

# **Examination of dualism of electromagnetic radiations under different perspectives: mechanism of low and high temperature superconductivity**

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## **Abstract**

Of the three different types of dualism viz., wave-particle, mass-energy and matter-wave of de Broglie, the mass-energy dualism in which the rest mass showing conversion to mechanical energy is dependent on the velocity of the particle. The other two i.e., wave-particle and matter-wave have identical basis for the dual exposition of property. The fundamental property which causes the dualism in them arises from two components. These are exhibited in different perspectives by the study of electromagnetic wave – one guided by wave and the other by quantum mechanics. They are independent but supplementary to each other. This connects Astrophysics, Astronomy, Nuclear Physics, Atomic Physics, Special Theory of Relativity, Gravitation and Gravity, Quantum Theory of Gravity etc. with apparently diverse and contradictory properties. The result shows correct interpretation of neutron-proton conversion in the nucleus through d- and u- quark exchange and is the source of perpetuity in magnetic forces. Mechanism of low and high temperature superconductivity has been examined that led to the explanation of the mystery of Bermuda Triangle.

***Keywords: Basis of wave-particle duality, Real source of exchange energy, Source of perpetuity of magnetic forces, Mechanism of low and high temperature superconductivity***

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## Introduction

Huygens in 1678 suggested wave properties of the electromagnetic radiation which was strongly opposed by Newton (1686). Instead, Newton predicted corpuscular property of the electromagnetic radiation. Since then a vigorous controversy started as to the true nature of light. This controversy continued for centuries till today as in some experiments, particle properties and in some other experiments wave properties were essential for explanation. These two contradictory conceptions could not be fitted satisfactorily within the known properties of the particles which is confined within finite boundary and waves which tend to dissipate in space. As a compromise, the wave–particle dualism was temporarily accepted till a conclusive solution could come out.

To add to the dilemma of wave-particle dualism, de Broglie [1,2] in 1925 proposed that the dualism is not confined to electromagnetic radiation (photon) alone but could be extended to matter itself and the corresponding waves are called Matter-Waves. The idea that matter is associated with wave and waves are associated with corpuscles was not easily accepted.

A link between wave and particle characters of the photon could be found in the expression  $E = h\nu$  (where  $E$  is the energy expressed in terms of mass and velocity) and frequency  $\nu$  (certainly a variable associated with wave motion). de Broglie compared this expression to Einstein's expression  $E = mc^2$  the similarity is only apparent as this refers to Einstein's theory of special relativity where motion of matter is in the region of  $c$ , the velocity of light.

By comparing these two expressions  $E = h\nu = mc^2$

or,  $h\nu/c = mc = \text{momentum of a photon}$

In terms of wavelength, this becomes  $\lambda = h/mc = h/p$ , for a *photon*, but this could not be applied to a *particle* whose velocity is not comparable to  $c$ .

In any case, de Broglie intuitively proposed the expression  $E = h\nu = mc^2$  for ordinary velocities ( $v \ll c$ ) of a mass  $m$  and the corresponding wave was called 'matter waves' and from this expression the wavelength of a matter of mass  $m$  could be calculated.

For an electron with low energy ( $1.6 \times 10^{-16}$  erg), the de Broglie wave length is  $1.2 \text{ \AA}$  which is of the same order of magnitude as the spacing in a crystal lattice. Using the spacing of a nickel crystal as a grating, Davisson and Germer were able to obtain diffraction pattern to show the wave character of the electron [3,4]. This behaviour is not restricted to electron alone, because the large particles like photon, neutron,  $\alpha$ - particle and even sodium atom also show diffraction with suitable crystals as gratings.

The low energy ( $v \ll c$ ) particles conform to the phase velocity of the wave ( $\omega/k$ ) which shows a variation of amplitude with respect to  $\lambda$  and the existence of real matter wave is established.

