

Physics of our Four-Dimensional Space

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Dedicated

To

John Archibald Wheeler

The eminent American physicist (1911-2008)

*Whose strong belief in existence of a simple idea behind all
Natural phenomena inspired me to find a new path for physics.*

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FOREWORD

The sole aim of this book is to convince our readers about the validity of a new four-dimensional (4D) model of physics justifying the existence of fourth space dimension. Due to the presence of an extra space dimension, this 4D space model is totally different from the standard model of particle physics. Standard model accepts the hypothesis of expanding universe with big bang origin disregarding the problem of singularity at the origin. However our new model accepts an alternate singularity-free cosmology and everyone will be surprised to know that theories and equations obtained from this new cosmology are able to give simple explanations of many puzzles of physics such as: internal structure of fundamental particle, origin of mass, origin of charge, origin of spin, origin of strong force, wave- particle duality of matter and radiation and many others.

Unlike unrealistic ten-dimensional string theory our new model assumes the existence of four-dimensional space so that our conventional three-dimensional space becomes the base of the projection of this four-dimensional space. Corresponding to every description of a phenomenon in our conventional three-dimensional universe there is an alternate description of the same phenomenon in this four-dimensional universe. For example, structure of a particle in our four-dimensional universe should be such that its projection on our three-dimensional universe would be a sphere to justify spherical shape of the particle.

As per the new model our four-dimensional universe is filled with two kinds of four-dimensional particles. Fundamental particles like electrons, protons are created from these four-dimensional particles when four-dimensional space

deforms locally. Our new model asserts that fundamental particles have 4D structures described by the equation, $w = \pm a \exp[-b(x^2 + y^2 + z^2)]$, where w is the displacement along fourth dimension perpendicular to x , y and z directions. Theoretically fundamental particles as described by this equation have 4D structures of infinite extent which justifies electromagnetic or gravitational influence of one fundamental particle on another at very large distance from it. There is no such device in our traditional 3D models to justify mechanism of action at a distance.

As per our new model every object in this universe moves as wave because fundamental particles constituting the object move as 4D wave pulses when 4D particles of 4D space execute local transverse vibrations along fourth dimension. Stable and localized nature of these 4D wave pulses is more appropriate to resolve wave-particle duality of matter than that done by a wave packet of 3D model because wave packets are not stable though localized. The equation of 4D wave pulse has been used to derive de Broglie hypothesis ($\lambda = h/mv$) of matter wave in a very simple way. Our traditional physics does not derive this but accepts it as a hypothesis because this equation is valid for radiation. New model also resolves the puzzle behind dual nature of radiation by assuming photon as a discrete wave of finite length in 4D space. This discrete wave behaves like a particle as it can be absorbed or emitted instantly. The progressive transverse nature of discrete waves or photons in a beam of light can explain double slit experiment and all optical phenomena in usual manner.

Our new model stands on laws of classical mechanics, but it supports quantum mechanics by relating Schrödinger equation to the 4D structures of fundamental particles and thus gives us the reason behind the success of Schrödinger equation

in almost all cases of micro particle physics. Quantum mechanics always gives correct mathematical answer by calculating the probability of an event but does not give a classical picture describing how the particular incidence occurs. Our new model resolves this mystery of quantum mechanics by describing the quantum behavior of micro particles by means of classical behavior of super micro particles of 4D space.

A 4D classical technique (named as spiral transformation) of converting energy into matter and vice versa is described in this book. To get a clear idea about this process, we have to understand the process of clay pot making on a rotating pad where masses of clay are added to the body of the pot along a 3D spiral path. In spiral transformation process, addition of 4D mass to the 4D structure of fundamental particle occurs along a 4D spiral path with the help of a photon. Standard model does not give us a classical picture of this phenomenon.

Traditional physics has no clear concept for charges of fundamental particles. It fails to answer how Nature dopes exactly equal amount of charges into particles of different masses? As per our new model charge is not a quantity that can be distributed over a fundamental particle. Concept of charge arises from the Coulomb force on the fundamental particle which is found to be independent of its size and dependent on its shape. This new concept is responsible for equal magnitude of charges ($\pm e$) of fundamental particles of different masses shape being similar for all.

According to point of inflexion theory of our new model repulsive Coulomb force becomes attractive strong force at the point of inflexion where convexity or concavity changes sign. So unification of these two forces is done in a very simple manner. This book provides an expression for unified coulomb

and strong force to justify this point of inflexion theory. Why electron-positron pair annihilates? What prevents electron in falling into nucleus? Why n-n or p-p combination is unstable in spite of strong attractive force? Why n-p combination (deuteron) is stable? These four observed facts are explained by the point of inflexion theory.

This new baby model is able to explain or interpret successfully a good number of fundamental laws, puzzles or phenomena of modern physics. These explanations and interpretations must not be regarded as accidental coincidences. A lot of more outcomes will emerge when more people take interest in developing or modifying this baby model.

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Chapter - 1

NEED FOR AN ALTERNATIVE TO STANDARD MODEL

Standard model is a name given to a theory of fundamental particles and their interactions. Standard model works on two basic ideas. First, all matter is made of elementary particles and second, these particles interact with each other by exchanging other particles which are associated with the fundamental forces. The standard model puts field theories quantum electrodynamics (QED) and quantum chromodynamics (QCD) under one umbrella. QED deals with electromagnetic force, the exchange particles being photons where as QCD deals with strong nuclear force, the exchange particles being gluons. In standard model, the weak nuclear force and electromagnetic force have been combined into a unified electroweak force, the exchange particles being photons, W^+ , W^- , and Z^0 bosons. Standard model also accepts the hypothesis of expanding universe with big bang origin where all the mass of our universe was compressed at the beginning of its creation.

Standard model provides a successful classification of all known particles and interactions with the help of a specific list of elementary particles that includes 36 quarks, 12 leptons, 12 mediators and one Higgs boson. This model also tells us what kind of processes each particle can go through and how to calculate the probability amplitude for each such process. The values of probability amplitude can be compared with experimental observations. In successful case the value of probability amplitude tallies with the experimental observation. Nearly every quantity that has been measured in particle physics laboratory during last fifty years falls right on the

predicted value. At present standard model seems to be highly successful in explaining most of the experiments and observations of modern physics. QED of standard model is quite successful in calculating the values of probability amplitudes for some properties of electron, the experimental results of which tally up to 10 decimal points. Cosmologists and astrophysicists successfully explain the evolution process of our universe with the help of fundamental particles and fundamental forces of standard model.

Then what is wrong with the standard model? For all its success standard model is not complete because it does not include gravity. Incompatibility between gravity and quantum mechanics is a question beyond standard model. Fractional charges of quarks have not been discovered till now and standard model cannot easily account for how neutrinos have mass nor can it explain why our visible universe contains only matter, not antimatter. Standard model does not answer why there are three generations of quarks while only first generation stably exists in proton and neutron and why top quark is as heavy as gold atom, though it is an elementary particle with $2/3e$ charge. As per the opinions of most physicists, all these shortcomings of standard model are negligible in comparison to huge number of successful cases.

In spite of tremendous success in explaining experiments and observations of modern physics, standard model is not at all a good model, not because of above mentioned shortcomings but because it includes large number of arbitrary elements and ad hoc assumptions. The equations of standard model contain a large number of arbitrary numbers to be filled by hand to fit the experimental results. Too many ad hoc assumptions make the model more complex, though they can fit everything. As an example, standard model has to assume the

existence of three types of colour quark for each flavor quark in order to meet the problem of violation of Pauli's exclusion principle. Another example is the assumption of the universal presence of Higgs bosons whose interactions with fundamental particles give them their mass.

The creators of standard model extended QED to tackle the fields of strong nuclear force in QCD. QCD deals with quarks and gluons whose existence has not been confirmed till now. The existence of quarks was speculated because fractional distribution of charges in quarks provided an easy classification of particles of particle-physics because of large number of choices to get charges $\pm e$ (for charged particles) or 0 (for neutral particles) from addition of charges $\pm 2e/3$ and $\pm e/3$ of quarks and anti-quarks. Many physicists believe that speculation for existence of quarks and gluons was correct and these elementary particles really exist in nature, because most of the experiments and observations of nuclear physics tally with the predictions of QCD theory. However most physicists strongly believe that there is something beyond quarks, gluons and QCD of standard model, but they have to accept this model at present as there is no alternative.

In 1913, when predictions of Bohr's theory of hydrogen and single ionized helium atoms match the experimental results of spectral lines up to five significant figures, many scientists believed that this theory is nearer to truth of nature. But Bohr's theory was found to be wrong as it could not be applied to heavier atoms and could not explain the intensities of spectral lines. Later vector atom model solved most of the problems of atomic physics giving extremely accurate predictions on spectroscopic experiments and observations. The success of vector model depended on large number of ad hoc assumptions made to fit the results of experiments and observations, but the

model had no sound theoretical basis. Finally vector atom model was replaced by new quantum theory which solved most of the problems of modern physics with the help of Schrödinger equation and electron spin. New quantum theory is based on precise mathematical postulates though it is counter-intuitive. The mystery behind the origins of all powerful Schrödinger equation and electron spin has been removed by our new 4D model.

The discussions of previous paragraph highlight how two wrong models give extremely accurate predictions on experiments and observations. If this argument is applied to standard model then it will not be wise to accept it with certainty as the final correct model of nature even though it gives extremely accurate predictions in most cases. No systematic researches have been done yet to find out the mysterious reasons why wrong models in many cases give extremely accurate predictions on experiments and observations. Similarity between truth elements of nature and some contents hidden in the assumptions of a wrong model may be the reason behind this mystery.

