent region. The process of burning continues as long as the adjacent region achieves ignition point. The energy in the intermolecular space is released, which appears as flame. The intermolecular space consists of Higgs Bosons, hence flame is made up of Higgs Bosons.

But in cutting, a cutting tool removes a small amount of mass from material and the process continues as long as the cutting tool is in contact with the material. This definition is equally applicable to shearing, planning, milling, drilling, grinding etc. etc.

This difference between burning and cutting is necessary to classify the use of Laser in industrial application at par with conventional cutting rather than burning. A lot of heat is generated in conventional cutting also. It results into high temperatures in cutting region affecting the tool properties and hence its performance. Use of coolant is to protect the tool from high temperatures.

Size of the removed material depends on the size of the tool used. In case water jet cutting, which uses fine sand, the removed particle is of fine size only. In flame cutting also, flame is made up of Higgs bosons, the removed particle is of fine size only. Similarly, laser, which consists of fine particles, exerts high force per unit area to remove the material. It generates a high temperature as well as the removed material is fine particles. Hence this is akin to conventional cutting. Because of high temperatures, it should not be confused with burning.

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