However, when ( $v \simeq c$ ) i.e., the particle moves with a velocity compared to that of light ( $10^8 \text{ cm/s}$ ), Einstein's special theory of relativity is to be invoked to explain the motion and the corresponding energy transfer will be guided by group velocity of the wave ( $d\omega/dk$ ). This shows that with increasing velocity, the mass of the particle changes to energy up to about 80% of the velocity of light. This is not the variation of the amplitude function but it indicates a probability distribution function leading to probability wave property and thus motion of the electron leads to the subject of wave mechanics of Max Born and Schrödinger.

To add to the complexity of the process, account must be taken of Heisenberg's Uncertainty Principle, which theoretically excludes the simultaneous determination of velocity and position of a particle. This uncertainty is also extended by the concept of wave nature of the matter which contributes to further uncertainty [5]. At sufficiently high velocity compared

to velocity of light, Newtonian mechanics is not valid but must be replaced by more general theory predicted by Einsteinian theory of relativity.

The corpuscular properties of an object are characterised not only by its momentum  $p = mv$ , but also by the energy  $E$  and the wave property is described by its wave vector  $k = 2\pi/\lambda$  and frequency  $\omega = \nu$ .

If an electron beam is impinged on a crystal of very thin metal foil, they experience diffraction on a photographic plate as the distribution curves are wave-like in shape. This wave determines the probability of finding the position of an electron and Max Born [6,7] proposed the name 'probability wave' to it. Experiments show that they are not only associated with the electron, but are also universal and associated with other particles of matter at all times. These are not always detectable as the wavelength of de Broglie wave rapidly falls off with increasing mass and velocities of the particles and therefore, escapes detection. The corpuscular properties of the particles remain up to a certain point. Electromagnetic waves do not show any corpuscular property but they experience interference and diffraction. As soon as the wave length becomes small enough they show corpuscular property and are able to knock electrons out of the metal. Thus, de Broglie's discovery unites into a coherent whole what appears to be mutually exclusive properties.

Mathematically, the electromagnetic radiation impinging on the surface of a metal produces a probability of wave motion (unlike real waves) as suggested by Max Born which is guided by wave mechanical principle only. Since probability is involved, this adds to the uncertainty principle of Heisenberg. This uncertainty is now known to be aided by the uncertainty from the wave motion itself.

The wave function  $\Psi$  of the uncertainty is a function of space and time i.e.,  $\Psi(xyz,t)$ . This wave function  $\Psi$  can be expressed by a product function  $\Psi(xyz) \times \Psi(t)$  where  $\Psi(xyz)$  is a

time independent space function (stationary state) and  $\Psi(t)$  is a time dependent part which gives rise to *radiation* (used for the calculation of the energy of the electron). This time dependent part indicates that the wave property of a function leads to particle property. This is the principle of photoelectric effect as advanced by Einstein as it indicates that waves also lead to particle character. This shows that “matter waves” predicted by de Broglie can be approached from both directions, i.e., “waves of matter” and “matter of waves”. The wave property is controlled by wave mechanics and the particle character is controlled by particle (quantum) mechanics as was suggested in a previous communication [8].

### **Velocity dependence of electromagnetic radiation (mass-energy dualism)**

- i) The expression for the kinetic energy of a particle is given by  $K.E. = \frac{1}{2} mv^2$  where  $m$  is the mass and  $v$  is the velocity of the particle. Mass  $m$  may vary from 0 (photon and neutrinos) to very high value and  $v$  may also vary from 0 ( $v \ll c$ ) to the velocity of light  $c$  ( $3 \times 10^8$  cm/s). In matter waves of de Broglie, the mass is less important whereas velocity variation distinguishes the characteristics.
- ii) When  $v$  is negligible compared to  $c$ , Newtonian mechanics is valid and the particle is guided by wave mechanics which shows diffraction and interference as wave properties. In this case, the motion is described by phase velocity  $v_p = \omega/k$  where  $\omega$  is the angular frequency and  $k$  is the angular wave number.
- iii) When the velocity of the particle is comparable to  $c$ , the motions are guided by the Lorentz's and Einstein's equation.