Standard model is a very complex model. Most of the processes in standard model are generally explained by means of mathematical terms like probability amplitude, creation operator, annihilation operator etc. without providing us classical pictures to incite our intuition. Further presence of large number of arbitrary elements and assumptions regarding universal (ether-like) presence of particles such as: virtual photons, virtual gluons, virtual electron-positron pairs, Higgs bosons, Dirac's electron sea etc. increase the complexity of the model. Many physicists believe that truth of nature will ultimately be described by simple ideas. Simplicity of Einstein's mass-energy relation and de Broglie's hypothesis

indicate that there might be simple clues, hidden somewhere, to explain the wonderful nature of our universe. Standard model may explain many experiments and observations, but it is possible that better simple models may replace it. We know how complex geocentric (false) theory of Ptolemy was replaced, after a long interval of fifteen hundred years, by simpler heliocentric (true) theory of Copernicus. So physicists are in search of an alternate simple model with minimum number of arbitrary elements and ad hoc assumptions. After development into a full-fledged one, the new four-dimensional space model described by this book may be a suitable substitute of standard model.

Chapter - 2

PRELIMINARY IDEAS ABOUT FOUR- DIMENSIONAL SPACE

Maximum how many mutually perpendicular straight lines can be drawn from a point on a plane surface? The answer is two, so a plane surface is two-dimensional. Similarly the space where we live is three-dimensional because maximum three mutually perpendicular straight lines can be constructed at any point. Does a space exist where maximum four mutually perpendicular straight lines can be constructed at any point in this space? The answer is yes though it is difficult to imagine the existence of 4D space because we are three-dimensional creatures. In the last chapter we shall assert by several arguments that our space is actually four-dimensional not three-dimensional. In this chapter we shall discuss about some simple ideas concerned with 4D space by means of dimensional analogy of one, two and three-dimensional space.

2.1: Picturing 4D geometry by dimensional analogy method.

Straight line, plane surface and flat volume (flat 3D space) has analogous meanings in one, two and three dimensions respectively. A straight line can be bent to become a curved line by occupying two-dimensional space. A plane surface can be bent to become a curved surface by occupying three-dimensional space. Similarly a flat 3D space can be bent to become a curved space by occupying four-dimensional space. The thickness of a straight line that divides a plane surface into two parts is zero. The thickness of a plane surface that divides the entire 3D space into two parts is zero. Similarly the thickness of a flat 3D space that divides the entire 4D space into two parts is zero. Two non-parallel straight lines lying in a plane will intersect at a point. Two non-parallel plane surfaces

lying in 3D space will intersect on a line. Similarly two non-parallel flat 3D spaces embedded in 4D space will intersect in a plane. But two parallel universes, like two parallel straight lines, will not intersect each other.

The n-sphere: A two-dimensional spherical surface with surface area $4\pi r^2$ that encloses a three-dimensional sphere of volume $4/3\pi r^3$ is denoted as 2-sphere. A one-dimensional circumference of length $2\pi r$ that encloses a two-dimensional circle of area πr^2 is denoted as 1-sphere. In general an n-dimensional hyper spherical surface with hyper surface area $\frac{2\pi^{\frac{n+1}{2}}}{\Gamma(\frac{n+1}{2})} r^n$ that encloses an (n+1)-dimensional hyper sphere of

hyper volume $\frac{\pi^{\frac{n+1}{2}}}{\Gamma(\frac{n+1}{2}+1)} r^{n+1}$ is denoted as n-sphere (here Γ

is gamma function). So as per the formulae mentioned in the previous sentence a three-dimensional hyper spherical surface with volume $2\pi^2 r^3$ that encloses a four-dimensional hyper sphere of hyper volume $\frac{1}{2} \pi^2 r^4$ will be denoted as 3-sphere and 0-dimensional points (two in number) that encloses a one-dimensional diameter of length $2r$ will be denoted as 0-sphere.

4D cylinder: Let us consider a right circular cylinder whose two circular caps are parallel to xy -plane. Then axis of this cylinder will be parallel to z -axis. Here every point of a circular cap will be equidistant from the opposite circular cap. Now let us imagine a 4D cylinder (called spherinder) with two equal size flat spherical caps parallel to xyz -flat space. Then axis of this 4D cylinder will be parallel to w -axis (axis along fourth dimension). Here every point of a spherical cap will be equidistant from the opposite spherical cap.

Tesseract: A square is bounded by four straight lines and a cube is bounded by six plane surfaces. Applying dimensional analogy we have a 4D object called tesseract (refer the article

‘Four-dimensional space’ of Wikipedia) which is bounded by eight numbers of cubes.

2.2: Three thought universes.

In this section we shall discuss about three imaginary universes of one, two and three dimensions out of which third one is closely related to our 4D universe.

First thought universe: Let 1D circumference of a grand circle embedded in 2D space is the space for our first thought universe. Suppose a 1D creature, occupying 1D space of negligible length, lives in this universe. For this creature there are only two directions along which he can move or send signals. If he start moving or start sending a signal along one direction and his motion or motion of signal is continued along this direction, then after a long interval of time, he or his signal will return to the starting point. If any one of the above mentioned two processes can be completed before the death of this creature, then he will be convinced to conclude that (a) his universe is finite (b) his universe is a closed one (c) his universe is unbounded (because a part this universe can be bounded by two points not whole universe). For a 2D outsider, this 1D universe is curved but idea of curvedness or straightness will not occur to the mind of the 1D creature, because unlike 2D creature he cannot bend his path of motion, neither can he change his direction of motion without retracing the original path. Also the idea that a 2D space exists and he is moving around a center located in this higher dimension will never occur to his mind.

Second thought universe: Let 2D spherical surface of a grand sphere embedded in empty 3D space is the space for our second thought universe. Suppose this space is partly empty and partly filled with 2D particles which assemble in different groups to

produce objects or creatures. Again suppose 2D creatures, each occupying 2D space of negligible area, live in this universe. For these creatures there are infinite numbers of direction along which each of them can move. Unlike 1D creatures of first thought universe, they can distinguish between curved line and straight line because they have space to bend a linear object into a curved one. If these creatures are civilized enough to be well acquainted with plane geometry, then it is possible that a few of them are brilliant enough to imagine about our first thought universe. Applying dimensional analogy of this 1D thought universe to their 2D universe they will be able to hypothesize that (a) their universe is finite but unbounded (b) their universe is curved but locally it is plane (c) any straight line path in their universe is the part of a great circle whose center coincide with the center of a 3D hyper circle i.e. sphere. If this thought universe is very large (like our universe), then it will not be possible on the part of its inhabitants to complete a journey along this great circle.

In case of our second thought universe we have assumed that 2D space of this universe contains 2D particles but the 3D space in which this thought universe is embedded is empty. Now imagine the complementary case – a grand 3D sphere (filled with one kind of 3D particles) separated from the surrounding 3D space (filled with other kind of 3D particles) by means of a spherical surface of separation whose thickness is zero. Geometrically this surface of separation is similar to our second thought universe. But physically, the particle layers adjacent to the surface of separation may exhibit surface tension property due to cohesive and adhesive force of attraction among two kinds of particles.

Third thought universe: Let 3D hyper spherical surface of a grand 4D hyper sphere embedded in empty 4D space is the

space for our third thought universe. Like second thought universe this one is finite but unbounded and curved but locally flat. But we are more interested in a universe complementary to this one because it resembles our universe which is nothing but a grand 3D hyper surface of separation of zero-thickness, separating a grand 4D hyper sphere (filled with one kind of 4D particles) from the surrounding 4D space (filled with other kind of 4D particles). In the next chapter we shall discuss about this in detail.

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Chapter - 3

STRUCTURE OF OUR FOUR-DIMENSIONAL UNIVERSE

In this chapter we shall discuss about the implications of two simple assumptions in shaping our new four-dimensional cosmology. One may identify these assumptions as speculations. But one thing is certainly clear - a cosmological model without speculations is impossible. Validity of these assumptions will be confirmed by the results of quantitative researches done later. But successful explanations or interpretations of large number of phenomena or puzzles of modern physics resulting from initial qualitative researches on this model indicates that these assumptions are correct.

3.1: About first two assumptions of our new model.

Before describing the structure of our 4D universe, it will be better to state following two assumptions with the help of which we can describe our 4D cosmology.

First assumption: *Our universe is four dimensional filled with two kinds of four dimensional hyper spherical particles.*

The idea of fourth space dimension is an old one, but the idea of four-dimensional space built up by 4D particles is definitely a new idea. In chapter-5 we shall describe how fundamental particle-antiparticle pairs are created from these 4D particles due to deformation of 4D space, like formation of water bubbles on water surface. Since fundamental particles are known as micro-particles of 3D space, these extremely small 4D particles will be known as super micro-particles of 4D space. These 4D particles are supposed to be guided by the laws of classical mechanics. In this book we shall describe all incidences by means of classical behavior of these 4D particles.

Second assumption: *Every 4D particle exerts two kinds of forces on every other 4D particle simultaneously, one is long range and other is short range in nature.*

The long range force is called hyper gravitational force because it is similar in nature to gravitational force of our conventional 3D universe. This force determines the structure of our universe by creating two 4D universe on two sides of our conventional 3D universe. The short range forces among 4D particles are similar to cohesive and adhesive forces. They are responsible for hyper surface tension phenomena on our conventional 3D universe which behaves like a grand elastic hyper spherical membrane separating two 4D universe on either side

3.2: Structure of our 4D universe.

It is already mentioned in the first assumption that our four-dimensional universe is filled with two kinds of four dimensional *hyper spherical particles*. The long range attractive force between any two particles of these two kinds is just like gravitational attraction between two particles of our conventional 3D universe. We may call this force as *hyper gravitational force*. The first kind of 4D particles are heavier, so due to central attractive forces among them they form a grand four dimensional hyper sphere around the center of our 4D universe. Let these particles be named as *inons* because they form the inner hyper sphere of the 4D universe. The second kind of 4D particles are lighter than the first kind and let them be named as *outons* because they form the outer hyper sphere of our 4D universe surrounding the inner 4D hyper sphere. So 4D space is not empty but filled with inons and outons - extremely small super micro particles.