The Kinetic Energy  $K. E. = \frac{1}{2} mv^2$  can be written as

$$K. E. = \left[ \frac{m_0 c^2}{\sqrt{1-v^2/c^2}} - mc^2 \right] = m_0 c^2 (1-v^2/c^2)^{-1/2}$$

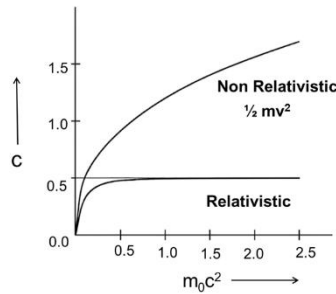
Using binomial expansion and omitting anharmonic terms

The total energy = K. E. +  $m_0c^2(1-v^2/c^2)^{-1/2} + m_0c^2$

$$= m_0c^2(1-v^2/c^2)^{-1/2}$$

Total Energy = K.E. +  $mc^2 = m_0^2c^2 (1-v^2/c^2)^{-1/2}$  where  $m_0$  is the rest energy of the mass ( $v = 0$ ), which is represented by group velocity,  $d\omega /dk = hv$ . In non-dispersive medium  $v_g = v_p$  where  $m_0$  changes to energy and reaches about 80% of the velocity of light.

Einstein [9] and Lorentz's [10] theoretical prediction of the relativistic kinetic energy expression has been verified experimentally for a variety of particles including electron. The expression shows that when  $v \simeq c$ , the magnitude of the expression becomes very large which suggests that no particle may have a velocity greater than  $c$ , as this will require an infinite quantity of energy. Figure I shows the variation in comparison to the non-relativistic expression of  $\frac{1}{2} mv^2$ .



**Fig. I: Einstein- Lorentz theory of mass-energy conversion**

iv) When the velocity is intermediate, both wave and quantum mechanics are operative. This shows Max Planck's probability waves which are non-real. This is described by a second order differential equation  $\delta^2\psi = 1/c^2 \times \delta^2\psi/\delta t^2$  where  $\psi$  is called a wave function. This is shown to be an amplitude function which is a measure of the probability. For a photon, this is dependent on the photon density and the intensity of the light is proportional to the square of the amplitude of the electric vector i.e.,  $I = c/4 \pi E^2$  showing a relationship between density of a particle

and  $\psi^2$ . Thus,  $\psi^2$  for an electron is proportional to the probability of finding electron in the volume  $dx.dy.dz$ .

### **Wave-particle dualism vis-à-vis matter-wave dualism**

Although wave–particle dualism remained as a subject of high controversy over centuries, the matter–wave dualism is of comparatively recent origin which was proposed by de Broglie in 1925. It is now necessary to examine their similarity or otherwise in view of the recent findings on wave-particle dualism [8, 11]. It has been shown that the enigmatic dualism of electromagnetic radiation and wave is but a result of presumption. The real reason lies in the presence of two different components in the electromagnetic radiation – one guided by wave mechanics and the other by quantum mechanics. This followed from the inadequacy of Big Bang theory of evolution of the universe in explaining the creation, binding and stability of the universe. The alternative proposal originates from the result of implosion of energy plasma and the cooling of super-heated state of the plasma under unusual thermodynamic process of decrease of entropy to attain a super-cooled state [12] of the universe (Earth). This facilitates the formation of virus, bacteria, enzyme and supports photosynthesis to aid vegetations in a space of over 20 billion years. It has also been shown that the two components of electromagnetic radiation have distinct function towards explanation of wave and particle activities. One component originating from the *magnetic vector* of the electromagnetic radiation was studied by *wave* mechanical principles and is responsible for the comparatively weaker attraction. The other part guided by *quantum* mechanics originates mainly from *electric vector* of the electromagnetic radiation and is responsible for the relatively stronger interaction. Thus, basic mechanism prevailing for both wave–particle dualism and also for matter–wave dualism shows the essentially similar processes in the two most controversial and hotly debated ideas of modern science. This similarity of description not only rectifies the assumptions of Newton which claims mutual attraction of all objects among themselves, but also explains the

unsuccessful battle of Einstein to find a quantum theory of gravity and arriving at a unified quantum field theory. The description signifies the fine distinction between wave and particle mechanics and clearly explains the electromagnetic phenomena like red-shift, tunnel effect, magnetic and photoelectric effect etc.

The electromagnetic radiation is neither affected by wave nor by quantum mechanical aspects and are guided by Newtonian Mechanics as real waves at the lower velocity and by the Einstein and Lorentz Relativity principles at higher velocity. On the other hand, the dualism of de Broglie matter-wave is guided by wave mechanics from wave to matter and by quantum mechanics from particle to wave. The latter is guided by the term  $p^2/2m$  (equivalent to  $E = \frac{1}{2}mv^2$ ) which smoothly changes real wave to virtual mass and finally to the relativistic waves leading to the formation of corpuscle from wave.

The bridging wave mechanical term ( $p^2/2m$ ) supplies the force necessary for punching out electrons from the metal in photoelectric effect. It means that while de Broglie matter-wave dualism is approachable from either direction, the electromagnetic wave-particle dualism is approachable from only one side. The de Broglie matter-wave dualism is partly governed by wave mechanics and partly by quantum mechanics with the contribution of phonons and magnons in addition to electrons.

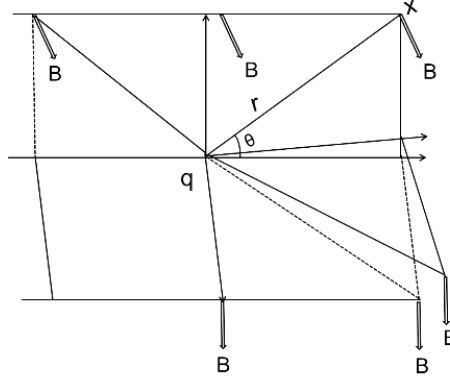
### **Magnetic field arising from an electric charge**

Although the importance of Electric field is mentioned by Maxwell, the magnetic field is not given proper weightage. In standard text books of physics magnetic effect is described as follows: -

A magnetic field is created by an electric charge  $q$  moving with velocity  $v$  to a distance  $x$  and is given by  $B = k \cdot q \cdot v \cdot \sin\theta / r^2$  where  $k$  is a constant,  $r$  is the distance between  $q$  and  $x$  and  $\theta$  is the angle between the line  $qx$  and the velocity  $v$ . This can be written as:

$$B = k.q.v.\vec{r} \quad \text{where } \vec{r} = \vec{r}/r$$

The field lines described by the electric charge spikes outwards but the magnetic fields are circles in plane perpendicular to  $v$  with centres along the line of  $v$  (Fig. II).



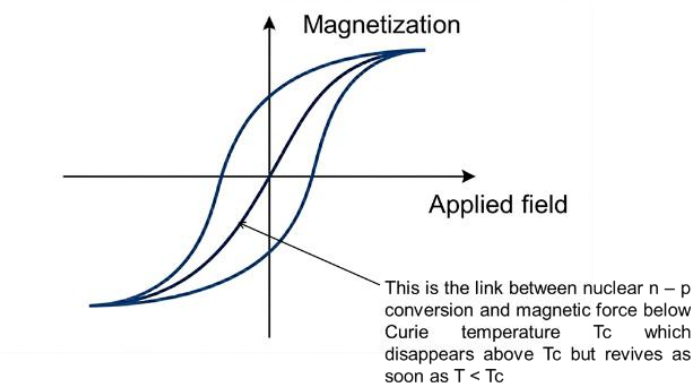
**Fig. II: Description of magnetic forces originating from an electric charge**

If  $k$  is a constant for magnetic field and  $k'$  for corresponding electric field then according to Maxwell's equations  $k/k' = c^2$  ( $c$  = velocity of light).

A few interesting results can be derived from these.