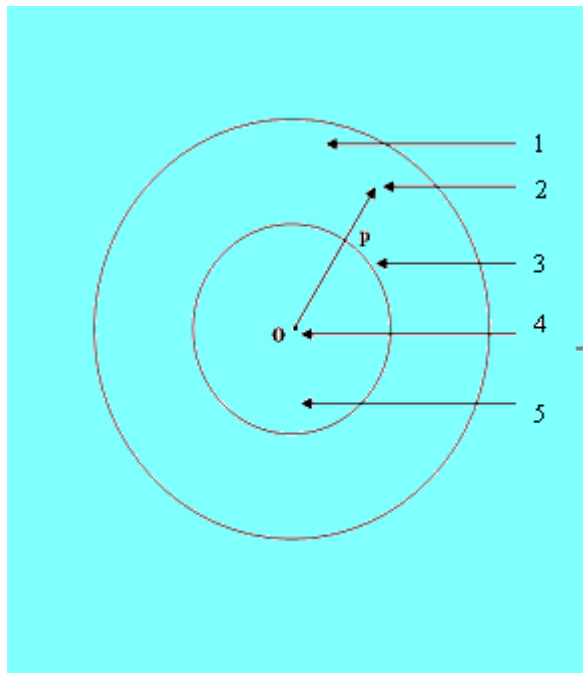


Fig.1 shows the structure of our 4D universe.

1: Outer 4D hyper spherical universe surrounding the inner 4D hyper spherical universe. 2: Hyper vertical direction which gives the concept of 'above and below' in 4D. 3: 3D hyper spherical surface that separate two grand 4D universe is our conventional 3D universe. 4: Center of 4D universe. 5: Inner 4D universe surrounded by outer 4D universe.

Our new model asserts that our conventional 3D universe is nothing but the 3D hyper surface of separation (fig.1) lying in between the inner 4D hyper sphere and outer 4D hyper sphere. Just like a two dimensional spherical surface separates an inner solid sphere and a concentric hollow outer sphere, our conventional 3D universe separates an inner solid 4D hyper sphere and a concentric outer hollow 4D hyper sphere. So our 3D universe is a grand three dimensional hyper spherical surface sandwiched between two concentric four dimensional hyper spheres. Third arrowhead of fig.1 points toward a circle which represents a 3D hyper spherical surface (our 3D universe) lying in 4D space. This figure shows that our 3D

universe is finite and but unbounded with no beginning and no end like Einstein universe [1]. Our 3D universe is curved, but it is flat locally because of grand size of the universe. Any straight line path in our 3D universe is the part of a great circle whose centre coincides with the centre of the 4D universe. An object moving along a straight path in any arbitrary direction will circle around the centre of our 4D universe and come to the starting point.

At any point in our 3D universe it is possible to construct three mutually perpendicular axes. But we can imagine an extra normal at every point. This extra normal, if produced along inward direction, will pass through the centre of our 4D universe. The outward direction of this extra normal is the hyper-vertical direction of our 4D universe at the point. This hyper vertical direction (pointed by 2nd arrowhead of fig.1) gives us the concept of 'above and below' in four dimensions. A straight line along the hyper vertical direction will intersect our 3D universe at a point which indicates that thickness of our universe is zero along this direction. So our 3D universe is just like a thin membrane that divides our 4D space into two parts. On upper side of this 3D membrane lays the outer hyper sphere of 4D universe filled with outons and on lower side lays the inner hyper sphere of 4D space filled with inons. To conceptualize how infinitely extended 3D space is a membrane of zero thickness, let us apply dimensional analogy to ocean surface. Here vastly extended 2D surface of separation divides 3D space into two parts - a 3D world of air on upper side and a 3D world of water on lower side. But what is the thickness of surface of separation here?

3.3: Hyper surface tension property of our 3D universe.

In our second assumption it is assumed that in addition to the long range hyper gravitational force there are also local attractive cohesive and adhesive forces between any two 4D particles. These two short range forces give rise to *hyper surface tension* phenomena in a manner similar to surface tension phenomena on the surface of water. The cohesive force between any two outons is assumed to be more than the adhesive force between an inon and an outon. For this reason the 3D hyper surface layer just above our 3D universe will exhibit hyper surface tension phenomena with positive hyper surface energy. This is because the outons lying within this 3D hyper-surface layer experience a net upward force and thus work must be done against this upward force to bring more outons to this hyper surface layer i.e. to increase the hyper volume of the hyper surface layer. Similarly we may assume that the cohesive force between any two inons is less than the adhesive force between an inon and an outon. This results in giving a negative hyper surface energy to the 3D hyper surface layer lying just below our conventional universe.

The net hyper surface energy of our 3D universe is the sum of the positive hyper surface energy of the 3D hyper surface layer lying just above our 3D universe and negative hyper surface energy of the 3D hyper surface layer lying just below our 3D universe. The net hyper surface energy per unit space should have such a value that particle formation in our universe will be smooth. If net hyper surface energy per unit space has large positive value, then formation of particles in our universe will be difficult. On the other hand if net hyper surface energy has a negative value, then our universe will be unstable because there will be a tendency of increase of volume at every place in the universe. So the value of net hyper surface

energy per unit space should be small but positive. Due to hyper surface tension phenomena our 3D universe behaves like an elastic 3D membrane of special kind with similar conditions on both sides so that a fundamental particle and its anti particle can be created on opposite sides.

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Chapter - 4

STRUCTURE OF FUNDAMENTAL PARTICLES IN 4D SPACE

In standard model particles like electrons and quarks are fundamental particles without any internal structures but particles like protons and neutrons are not fundamental. In our new model quarks have no existence and we will follow old convention to call electrons, protons, positrons and anti-protons as fundamental particles though they are constituted by super micro particles - inons and outons of 4D space. The structures of these particles in 4D space are not hyper spherical but their projections on our 3D space are spheres justifying their spherical shape in 3D space.

4.1: Four-dimensional structure of fundamental particles.

The structures of fundamental particles like electrons, protons, positrons and anti-protons in 4D space are determined by the third assumption of our new model.

Third assumption: *Fundamental particle with negative charge (or positive charge) is created when our flat three dimensional universe is deformed locally into upper side (or lower side) forming a 4D structure given by the equation, $w = \pm a \exp[-b(x^2 + y^2 + z^2)]$ where w is the displacement along fourth dimension perpendicular to x , y and z directions.*

The equation mentioned in third assumption is very important for our new model. We shall describes in this book how the structure of fundamental particle as described by this equation is responsible for the origin of strong force and how this structure is related to Schrödinger equation and de Broglie hypothesis supporting quantum mechanics and resolving wave

particle duality of matter. So let us repeat this equation to number it as the first equation of the book.

$$w = \pm a \exp[-b(x^2 + y^2 + z^2)] \quad \dots \dots (1)$$

This is the equation of the curved 3D hyper surface of the 4D structure of a fundamental particle (formed at origin of our 4D co-ordinate system) whose base is flat 3D hyper surface containing 3D space axes. Here w is the distance of any point (x, y, z, w) on the curved 3D hyper surface from its flat 3D base.

The 4D structure of a fundamental particle as defined above is named as **4D Gaussian structure** because the edge of the cross section of its 3D hyper surface by any hyper vertical plane containing w -axis is a Gaussian curve. Putting $x = y = z = 0$ in equation (1), we get $w = \pm a$ which shows that position of vertex of the 4D Gaussian structure is at a distance of $\pm a$ from its flat base. Here ' a ' is called height of the 4D structure and is different for particles of different masses. As per third assumption ' a ' is positive for a particle with negative charge and is negative for a particle with positive charge. Again ' b ' in the equation (1) is regarded as constant. So shape will be similar for all particles because for any two different particles the ratio $w/w' = a/a' = \text{constant}$ if $x = x'$, $y = y'$ and $z = z'$. Fig. 2 shows the 4D Gaussian structure of an electron which is formed on the upper side (' a ' is positive) of our 3D universe.

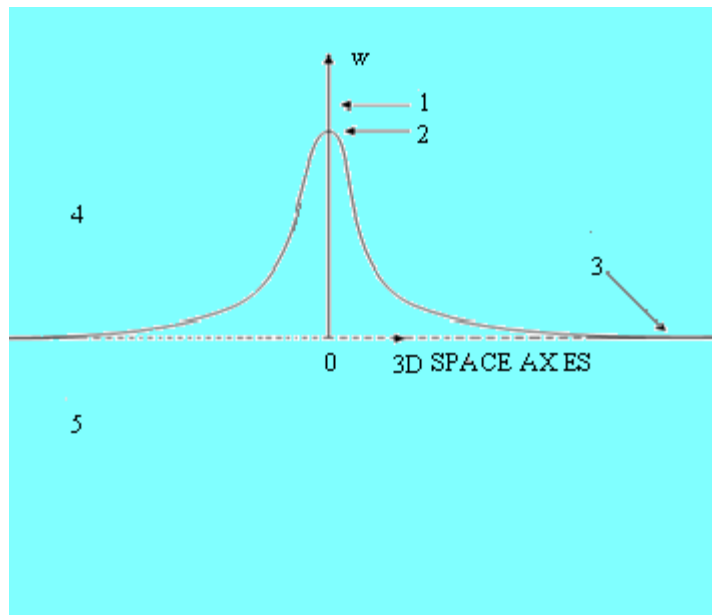


Fig.2 shows 4D Gaussian structure of electron.

1: Hyper vertical direction 2: Vertex of Gaussian structure of electron 3: Flat 3D universe 4:4D outer universe 5: 4D inner universe.

4.2: How can infinitely extended 4D Gaussian structure be localized?

The structure of fundamental particles as described by equation (1) extends from minus infinity to plus infinity along x , y and z axes. This justifies electromagnetic and gravitational influence of a fundamental particle on another fundamental particle at very large distance from it. There is no such device in our 3D models to justify mechanism of action at a distance.

Although theoretically the 4D Gaussian structure has infinite extent, but practically it represents a particle localized at the origin provided the value of ' b ' in equation (1) is very large. To justify the range of strong nuclear force the value of ' b ' has been taken as order of 10^{30} in S.I. units. Let us verify how far this value of ' b ' satisfies localized condition of the 4D

Gaussian structure. Putting $x=10^{-12}$, $y = 0$, $z = 0$ and $b = 10^{30}$ in equation (1) we find that $w = a \exp(-10^6)$. So the value of 'w' (whose value at origin is a) is very negligible at a very small distance (10^{-12} m) from the center of the base of the 4D Gaussian structure. So 4D Gaussian structure is very much localized for this value of $b = 10^{30}$.

The projection of this structure on its 3D base (that coincides with our conventional 3D universe) is a finite sphere (neglecting the distant parts of structure which are ineffective) which justifies spherical shape of fundamental particles in 3D space.

4.3: Calculation of volume of 3D hyper surface and hyper volume of the 4D Gaussian structure

Suppose the 4D Gaussian structure of a fundamental particle satisfy the equation

$$w = a \exp[-b(x^2 + y^2 + z^2)].$$

The cross-section of this structure by x - w plane lies under a two dimensional Gaussian curve that satisfy the equation

$$w = a \exp(-b x^2).$$

The slope of this curve at the point $(x, 0, 0, w)$ is given by

$$\frac{dw}{dx} = -2abx \exp(-b x^2)$$

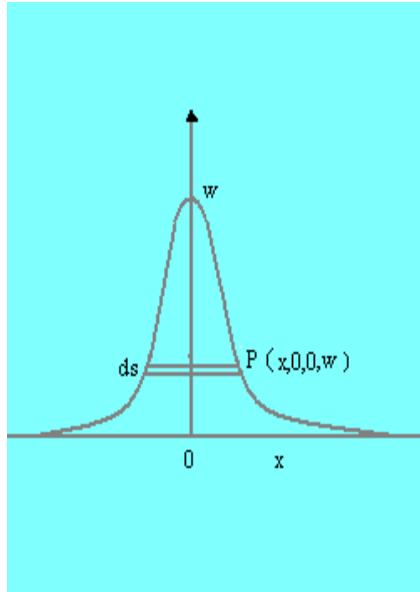


Figure 3: Showing cross section of 4D Gaussian structure by x-w plane

From elementary calculus we know that

$$ds = \left\{ 1 + \left(\frac{dw}{dx} \right)^2 \right\}^{\frac{1}{2}} dx = \{ 1 + 4a^2 b^2 x^2 \exp(-2b x^2) \}^{\frac{1}{2}} dx = \{ (1 + 2a^2 b^2 x^2 \exp(-2b x^2)) \} dx$$

where we have neglected the higher order terms of binomial expansion as value of $4a^2 b^2 x^2 / \exp(2b x^2)$ is very small (for value of $b = 10^{30}$).

If our Gaussian structure were three dimensional instead of four, then area of its curved surface would have been $\int_0^\infty 2\pi x ds$ (Fig.3), but for 4D Gaussian structure, volume of its 3D curved hyper surface is $\int_0^\infty 4\pi x^2 ds$. This volume is infinite giving infinite hyper surface energy to the 4D Gaussian structure. This seems uncomfortable. But 4D Gaussian structure has finite hyper surface energy, because before its formation its curved 3D hyper surface coincides with the

volume $\int_0^\infty 4\pi x^2 dx$ of its 3D flat base which is also infinite and the net increase of volume is not infinite. The net increase of this volume is given as

$$V = \int_0^\infty 4\pi x^2(ds - dx) + V' = \int_0^\infty 8\pi a^2 b^2 x^4 \exp(-2b x^2) dx + V' = 8\pi a^2 b^2 \frac{3}{8} \sqrt{\frac{\pi}{(2b)^5}} + V'.$$

$$\text{Or } V = k_1 b^{-\frac{1}{2}} a^2 + V'. \quad \dots \dots (2)$$

The additional term V' enter into above equation because at a point very near to the axis of Gaussian structure where x^{-2} is of same order of magnitude as 'b', the higher order terms of the above binomial expansion cannot be neglected.

If our Gaussian structure were three dimensional instead of four, then its volume would have been $\int_0^\infty 2\pi x w dx$ (Fig. 3), but for 4D Gaussian structure its hyper volume is given as

$$V_{hyper} = \int_0^\infty 4\pi x^2 w dx = \int_0^\infty 4\pi a x^2 \exp(-b x^2) dx = 4\pi a \cdot \frac{1}{4} \sqrt{\frac{\pi}{(b)^3}} = k_2 b^{-\frac{3}{2}} a. \quad \dots \dots (3)$$

Equation (2) and (3) show a special property of a 4D Gaussian structure by which the enclosed hyper volume is proportional to 'a' where as enclosing hyper surface is proportional to higher power of 'a' (in contrast to hyper spherical or spherical structure).

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4D CLASSICAL PICTURE OF MATTER-ENERGY CONVERSION

Pair production and absorption of photon by atom are processes in which radiation energy of photon is converted into matter. Particle-antiparticle annihilation and emission of photon from atom are reverse processes in which matter is converted into radiation. Standard model does not have any classical pictures for these processes. Our new model will explain these phenomena by means of a 4D classical technique. In order to have an easier understanding of these processes in 4D space, we shall describe here a mechanical thought experiment as an analogical illustration.

5.1: A thought experiment as an analogical illustration.

Let us imagine a simple mechanical experiment in which two circular disks of different size are kept side by side on a frictionless horizontal plane surface. These two disks cling to each other because we assume a force of attraction between them. Let us further assume that each disk is formed by winding spirally a long thin tape (like magnetic audio tape that is used for recording sound) over a tiny axle. We shall make such an experimental arrangement that when the free end of the tape of each disk is pulled out, the disk will rotate about its vertical axis passing through center, rewinding the tape spirally and thus decreasing the size of the disk.

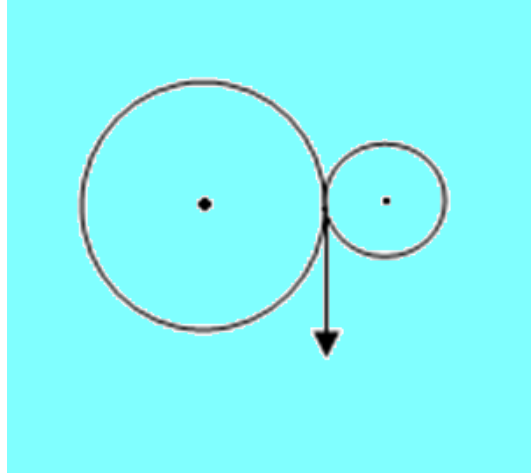


Fig.4 shows two circular disks of our mechanical thought experiment

Now let us hold the free end of the tapes of both disks simultaneously with one hand and pull them out with same constant speed. When this is done the radius of each disk will decrease and centers of two disks will come closer because there is an attraction force between them. They will come closer with different accelerations and it can be verified that acceleration of smaller disk is more than that of larger disk because for each complete rotation of larger disk, smaller disk will make more number of complete rotations. In a reverse process, the distance between centers of two disks and their size will increase when tapes enter into the disks by rotating them in opposite direction.

What inferences we get from above thought experiment?

First inference: The accelerations of two disks are inversely proportional to their size (or indirectly to mass) similar to Newton's 2nd law. These accelerations that give rise to a new force depend on thickness of tapes and on velocity of pulling out of these tapes, but do not depend on the original attraction

force between these disks. The only role of this attraction force is to help these disks in clinging to each other.

Second inference: A spiral process can be reversible so that a system in its reverse process will pass through exactly same phases which are traced in forward process.

Third inference: The mass of the tape that leaves or enters a disk is distributed over a long region of finite length and this mass leaves or enters the system serially not whole at an instant.

Analogous things happen in our 4D space when a photon (which is supposed to be a transverse progressive wave of finite length in 4D space) is emitted from a hydrogen atom. Here along with the emission of photon both proton and electron spin around their axes and come closer each experiencing same electric force. In the reverse process of absorption, the distance between proton and electron increases as a photon enters into the atom. Thus in our new model it is possible to get a classical picture explaining the techniques of emission and annihilation and their reverse processes of absorption and pair production. We are familiar with the process in which a potter makes a pot by adding clay spirally (helical spiraling) on a rotating pad. Similarly a gamma-ray, photon, under certain condition, will deform the 4D space creating two Gaussian structures (electron-positron pair) on both sides of our conventional 3D universe. This process of creation of matter from radiation that has been described below will be known as *spiral transformation*.

5.2: Classical picture of pair production.

Fundamental particle and anti particle pair[2] such as electron and positron are created when a high frequency photon, under certain condition, deform our flat 3D space to

create two 4D Gaussian structures on either side carrying with them three different energies- (a) photon energy converted into rotational kinetic form (b) hyper gravitational energy of the 4D particles lying inside the hyper volume of the Gaussian structure (c) hyper surface tension energy of the 3D hyper surface of the Gaussian structure. These three energies contribute to internal energy or mass of a fundamental particle. For electron hyper gravitational energy is positive because it is formed by inons of inner 4D world when flat 3D hyper surface of separation (our universe) is deformed into upper side where potential energy of all 4D particles is positive with respect to the surface of separation. For electron hyper surface energy is negative (section 3.3), because it is formed by inon layer lying just below our universe. Positron which is formed below the surface of separation has an inverted shape with negative hyper gravitational energy and positive hyper surface energy.