- 1) This expression relates electric, magnetic and optical fields into one. The optical field denotes that electromagnetic radiation may travel through vacuum without any 'ether' as believed earlier and the magnetic and electric fields are related to one another.
- 2) The expression  $k/k' = c^2$  means that the ratio is constant and the forces (electric and magnetic) increase or decrease in the same proportion.
- 3) We come to the expression of the cross and dot products for the magnetic vector  $(A \times B).C = \text{constant}$ . This leads to the idea of quantum of energy as proposed by Planck and intuitively applied by Einstein in explaining the photoelectric effect by the expression  $K. E. = \frac{1}{2} mv^2 = h\nu - w$  where  $w$  is the photoelectric work function and  $\frac{1}{2} mv^2$  is the excess energy of the electron ejected from the metal surface.
- 4) The electric and magnetic vectors are perpendicular to each other and are guided by their cross product. These vectors are also perpendicular to the optical vector.

- 5) It appears that the particle property of the wave (arising from the time dependent part of  $\psi$ ) is most probably responsible for the extra quantum influence of the rotation and revolution of the electron spin. This is also the quantum influence of the Compton effect of transfer of momentum in elastic collision of objects.
- 6) But the most important influence that can be derived from the magnetic vector is the perpetuity of magnetic effect as represented by the hysteresis curve which evolves from the proton-neutron conversion in nucleus as a result of d-u exchange (Fig. III). This exchange satisfies all the properties and can be termed as d-u quark exchange force in lieu of simple 'exchange force'.



**Fig. III: Hysteresis curve which links nuclear exchange force to produce perpetuity of magnetic force**

### **Mechanisms of Low Temperature and High Temperature Superconductivity**

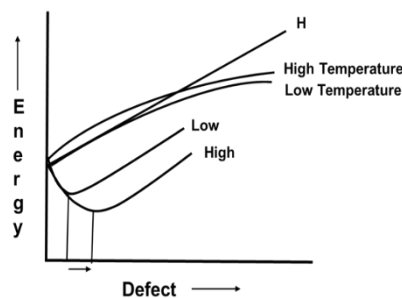
In addition to crystalline, liquid, gas and plasma states of matter, there are two more states of aggregation, viz., quantum liquid and quantum crystal. In these, the atoms are in a state of quantum oscillator where the motion of atoms could not be damped even at absolute zero temperature. The quantum liquid is responsible for super conduction of metal at low temperature while the quantum solid is responsible for super conduction at high temperature. According to de Broglie's idea to each wave, a particle is assigned with energy  $E = \hbar\nu$  and momentum  $p = \hbar k$ . The particle is usually called a quasi-particle and is called a phonon. This is an elementary particle of sound energy with frequency  $\omega$  as the photon is the elementary

particle of light. Heat is transferred by phonons, electrons, and magnons. Magnon is responsible for the temperature dependence of the magnetic moments which is a quantum of the oscillation of the electron spin. Electric charge is carried only by electrons.

The number of phonons and magnons depend on the temperature because they are quantum oscillators and these usually decrease with temperature. So, at low temperature near 0 Kelvin, these are almost non-existent and do not contribute to the rise of temperature. This is of importance in describing the mechanism of low temperature superconductivity.

### High Temperature Superconductivity

Almost all solids contain defects (of structure or composition) and these influence properties like superconductivity, diffusion etc. Intrinsic defects are defects that occur with the pure substance while extrinsic defects arise due to the presence of impurities. Point defects occur at single site but extended defects are ordered in one, two or three dimensions. All solids have a thermodynamic tendency to acquire defects because these introduce disorders to increase entropy. The Gibbs expression  $G = H - TS$  has contribution from enthalpy and the entropy of the samples.



**Fig. IV: The formula  $G = H - TS$  shows the increase in defect concentration with increasing temperature**

As the temperature is increased, the minimum of Gibb's energy curve moves to the right i.e., at higher concentration of defect (Fig. IV). At higher temperature, the number of phonon and magnon also increases.

It has been suggested that electrons jump into the interstitial position and form “electron pairs” [13,14] just like the pairing of electrons by “exchange reaction” impart stability to a chemical bond. The exchange interaction as binding force was mathematically rejected by Coulson [15]. However, a d- and u- quark exchange mechanism has been proposed to clear the situation by overcoming the objections.