Mass of a fundamental particle depends upon the size of its 4D Gaussian structure. Out of infinite possible 4D Gaussian structures Nature will select that equilibrium 4D Gaussian structure of a particular size for which hyper gravitational energy of its mass is equal in magnitude but opposite in sign to its hyper surface energy. This equilibrium size fixes the mass of a fundamental particle. In the last section of this chapter we shall show that an equilibrium size for mass exists for 4D Gaussian structure. At equilibrium size, the sum of hyper gravitational energy and hyper surface energy of electron or positron is zero. Then how does the particle get its rest mass energy? The photon involved in the pair production process gives a part of its energy to electron or positron to account for its rest mass energy. This fact has been highlighted in our fourth assumption.

Fourth assumption: *At every stage during the pair production process of transformation of radiation energy into matter, radiation energy utilized by photon is equal to magnitude of both hyper gravitational energy and hyper surface energy of the 4D structure of fundamental particle.*

So after the completion of pair production process the following equation will be valid for both electron and positron.

$$\frac{1}{2} h\nu_0 = m_0c^2 = \text{magnitude of hyper surface energy}$$

$$= \text{magnitude of hyper gravitational energy..... (4)}$$

Here ν_0 is the threshold frequency of γ -ray photon in pair production process and m_0 is the rest mass energy of electron or positron.

In this pair production process radiation energy is transformed into matter energy of fundamental particle. We shall call this transformation process as *spiral transformation* because 4D masses are added spirally to the 4D Gaussian structure when it is under rotation (detail information about this process is given in section 5.3, clay-pot making on a rotating pad is a 3D spiral process). Here addition of 4D mass occurs along a 4D spiral path (helically spiral) to ensure the reversibility of the process. For electron the beginning of this transformation process is associated with the formation of vertex of the 4D Gaussian structure at a point on the flat 3D universe. Then hyper-volume of the Gaussian structure increases as vertex rises gradually when inons of the hyper-surface layer lying just below our 3D universe are added spirally to the hyper surface of the Gaussian structure which is rotated as more and more of the energy of photon takes part in the transformation process. It is to be noted that the condition of equation (4) is satisfied at every stage of the transformation

process (fourth assumption). Similarly an inverted 4D Gaussian structure for positron is formed below the flat 3D hyper surface of our universe.

If the energy of photon is sufficiently high then complete structures for electron and positron are formed. If the energy of the photon is more than the threshold energy required for pair production, then after the formation of two complete 4D Gaussian structures for electron and positron, both of them become free acquiring some K.E. in expense of this extra energy of photon. However if the energy of the photon is less than the threshold energy required for pair production, then after the formation of two incomplete Gaussian structures spiral transformation proceeds in reverse direction, gradually decreasing the size of the Gaussian structures of electron and positron till complete annihilation at a point on the 3D universe where vertexes of both vanish along with the emission of two photons in opposite directions. During the process of spiral transformation the electron-positron pair forms an unstable composite system to which we call positronium.

After its formation, the 4D Gaussian structure of electron is separated from the rest of the universe and acquires particle status because it can easily move as a 4D Gaussian shape wave pulse satisfying the equation (its derivation is given below)

$$w = A \exp[-b(x - vt)^2] \quad \dots (5)$$

Where v is velocity and we have suppressed 'y' and 'z' coordinates as motion is assumed to be along a path parallel to x -axis. Actually there will be no transfer of particles of the medium (inons and outons) along the direction of motion; rather a disturbance in the form of a wave is transmitted when 4D particles execute transverse local displacements along hyper vertical direction. Just like the apparent motion of wave on the

surface of water (the real motion being the transverse vibrations of particles of the medium), the motion of every object in our universe is apparent, the real motion being the local transverse displacements of inons and outons which constitute the fundamental particles of the object.

Deriving equation (5) from equation (1): Let 4D Gaussian structure of an electron located at the origin of a 4D co-ordinate system is represented by the equation

$$w = a \exp[-b(x^2 + y^2 + z^2)].$$

The cross section of this structure by a plane parallel to x - w plane and passing through the point $(0, y_1, z_1, 0)$ is a 2D structure under a 2D Gaussian curve represented by the equation

$$w_1 = a \exp[-b(x^2 + y_1^2 + z_1^2)],$$

$$\text{or } w_1 = a \exp(-by_1^2) \exp(-bz_1^2) \exp(-b x^2),$$

$$\text{or } w_1 = a_1 \exp(-b x^2),$$

where $a_1 = a \exp(-by_1^2) \exp(-bz_1^2)$ is a constant as y and z co-ordinates of every point on this curve are y_1 and z_1 respectively.

If this 2D Gaussian curve move with velocity v as a wave pulse in a direction parallel to x -axis then it will be represented by the equation

$$w_1 = a_1 \exp[-b (x - vt)^2].$$

For another 2D Gaussian curve cut by a plane parallel to x - w plane and passing through the point $(0, y_2, z_2, 0)$, the equation of wave pulse will be given as

$$w_2 = a_2 \exp[-b (x - vt)^2],$$

where $a_2 = a \exp(-by_2^2) \exp(-bz_2^2)$.

In this manner we will get infinite number of equations corresponding to infinite number of points on y - z plane and summation of these equations should be the required equation of the 4D wave pulse of electron.

$$w = w_1 + w_2 + w_3 + \dots = (a_1 + a_2 + a_3 \dots) \exp[-b(x - vt)^2],$$

$$\text{or } w = A \exp[-b(x - vt)^2] \quad \dots (5),$$

where $A = (a_1 + a_2 + a_3 \dots)$ is a finite quantity as hyper volume of 4D Gaussian structure is finite.

5.3: Spiral transformation.

Spiral transformation is a reversible process of interaction between two 4D Gaussian structures (two particles) in which a thin layer of 4D mass particles enters into (or emerges from) each of them along its flat spherical base whose radius increases (or decreases) spirally – the whole process being initiated by a photon when it enters into (or emerges from) the two-particle composite system.

This definition is not sufficient to have a clear understanding of the process. Therefore we will highlight all its important features one by one in order to provide detail information about the process. Themes of some of these features are intuitively understandable while ideas behind some other features are originated from the mechanical thought experiment described in the section 5.1. However we need further research for confirmation of the validity of ideas behind the whole process.

Important features of spiral transformation:

(i) During spiral transformation the two-particle composite system remains in an unstable bound state.

(ii) At every stage of the process, the size or radius of the flat spherical base of each particle is less than that of its free state.

(iii) At every stage of the process, the flat spherical bases of two 4D Gaussian structures coincide with the flat space of our 3D universe (fig. 6)

(iv) At every stage of the process, each 4D Gaussian structures touches the other one at a single point (point of contact) which is the point of intersection of two spherical bases lying in our 3D universe.

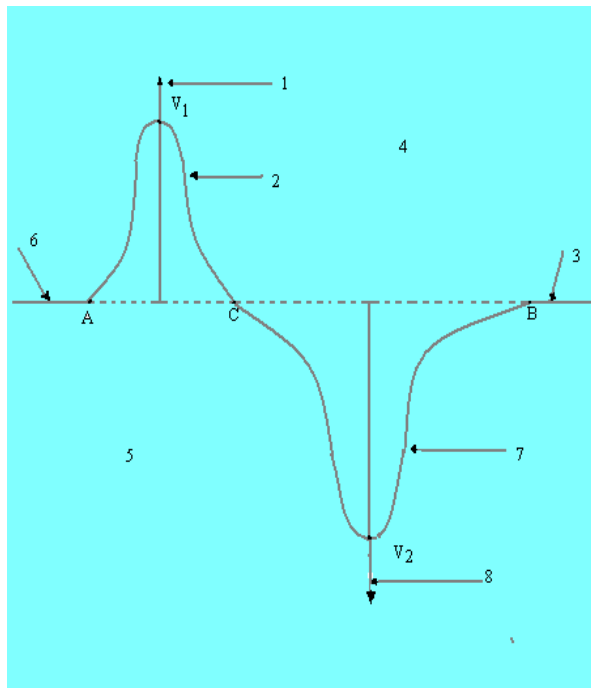


Fig.6 shows positions of two 4D Gaussian structure in a particular state during spiral transformation.

V_1 : vertex of 1st 4D Gaussian structure of a particle with -ve charge. V_2 : vertex of 2nd 4D Gaussian structure of a particle with +ve charge. C: point of contact. AC: flat spherical base of 1st 4D Gaussian structure. CB: flat spherical base of 2nd 4D Gaussian structure. 1: hyper vertical direction. 2: curved 3D hyper surface of 1st 4D Gaussian structure. 3, 6: our 3D universe (flat region). 7: curved 3D hyper surface of 2nd 4D Gaussian structure. 8: opposite of hyper vertical direction.

(v) As spiral transformation continues specific positions of the curved hyper surfaces of two 4D Gaussian structures come to their point of contact in succession. These positions are points of two 2D Gaussian curves lying on these two 4D Gaussian structures.

(vi) The 4D path along which 4D mass particles are added to or removed from a 4D Gaussian structure is not purely spiral but helically spiral, because along with the gradual increase or decrease of the radius of spherical spiral path, the height of the path also increases or decreases gradually along hyper vertical direction (we may remember that helical spiraling in 3D space occurs along a circular path of increasing or decreasing radius and height).

(vii) The addition or removal of 4D mass particles to 4D Gaussian structure does not occur in any arbitrary manner, but in a fixed manner so that at every stage of the spiral transformation process, the hyper surface energy of 4D Gaussian structure (of equilibrium size) will be equal in magnitude but opposite in sign to its hyper gravitational energy (4th assumption).

(viii) The energy of photon involved in spiral transformation process is the only energy to contribute to the internal energy of 4D Gaussian structure as hyper surface energy and hyper gravitational energy cancel each other in maintaining equilibrium stability.

(ix) The increasing or decreasing of radii of flat spherical bases of two 4D Gaussian structure results in the increasing or decreasing of their distance of separation which in turn gives rise to an acceleration or force (attractive or repulsive). This is similar to the result of the first inference of our mechanical thought experiment.

(x) Like our mechanical thought experiment (as per second inference), spiral transformation process is reversible.

(xi) As per third inference of our thought experiment a photon of finite length is to be serially absorbed by particle-antiparticle pair during spiral transformation process.

(xii) Spiral transformation can be complete where whole masses of two particles are involved, as in pair production and particle- antiparticle annihilation or this process can be partial where a small part of the whole mass is involved, as in case of emission or absorption by atoms.

Classical picture of emission and absorption in atoms:

Spiral transformation process can explain the emission and its reverse process of absorption in atoms, although it will be a very complex process in a multi-particle system. It is a rapid process which may account for the instantaneous emission of photoelectron from atoms. Standard model does not give us a classical picture of internal mechanism to show how emission and its reverse process of absorption occur in atoms. Spiral transformation process of the new model gives a clear classical picture of these phenomena. Let us consider the simplest example of hydrogen atom. Electron and proton of the atom are two 4D Gaussian structures lying on opposite sides of our universe with their 3D bases coinciding with a part of our 3D universe. A photon is a progressive hyper surface wave of finite length (described in the section 6.1) with amplitude small in comparison to height of Gaussian structures. Obviously the photon moving along the 3D hyper surface (our universe) will enter the atom along the intersecting 3D bases of electron and proton. The photon will transfer its energy to electron and proton and in the process of spiral transformation the radius of their 3D base increases. This increases the separation between

electron and proton. In this manner a sufficiently high energetic photon may ionize the atom. Reversibility of the process is maintained because energy transformation takes place along a spiral path.

5.4: Origin of mass.

In the section 5.2 we have mentioned that out of infinite possible 4D Gaussian structures Nature will select that equilibrium 4D Gaussian structure of a particular size for which hyper gravitational energy of its mass is equal in magnitude but opposite in sign to its hyper surface energy. This equilibrium size fixes the mass of a fundamental particle. In this section of we shall show that equilibrium 4D Gaussian structures actually exist due to a special property of Gaussian structure. In the section 4.3 it has been shown that hyper volume of 4D Gaussian structure is proportional to its height ' a ' but its hyper surface area minus base area is proportional to ' a^2 '. So for this reason rate of increase of hyper surface energy will be more than that of hyper gravitational energy for large value of ' a '. The exact nature of variation of these two energies with ' a ' is not important for us now, but investigation will reveal the fact that the graph has two points of intersection where hyper surface energy is equal to hyper gravitational energy.

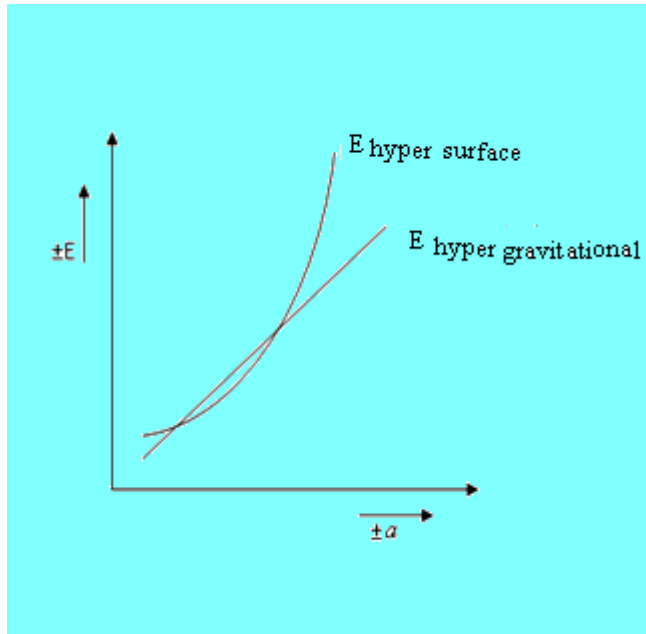


Fig.6 shows equilibrium points where hyper surface and hyper gravitational energy of fundamental particles are equal.

The point of intersection at A (fig.4) with small value of 'a' corresponds to equilibrium Gaussian structure of electron and positron. Similarly the point B with large value of 'a' corresponds to equilibrium Gaussian structure of proton and anti-proton. These two points are unstable equilibrium positions because a slight decrease in the value of 'a' (for electron and proton) and slight increase in the value of 'a' (for positron and anti proton) result in decrease of net energy ($| E_{\text{hyper gravitational}} - E_{\text{hyper surface}} |$) of the system. The K.E. received by these four Gaussian structures from photons make them stable in spite of their unstable equilibrium conditions (like a wheel that continues to remain in its vertical unstable equilibrium position when it is in motion).

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Chapter - 6

CONCEPT OF PHOTON AND MATTER WAVE IN 4D SPACE

Nature of light is very confusing because of its dual character. Some experiments can only be described by wave model whereas others are described only by photon model. In QED all optical phenomena can be described by using photon model. QED gives final mathematical answer by calculating the probability amplitude of an event without giving us a classical picture describing how the particular incidence occurs. But QED uses the notion of wave in calculation of probability by taking into account the frequency of photon. So traditionally we were bound to accept both wave and particle models and admit that there is no single classical picture to describe nature of light. Below we shall describe how our new model resolves the puzzle behind wave particle duality of radiation and matter.

6.1: Wave particle duality for radiation.

Due to hyper surface tension phenomena our universe behaves like an elastic 3D membrane of special kind and thus allows creation of mechanical wave when 4D particles execute to and fro vibrations along the 4th dimension (w - axis). We assume that particles of light or photon are nothing but mechanical waves in 4D space. A photon satisfy particle nature by being absorbed or emitted instantly in interaction experiments like photoelectric effect and satisfy wave character in propagation experiments like interference effect. Again according to 10th important feature of spiral transformation process, a photon of finite length is to be serially absorbed by particle-antiparticle pair during this process.

Thus a photon should be a sinusoidal progressive 4D wave of finite length travelling along a straight line path. This assumption is more appropriate because of the following reasons. (a) It directly retains the transverse nature of light. (b) It satisfy the conditions of spiral transformation process (c) Energy of a photon is proportional to number of waves it contains and a photon of certain length contains more number of waves if its wave length is less. (d) It satisfies particle nature of light in interaction experiments in which a photon (a wave of finite length) is absorbed serially, but instantly because the time interval between beginning and end of spiral transformation process is very short. Photons, which are discrete waves of a beam of light, will produce separate clicks in a photo multiplier tube and will be distinguished clearly when intensity of light is very weak. (e) The progressive transverse wave nature of light can explain double slit experiment and all optical phenomena in usual manner.

6.2: Matter wave

We know that the localized particle wave packet is not stable as it spreads [3] with the passage of time, so it may not represent a stable particle. But our 4D Gaussian wave pulse represented by the equation (5) is both localized and stable, so it truly represents a particle. In equation (5) 'v' is the velocity with which a point of constant phase moves along x-axis and energy of the particle is also transmitted with the same velocity 'v'.

So, velocity of mass-energy = phase velocity,

$$\text{or } v = v\lambda \quad \dots\dots (6)$$

If $h\nu$ is the energy access over the threshold energy required for pair production, then half of this energy gives kinetic

energy to electron where as other half gives kinetic energy to positron. Then we have

$$\frac{1}{2} h\nu = \frac{1}{2} mv^2$$

or

$$h\nu = mv^2 \quad \dots (7)$$

Equations (6) and (7) give

$$\lambda = \frac{h}{mv} \quad \dots (8)$$

This is de Broglie hypothesis. Our traditional physics, instead of deriving it in this manner, accepted it as a hypothesis because this relation is valid for radiation. Again a hypothetical phase velocity c^2/v [2] was attributed to the particle using the relation $h\nu = mc^2$. . But this point of view is questionable because $v = mc^2/h$ has not the same value as that described in equation (7).

6.3: Schrödinger equation from the new model.

Let us write equation (5) again for sake of convenience

$$w = A \exp[-b(x - vt)^2] \quad \dots (5)$$

Equations (6) and (8) can be used to modify equation (5) which becomes

$$w = A \exp [zi(kx - \omega t)], \text{ Where } k=2\pi/\lambda, \quad \omega = 2\pi\nu$$

$$\text{and } z = \frac{ibh^2}{4\pi^2 m^2 v^2} (kx - \omega t).$$

So we get

$$w=A \exp[i(kx - \omega t) + i(kx - \omega t) \dots \text{summed for } z \text{ times}]$$

or

$w = A' \exp[i(kx - \omega t)] \times A' \exp[i(kx - \omega t)] \dots \dots$ multiplied for z times,

where $A' \times A' \dots \dots$ multiplied z times = A

If we take

$$\Psi = A' \exp[i(kx - \omega t)] \quad \dots \dots (9)$$

Then equation (5) becomes,

$$w = \Psi \times \Psi \times \dots \dots \text{multiplied for z times.} \quad \dots \dots (10)$$

Thus we see that the displacement 'w' in equation (5) can be expressed as the product of z number of equal displacement Ψ of a plane progressive wave represented by equation (9). So if 'w' of equation (5) describes the behavior of a fundamental particle, then Ψ of equation (9) will also describes the behavior of the same particle. We know how equation (9) can be used to derive [4] Schrödinger equation. In this way Schrödinger equation is related to structure of fundamental particle because equation (5) is obtained from equation (1). Perhaps this is the reason behind successful applications of Schrödinger equation in physics.