Objections for electron pair formation and exchange of identical particles were examined critically and was rejected by Coulson

- i. Pairing of electrons to produce conducting system.
- ii. Exchange of electrons for bonding (Heitler – London theory) [16].
- iii. Exchange of two identical particles does not clear the situation ( $\mu$ -meson or  $\pi$ - meson by Yukawa) [17].
- iv. Pairing of electrons will decrease the number of free electrons according to Pauli exclusion principle.

So, formation of “Cooper’s pair” will decrease the number of electrons and will be against the HTSC. But, the overlap of Brillion zones as discussed will offset the difficulty.

High temperature superconductivity is powered by magnetic vector through nuclear exchange of quarks and is perpetual, unless heated when magnetism is lost. Otherwise, it may last for 10,000 years [18] This is the reason why magnetic effect is not lost from the system and is preserved as the central common channel (ccc) of the histogram curve. Low temperature superconductivity is powered by electric vector through solar energy and is not perpetual, hence no histogram curve is expected.

It is now possible to distinguish and differentiate between the mechanism of low temperature superconductivity and high temperature superconductivity. It appears that these mechanisms are completely different from one another and cannot be applied simultaneously to both phenomena. At the *momentum space*, the low temperature superconductivity is defined

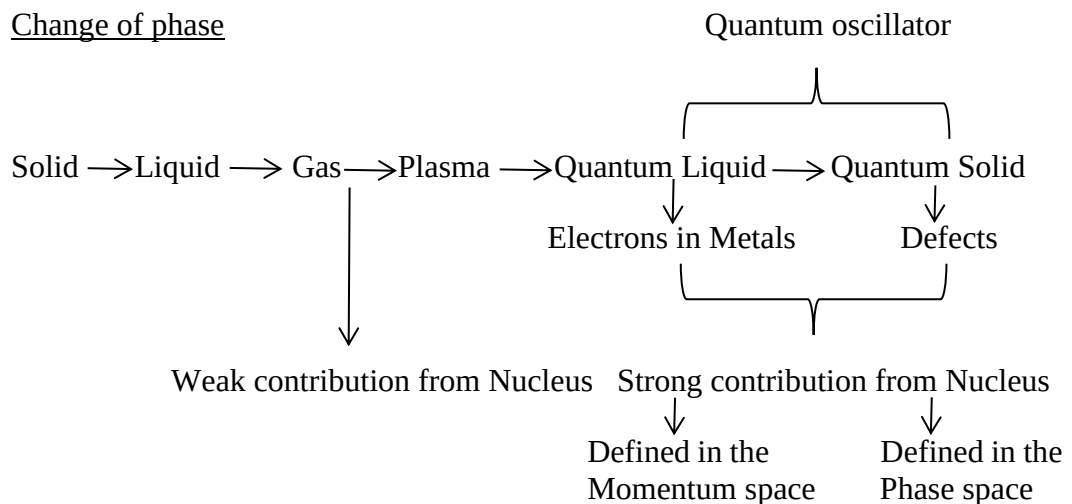
as contributed by phonons and magnons which are in a state of quantum liquid as suggested (they are in quantum oscillator state). On the other hand, the HTSC is contributed by overlap of crystal lattice spacing in quantum crystal state (also in quantum oscillator state) in *phase space* by the overlap of Brillion zones which opens the tunnelling path for electrons in three dimensions (as suggested in an earlier communication [19]. At high temperature, number of electrons, phonons and magnons all contribute to high temperature superconductivity.