Chapter - 7

UNIFYING COULOMB AND STRONG NUCLEAR FORCE

In this chapter we shall introduce two new ideas. According to the first, the force between two fundamental particles vanishes at the instant when the point of inflexion ($d^2w/dx^2 = 0$) of the curved hyper surface of any one particle becomes the point of contact during spiral transformation process along x - axis and just after this instant, the direction of the force changes as d^2w/dx^2 changes sign. This idea explains the origin of attractive strong nuclear force from the repulsive Coulomb force. Another new idea is the idea of the shape determining the property of charge and size determining the property of mass of a fundamental particle. The equal magnitude of charges of many particles of different masses is due to their similar shape. In this chapter we shall explain how these two ideas come from a single expression of unified force that unifies Coulomb and strong forces.

7.1: Origin of strong force.

At this point let us refresh our minds about some properties of two-dimensional Gaussian curve satisfying the equation

$$w = a \exp(-bx^2). \quad \dots (11)$$

Then,

$$\frac{dw}{dx} = -2abx \exp(-bx^2), \quad \dots (12)$$

and

$$\frac{d^2w}{dx^2} = 2ab \exp(-bx^2) (2bx^2 - 1). \quad \dots (13)$$

The slope of the Gaussian curve at any point is found from equation (12). The slope of the curve is zero at $x=0$. The slope decreases as x increases and becomes maximum negative at $x = 1/(2b)^{1/2}$, which is the point of inflexion satisfying the condition $d^2w/dx^2=0$. There after the slope increases and reaches the value zero again at $x = \infty$. So the point of inflexion is the turning point from where the slope increases in one direction and decreases in other direction i.e. on one side of the point of inflexion d^2w/dx^2 is +ve and on the other side it is negative. Then it is logical to assume that at this point of inflexion the repulsive Coulomb force between two protons is converted into attractive strong nuclear force. The change of direction of force is consistent with mathematics as w is differentiable at the point of inflexion. In this way our new model will be able to unite strong nuclear force and electromagnetic force in a simple way. If the value of ' b ' in equation (11) is taken as the order of 10^{30} in S.I. units then point of inflexion will be at a distance of $1/(2b)^{1/2} \approx 10^{-15}$ m from the center of the Gaussian structure. This is the range of strong nuclear force.

The above point of inflexion theory is supported by the fact that it can easily explain why electron-positron pair annihilates but electron-proton pair forms a stable combination and why n-n or p-p combination is unstable [5] in spite of strong attractive force but n-p combination (deuteron) is stable. As equal size electron and positron approach each other, points of inflexion of both come to point of contact simultaneously (during spiral transformation process) and so attraction is continued further as direction force changes sign twice. However when electron and proton approaches each other, the point of inflexion of electron (see below) comes to point of contact earlier and thus changing the attraction to repulsion and this prevents electron in falling into nucleus. Similar arguments can be made for n-n, p-p

(discussed in the section 7.2) and n-p combinations (discussed in the section 7.3).

Why electron-proton pair forms a stable combination: We have already discussed how the theory associated with the point of inflexion explains the origin of strong nuclear force. But this theory is a general one and can be applied to spiral transformation process between any two fundamental particles. Now let us apply this theory to electron-proton pair. If the centers of their base initially lie on x -axis, then displacement of these centers will be along x -axis during spiral transformation and the cross section of the curved hyper surfaces of their 4D Gaussian structures by x - w plane will be two 2D Gaussian curves. Fig. 7 shows this cross section at a particular state of spiral transformation process.

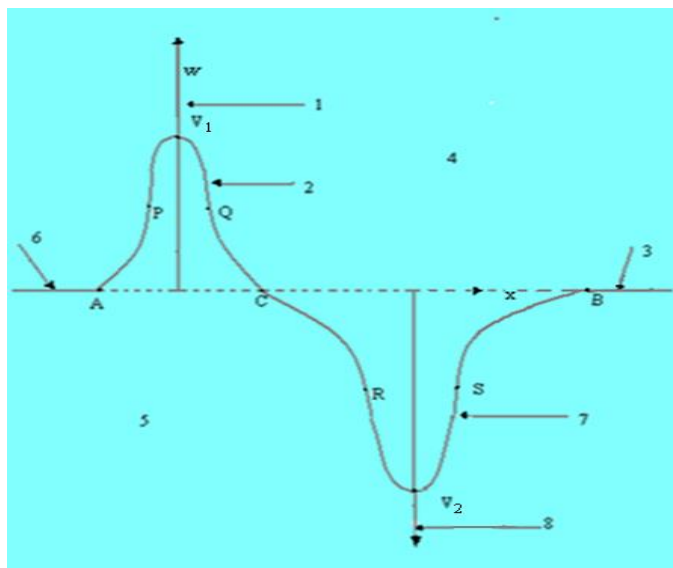


Fig.7 shows cross section of two 4D Gaussian structure of electron-proton pair by x - w plane in a particular state during spiral transformation.

V_1 : vertex of 4D Gaussian structure of electron. V_2 : vertex of 4D Gaussian structure of proton. AC: diameter of the flat spherical base of electron. CB: diameter of the flat spherical base of proton: point of contact P, Q, R and S: points of inflexion. 1: hyper vertical direction. 2: 2D Gaussian curve on the curved 3D hyper surface of electron. 3, 6: our 3D universe (flat region). 7: 2D Gaussian curve on the curved 3D hyper surface of proton. 8: opposite of hyper vertical direction.

In this figure (a) V_1 and V_2 are vertexes of 4D Gaussian structures of electron and proton respectively (b) C is the point of contact (c) AC is diameter of the spherical base of electron (d) CB diameter of the spherical base of proton (e) P and Q are points of inflexion of electron (f) R and S are points of inflexion of proton.

If w_1 and w_2 are w -coordinates of the points on two Gaussian curves, then following statements regarding slope (dw/dx) and its 1st derivative (d^2w/dx^2) at any point on these curves may be verified.

- (i) Between AP $\frac{dw_1}{dx}$ is +ve and $\frac{d^2w_1}{dx^2}$ is +ve.
- (ii) Between PV₁ $\frac{dw_1}{dx}$ is +ve and $\frac{d^2w_1}{dx^2}$ is -ve.
- (iii) Between V₁Q $\frac{dw_1}{dx}$ is -ve and $\frac{d^2w_1}{dx^2}$ is -ve.
- (iv) Between QC $\frac{dw_1}{dx}$ is -ve and $\frac{d^2w_1}{dx^2}$ is +ve.
- (v) Between CR $\frac{dw_2}{dx}$ is -ve and $\frac{d^2w_2}{dx^2}$ is -ve.
- (vi) Between RV₂ $\frac{dw_2}{dx}$ is -ve and $\frac{d^2w_2}{dx^2}$ is +ve.
- (vii) Between V₂S $\frac{dw_2}{dx}$ is +ve and $\frac{d^2w_2}{dx^2}$ is +ve.
- (viii) Between SB $\frac{dw_2}{dx}$ is +ve and $\frac{d^2w_2}{dx^2}$ is -ve.
- (ix) At the points of inflexion P and Q $\frac{d^2w_1}{dx^2}$ is 0.
- (x) At the points of inflexion R and S $\frac{d^2w_2}{dx^2}$ is 0.

Before finding an expression for force between two 4D Gaussian structures, let us verify a tentative rule that gives us the nature or direction of this force. According to this rule:-

The force between two 4D Gaussian structures during spiral transformation is repulsive, attractive or zero as per the product of two 2nd derivatives terms (in this particular case it is $\frac{d^2w_1}{dx^2} \cdot \frac{d^2w_2}{dx^2}$) at the point of contact is +ve, -ve or zero respectively.

At the particular positions of electron-positron pair as shown in fig.7 the force is attractive because the product $\frac{d^2w_1}{dx^2} \cdot \frac{d^2w_2}{dx^2}$ at the point of contact is negative. The result will be same in all states when the distance of separation between two particles is larger. As these particles approach each other the force continues to remain attractive until one of the points of inflexion Q or R becomes the point of contact when the force vanishes as the product $\frac{d^2w_1}{dx^2} \cdot \frac{d^2w_2}{dx^2}$ is zero. Due to smaller size structure of electron, its point of inflexion Q becomes the point of contact before the point R reaches the point of contact.

Spiral transformation stops when the point Q becomes the point of contact because force is repulsive when any point beyond Q (between QV₁) becomes the point of contact as $\frac{d^2w_1}{dx^2}$ is -ve at that point. *So the two particle system becomes stable when the point of inflexion of electron is the point of contact. This is known as the **ground state of hydrogen atom.***

7.2: Finding an expression for unified Coulomb and strong force.

Let Gaussian structures of two fundamental particles are given by equations

$$w = a \exp[-b(x^2 + y^2 + z^2)] \quad \text{and}$$

$$w' = a' \exp[-b(x'^2 + y'^2 + z'^2)]$$

If center of their bases lie on common $x - x'$ axis, then force between them will depends on derivatives with respect to x or x' . The force on the particle with height ' a ' is given as

$$F_a = K/x^4 \times \frac{d^2w}{dx^2} / \left| \frac{dw}{dx} \right| \times \frac{d^2w'}{dx'^2} / \left| \frac{dw'}{dx'} \right| \times (a - w) / a \quad \dots \dots (14)$$

This equation is obtained on trial basis, not derived. Here all the 1st and 2nd second derivative terms are with respect to the point of contact.