### Concluding Remarks

- 1) It is not proper to think that the wave–particle dualism is an inexplicable chameleon like property which sometimes show particle and sometimes show wave property at its own sweet will. It has been shown that these propositions are the result of perfectly legitimate logical conclusion involving accepted theories [8, 11]. The same is true for other types of dualism like mass–energy and matter–wave dualism of de Broglie. The mass–energy conversion is an effect of direct conversion of nuclear energy to mechanical energy through the equation  $E = m_0c^2$  depending on the velocity of the particle reaching almost  $c$ , the velocity of light. Wave–particle dualism was proposed by de Broglie which characterizes particle with a motion and the wave by a wave vector. He proposed  $p = \hbar k$ , where  $p$  (momentum) is assigned with  $E$  (energy) and  $k$  (the wave vector) is assigned with frequency  $\omega = hv$ . For a free particle in vacuum  $E^2 = c^2p^2 + m^2c^4$  and for a wave in vacuum  $\omega^2 - c^2k^2 = 0$ . Thus, for electromagnetic radiation we can assign a particle with  $m = 0$ , velocity =  $c$  (light). With higher energy, higher is the momentum (photon). With  $E = cp$ , the formula  $E = \sqrt{c^2p^2 + m^2c^4}$  shows that for  $p \gg m$ ,  $E = cp$  and for  $p \ll m$ ,  $E = m_0c^2$ .
- 2) The root cause of dualism in the cases cited above appears to originate from the source of energy involved in the process. There are two main energy sources, one *external* which receives energy from solar source. The other an *internal* which receive energy

from nuclear sources. The impact of nuclear energy is not very great on electromagnetic radiation excepting its influence on photoelectric effect, magnetic effect and Compton effect. But in systems involving quantum oscillators like in quantum liquid and quantum solid systems, the role of nuclear energy is most important for mass–energy conversion. The rest mass converts to the mechanical energy and in de Broglie matter-wave, a nucleus supplies the energy for particle formation.

- 3) Many facets of dualism exist in different phases of matter. The whole process may be briefly described as follows: -



- 4) Newton (and probably the mathematicians associated with him at those times) were at a loss to explain the gravitational laws which were totally independent of dielectric (medium) in between. No object (big or small, of any shape, stable or unstable, charged or uncharged, radioactive or not, hot or cold) had any influence and the aloofness could not be satisfactorily explained. Le Sage in 1784 proposed that gravity is actually a pushing force caused by physical particles colliding with matter. But due to lack of proper theoretical and experimental evidence this claim could not be substantiated.

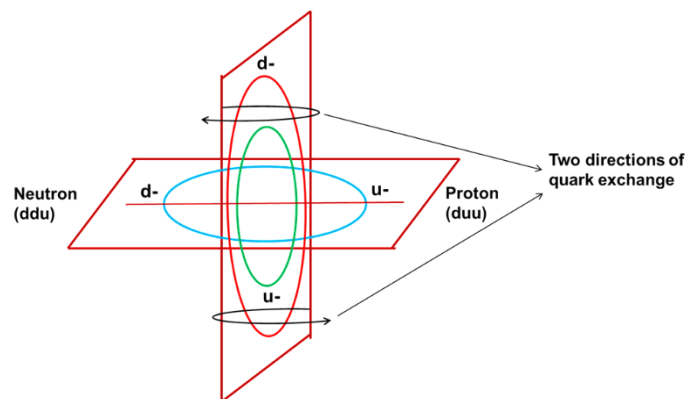
In search of a suitable alternative to provide for the attractive force Newton and other mathematicians of those times had to bypass the problem by invoking attraction coming from terrestrial objects among themselves. This assumption made the universal laws to be considered as infallible although nothing in favour or against was known about such attraction at those times.

But with the advancement of space science now we came to know that the astronauts can move in space without any attraction or repulsion among each other. With this one stroke of information Le Sage's suggestion was vindicated whereas the claim of infallibility of Newton's laws went to smithereens and the assumption of an alternative force or attraction prevaricated. With the availability of such evidences at present time [8, 11] it seems possible to recast the theory for universal gravitation as follows:

“Universal gravitation is a strong quantum mechanical force with conglomerative tendency which i) prevents the universe from falling apart in space. ii) holds the stars in space through gravitation and iii) holds planets with residual force as gravity. Thus, ‘binding force of universe’, ‘gravitation of stars and gravity of planets’ are the same quantum force in different guises.

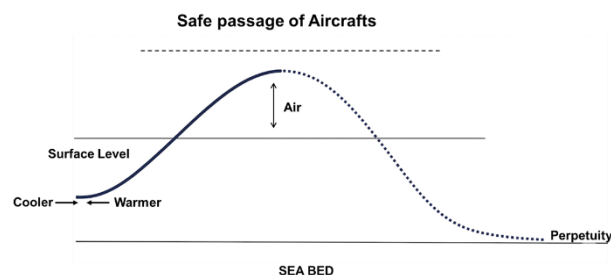
- 5) Einstein was no exception to the idea of infallibility proposed by Newton (and the mathematicians). He tried heart and soul to provide a suitable justification of proposing a unified field theory. Newton's interpretation about gravitation and gravity led Einstein [20] to a painstaking research of finding a unified field theory which was not successful. It has been shown at present that gravitation and gravity are the result of a quantum force [21]. Thus, which was proposed as a unified field theory now can be considered as unified quantum theory after course correction.

- 6) Scientists are at pains to suggest a proper explanation of ‘exchange force’ which can withstand the mathematical objections of the concept by Coulson [15]. At present, a nuclear u- and d- quark exchange force has been proposed which appears acceptable in face of Coulson’s objections and can thus be termed as ‘u-d quark exchange force’
- 7) The mechanisms of low temperature and high temperature superconductivity (LTSC and HTSC) are completely different from one another. The LTSC is dependent on solar energy (*external* source) and is not perpetual because emission of the electrons from metal ceases as soon as the solar energy is discontinued. Meissner [22] effect also goes against the solar energy. At lower temperature when the number of phonons and magnons are small, only electrons contribute to HTSC. This phenomenon, called superconductivity was observed first by Kamerlein Onnes in 1911 [23]. On the other hand, HTSC is dependent on nuclear energy (inner source) where a d-u- quark exchange takes place to supply a perpetual magnetic force (vide Fig. V). At warmer temperature the number of free electrons become lower but channels open in three dimensions to allow for overlapping of Brillion zones. At this temperature, number of electrons, phonons and magnons all contribute for HTSC. In neither case the contribution of quarks is essentially important.



**Fig.V : Quark exchange reaction in the nucleus in neutron – proton conversion**

8) Using NMR method, File and Mills demonstrated the perpetuity of magnetic force by the decay of the super current in a solenoid. This decay process is quite long and may continue for not less than hundred thousand years [18]. This perpetuity results from the formation of d- and u- quarks which are formed due to the absence of Meissner effect, are aided and abated by mutual enforcement to form swarms of *transient* d- and u- quarks to attract anything and everything to the sea bed and then to perpetuity. This has been described in a recent publication [24]. At lower temperature, the perpetuity disappears and the hysteresis curve vanishes (vide Fig. VI) but reappears as soon as temperature rises. When we come to the question of quarks, some more considerations seem necessary. Action of quarks as described in the case of Bermuda triangle reminds us of quicksand which draws anything downwards. But quicksand is far less dangerous because one who knows swimming can keep oneself adrift, but for quarks no respite is expected.



**Fig. VI: Two-Dimensional Description of Mystery of Bermuda Triangle**

9) It is usually seen that natural processes are quite simple and unchangeable with time. The laws that prevailed at the beginning of the universe are still operative except some marginal changes due to lowering of temperature. Unable to study correctly and unable to crack the protected password of natural processes, we sometimes use mathematical jugglery.

Physics in different aspects, be it Astrophysics, Astronomy, Nuclear Physics, Wave–particle dualism, Einstein’s Special Theory of Relativity, Atomic Physics etc., are not

independent of one another and there is every possibility that all these are manifestations of one single concept but appears differently in different perspectives. The present work shows the real reason for wave–particle dualism that lies in its bi-component description of electromagnetic radiation. This description can be extended to almost all the different aspects of physics except some *tera-incognita* like fundamental constituents of matter. Thus, to some extent a jigsaw puzzle like components may be put forward.

## Acknowledgement

The author laments his inability to find words to express gratitude to vixra.org preprint service for their ready acceptance of the series of papers without any prejudice for the examination of scientific minded people at large.

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