Now suppressing y, y', z and z' coordinates we get

$$\begin{aligned} F_a &= K/x^4 \times 2ab \exp(-bx^2)(2bx^2 - 1) / -2abx \exp(-bx^2) \\ &\times 2a'b \exp(-bx'^2)(2bx'^2 - 1) / -2a'bx' \exp(-bx'^2) \\ &\times [1 - \exp(-bx^2)] \end{aligned}$$

If particles are two protons then $a = a', x = x'$,

and we get

$$F = K \frac{(2bx^2 - 1)^2}{x^6} [1 - \exp(-bx^2)] \quad \dots \dots (15)$$

This is the expression for unified force between two protons separated by a distance $2x$.

The force is repulsive over entire range as both d^2w/dx^2 and d^2w'/dx'^2 changes sign simultaneously at $x = x' = \frac{1}{\sqrt{2b}}$. That is why p-p combination is unstable.

For Coulomb range ($x \gg 10^{-15}$), $\exp(-bx^2)$ and -1 in the brackets of equation (13) are neglected as $b \approx 10^{30}$. So we get

$$F_{coul} = K \frac{4b^2}{x^2} \quad \dots \dots (16)$$

This equation shows that Coulomb force is inverse square and depends on ' b ' (shape) not on ' a ' (size).

Origin of charge: Traditionally we have no clear concept for charges of fundamental particles. We fail to answer: (a) Why there are two kinds of charge? (b) How Nature dopes exactly equal amount of charges into particles of different masses? (c) How charge of a fundamental particle is forced to concentrate near a point where there are forces of repulsion between its constituent parts? New model answers all these questions simply by accepting the result of equation (16) which states that that shape (and not size) of the Gaussian structure determines the property of charge. Charges are not quantities to be doped into particles of different masses. It is the Coulomb force which gives the concept of charge. Thus magnitude of Coulomb force between any two fundamental particles (with charges $\pm e$) irrespective of their masses is same because it depends on the value 'b' (and not on 'a') which is constant as all particles have similar shape. Negative charge ('a' is +ve) and positive charge ('a' is -ve) are formed on upper and lower sides of our universe respectively.

7.3: Stability of n-p combination (deuteron).

A composite system of particles will be stable if the net forces among them are attractive. Before applying our point of inflexion theory to know the reason of stability of deuteron, we shall discuss how neutron, a constituent of deuteron, is formed from electron and proton by a new process called *slipping in 4D space*. Our assumption about this new 4D process is yet to be verified by future research. Before discussing the process of slipping of a fundamental particle in 4D space, let us discuss about a simple thought experiment demonstrating mechanical slipping of a rotating wheel.

A thought experiment to demonstrate mechanical slipping:

Let us consider rolling motion of a wheel on horizontal plane surface. This surface is supposed to be rough enough to sustain

the rolling process but almost frictionless to sustain the slipping of the point of contact of the wheel on the surface. Let us suppose that, the wheel which is initially spinning about its axis (kept horizontal) is placed gently on the surface in order to start the rolling process. During rolling linear kinetic energy of the wheel is gained at the cost of a part of its rotational kinetic energy of pure spinning motion. Now let us suppose again that, the wheel which is initially spinning about its axis (kept horizontal) is projected so that its point of contact will slip through a distance on the surface before starts rolling. In this case, the linear kinetic energy of wheel during slipping is obtained from an external agent not from the spinning motion. Below we shall show how analogical incidence occurs during slipping of a fundamental particle in 4D space.

Formation of neutron by slipping in 4D space: For neutron an idea may be suggested that it is formed when high velocity electron is slipped into proton whose larger size provides an approximate flat path for small size electron. Unlike spiral transformation this slipping is a different process in which mass or size of both electron and proton remain unchanged. This is due to the fact that electric field energy of spiral transformation process is not utilized during slipping of electron into proton. The energy requirement of slipping process is obtained from an external agent. As discussed earlier, the mass or size of both electron and proton decreases when hydrogen atom is formed by spiral transformation process in which emitted photon takes away a part of the energy of the composite system. That is why mass of hydrogen atom is less than that of neutron.

Applying the point of inflection theory to n-p combination:

When a small size 4D Gaussian structure of electron is slipped into the large size 4D Gaussian structure of proton, it is assumed that points of inflexion of proton and electron slightly

change their position due to modification of their shape in the composite system i.e. neutron. When a neutron is forced to approach a proton to form deuteron, the modified curved surface of proton of neutron touches the curved surface of proton of deuteron at the point of contact. Due to unsymmetrical locations of points of inflexion of these two curved surfaces, they do not become the point of contact simultaneously (unlike p-p combination) during spiral transformation. When one of the two points of inflexion becomes the point of contact, the product of two 2nd derivative terms ($d^2w/dx^2 \cdot d^2w'/dx'^2$ in equation-14) will be -ve, so that the force between neutron and proton becomes attractive to bind them in deuteron. This attractive binding force between proton and neutron in deuteron becomes repulsive as their separation decreases further (verified experimentally) when other point of inflexion becomes the point of contact to make the product $d^2w/dx^2 \cdot d^2w'/dx'^2$ positive.

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Chapter - 8

REALIZING EXISTENCE OF FOURTH SPACE DIMENSION

As per our new model the empty space of our 3D universe is flat locally and this local flatness at a place disappears if a particle is created at that place just like the plainness of water surface at a place disappears when a bubble is created at that place. In the chapter – 5, we have already discussed how (during pair production) two 4D Gaussian structures of electron and positron are created by spiral transformation when 4D masses are added to the structures along their flat spherical bases that coincide with our flat 3D universe. Here both electron and positron touch each other at the point of contact which is the point of intersection of two spherical bases and our 3D universe. Not only in this particular case but in all cases of interaction, the point of contact of interacting particles lies in our 3D universe which is a 3D hyper surface dividing our 4D universe into two parts. This may be the reason why we are unable to feel the existence of fourth space dimension. To justify the existence of fourth space dimension, we have to find some examples in which fourth space dimension has indirect effects on geometrical or physical principles of 3D space.

8.1: Justifying existence of 4th space dimension.

Some examples justifying the existence of 4th space dimension will be discussed in this section.

Why there are two kinds of charge: Our traditional physics does not answer this question. We can give a probable answer to this question by assuming the existence of 4th space dimension. As per our new model our 3D universe is a 3D

hyper surface separating two 4D worlds on its two sides (upper and lower). Negative charge and positive charge are formed on upper and lower sides of our universe respectively.

Existence of spin quantum number: We know that solution of Schrödinger equation for a one electron system in a spherically symmetric potential field of 3D space gives infinite numbers of discrete states expressible in terms of three quantum numbers n , l and m . These three quantum numbers can take infinite number of values because the distance to which an electron can go in 3D space is not bounded. Analogically the fourth quantum number spin is supposed to originate from the existence of extra 4th space dimension. Unlike other three quantum numbers, spin quantum number (s) takes finite number of values such as $\pm 1/2$, ± 1 etc. because structures of fundamental particles cover a finite small distance along 4th dimension.

Comparison with Einstein's model of universe: The line element [6] of Einstein's static cosmological model of universe is given as

$$ds^2 = -\left(1 - \frac{r^2}{R_0^2}\right)^{-1} dr^2 - r^2 d\theta^2 - r^2 \sin^2 \theta d\phi^2 + dt^2.$$

Now under the transformation,

$$x=r \sin \theta \cos \phi, y=r \sin \theta \sin \phi, z=r \cos \theta \text{ and } w=R_0\left(1 - \frac{r^2}{R_0^2}\right)^{\frac{1}{2}},$$

above line element reduces to

$$ds^2 = -(dx^2 + dy^2 + dz^2 + dw^2) + dt^2.$$

The line element in this form suggests that spatial geometry of Einstein universe is the immersion of a grand 3D hyper spherical surface of radius R_0 in a 4D Euclidean space where

$$R_0^2 = x^2 + y^2 + z^2 + w^2.$$

Geometrically 4D universe of our new model is similar to Einstein universe because both are finite but unbounded and curved but locally flat. But physically they are different. The 4D space of Einstein universe is supposed to be empty where as 4D space of the universe of our new model is filled with two kinds of 4D particles on either side of a grand 3D hyper spherical surface of radius R_0 (our 3D universe).

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EPILOGUE

The new model described in this book is at its beginning stage dealing with topics limited to a very small portion of modern physics associated with stable or semi stable fundamental particles like electron, positron, proton, anti-proton and neutron. At present our new model is silent about many other particles of particle physics, but it is hoped that future research on this model will find a way out of this problem. Most of these particles are unstable and an idea may be suggested that these unstable particles are supposed to be unstable excited quantum states of stable fundamental particles. Accordingly, for example, muon and tauon are excited states of electron. Lastly author strongly believes that spiral transformation process, which is associated with basic assumptions of this new model, can be used to derive equation (14). This derivation will confirm the validity of this new model.

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REFERENCES

1. J.V. Narlikar, G. Burbidge. *Fact and speculation in Cosmology* (Cambridge university press, New Delhi, 2008) p. 97.

2. M. R. Wehr, J. A. Richards, T. W. Adair. *Physics of the Atom* (Narosa Publishing House, New Delhi, 4th edition) p.187, p. 263.
3. J. Bernstein, P. M. Fishbane, S. Gasiorowich. *Modern Physics* (Pearson Education New Delhi, 2003) p.184.
4. L. I. Schiff. *Quantum Mechanics* (McGraw-Hill Inc. Singapore, 3rd edition) pp. 20-22.
5. R. R. Roy, B.P. Nigam. *Nuclear Physics* (New Age International New Delhi, 2012) p. 49.
6. K. D. Krori. *Fundamentals of Special and General Relativity* (PHI Learning private limited, New Delhi, 2010)p.277

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