NEW PARADIGMS IN PHYSICS

New Ideas for the Extra Dimensions and for Deriving the Basic Laws of Physics

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As geometry is constructed from points and their separating distances, physics may be similarly constructed using identical material points and their separating distances with the additional requirement that all points have infinitesimal masses and move all the time at the speed of light. Pairs of such points can get locked together in circles to make doublet particles that can have any speed from zero to that of light, at which point the doublet disintegrates. Using this construct together with the rich mathematical properties of a 3D space, a mechanical definition of time, and simple symmetry rule for displacement, it is possible to derive many of the fundamental laws of physics such as the inverse square laws of gravitation and static electricity, many of the relativistic and quantum mechanical results such as the mass-energy conversion of Einstein and the quantized energy levels of Planck and Bohr. In addition, a better understanding of some illusive terms like inertia and force becomes possible. No arbitrary constants are needed in the process. Extra dimensions (variables that are not a distance) are created as a result of this setup — but they are all found to be discrete. Mass, charge, spin, and time are some notable examples.

1 Introduction

We use common ideas, simple constructs and simple mathematics to shed light on the origin of the grand laws of physics that have hitherto remained untied together. That this is possible was a big astonishment to the author having spent years of search to achieve the same using fields and waves excluding discrete masses. We first postulate the existence of a 3D Euclidian space containing a large number of material points (point masses). The distance between the points is to be a continuous function, which goes well with our intuition, as we never observed material objects jump without passing through all joining points in between. We then realize that this postulate endows the space with an enormously rich structure [1] due to the fact that the distance becomes analytic and infinitely differentiable. The masses must be infinitesimal in order to move continuously at the speed of light without violating Einstein's and other results in this regard. We are tacitly assuming that no space can be defined without material points. As to what is a material point is left undefined.

Material points can acquire other properties like electric charge etc which we will come to meet later. When the separating distance between two material points of suitable attributes is small, they trap each other to make a doublet particle. This combined structure can have any speed — from zero to that of light, in which case it disintegrates into two point particles. Bound states of equal masses do exist in physics as in the case of the exotic particle "positronium" [2]. The normal mass of a material body, composed of a large number of such doublet particles, is simply the total number of doublets and hence it is discrete. We note that an immediate benefit of this setup is a simple mechanism for converting mass into energy and visa versa if we associate energy flux with point particle flux. In fact it amounts to an ultimate unification of the of mass and energy concepts. We also note that a space with continuously moving material points may be an alternative and fairly convincing way of interpreting Einstein's space time continuum ideas. This becomes even more apparent as we arrive at the same relativistic results using the simple doublet structure.

To reach to the more fundamental laws of physics, we shall put a simple mechanical definition for time and a symmetry rule that governs the displacement of point particles (and doublets as a result) in space. We shall consider such grand ideas with the simplicity they deserve, as Einstein have suggested in more than one occasion — what is needed is simple physical interpretations rather than complicated mathematical descriptions [3]. The transformation between point and doublet particles may be looked at as a process of equilibrium or a continuous forward and backward transformation — an evaporation condensation process if you like, and one that can be observed on larger and larger scales in nature. The trapping and escape of photons in matter(radiation), of electrons out and into the nucleus of different materials, of whole molecules from the surfaces of any liquid and the trapping and escape of large masses in volcano eruptions on planets and stars are few such examples.

Doublet particles are to be taken to represent the simplest form of condensed matter, whereas singlet particles are to represent energy flux. Singlet particles may also combine (along their flight path) in any number and remain as different energy fluxes as long as they do not take the form of circularly bound doublets. Doublets can also come together(condense) and combine to form massive particles. In [4] the doublet structure is examined further and it is shown that the geometrical rules for the combination(packing) of doublets seem to fit well measured values of different forms of condensed matter.

2 Theory

2.1 Space and Time

Intuitively, it is not possible to define space when it is devoid of matter [6, 7]. Our starting point therefore is to assume the existence of material points with infinitesimal masses that move all the time at the characteristic speed of the space — the speed of light c. The numerical value of $c = 2.99{\times}10^8$ comes from our arbitrary choice for the units of distance and of time. A 3D Euclidean space may(at one instance) be structured out of *all* such material points and the distances that separate them. This space is continuous to go with our intuition — that is to say when material points move, they do not jump, but pass by all the joining points along the path of motion as given earlier.

We then note that time itself can not be defined in a space devoid of motion. Just imagine one is at night in a desert with nothing moving — no moon, no stars and not even a heart beat. In this setup there is no way to see time flowing. So we are led to say that time must be connected with the motion of material points. To get a sense of time we need an observer point and a moving point, since if we move along a straight line without being able to observe anything else moving, we will not be able to see time flowing either. The problem now is that any observation over a distance must rely on light propagation and will introduce the well known complication of a finite value of c.

A simple case however, where this is not a problem is the case of two material points moving on a circle in a doublet formation and the observer point is sitting on the path of this doublet. We can then define time as the *number* of visits of the doublet members. This number has all the characteristics of time since it is an *ever increasing* variable (pointing in one direction- hence the arrow of time expression) and it is *symmetric* in the sense that the zero of count (zero of time) can be placed anywhere. It is, however, *discrete* according to this picture. It is also an independent variable in the sense that it can have any integral value for any value of the other three spatial coordinates. This is well in tune with our intuition of the variable "time", as we always rely in our time measurements on some sort of oscillation and count the number of such oscillations to measure time. If light can be sent to come back in a straight line to a distant point, the distance to that point can be judged from the knowledge of the period taken as given by the number of rotations(visits) of our local doublet members and the assumption that the characteristic speed c is constant all the time. Time can thus be looked at as a measure of the distance travelled by any material object to the distance travelled by a material point as given by the circumference and the number of rotations of our local doublet.

A mathematical fact is that if a particle in an *isolated* system follows one path exactly more than once, it will continue to do so for ever. We can convince ourselves with this if we remembered that the number of points along an even a *differential line segment* of such path is more than enough to fix any number of *constants* in the solution of the differential equation of motion — thus ensuring that the path is fixed and unchanged in subsequent visits. This conclusion is possible only if the line of motion is continuous and analytic (infinitely differentiable) which is the reason for our original assumption. The emergence of such eternal stability can prove useful in explaining the eternal stability of some of the elementary particles like the photon and the electron when in isolation.

We also note that the rich mathematical properties of the path of motion in space lead to new variables or dimensions that are independent of the original three spatial dimensions. Any extra dimension derivable this way appears to be not a distance and only discrete however. We notice also that the creation of such extra variables comes out of a process of a closure or folding in the path of motion and turning it into a multi-valued variable in which every point is described not only by its three space coordinates, but also by other numbers derived from the multiplicity at that space point. We mention angle measurement as one more example of such multiplicity.

Since the velocity of a moving point is a mathematical derivative with respect to time, and as time is represented by a number, we conclude that the process of determining the velocity and acceleration, (or the process of going from static to kinematic and dynamic), is a process of comparison (ratio) of the motion of a larger system with that of a simpler and standard one like a doublet. In other words, the motion of the simple doublet is effectively being used as a yardstick to gauge the velocity and acceleration of more complicated systems. This definition of time breaks down of course for periods that are smaller than one unit of measurement (determined by the smallest possible doublet) whatever that may be. Since time is discrete, velocity, acceleration, force, momentum and any similarly related variable are all discrete. This will later lead to the Heisenberg uncertainty principle.

2.2 Laws of motion — action and reaction

We put here a simple rule for the displacement of material points that goes with the state of natural symmetry possessed by two material points (in isolation) in the form; "*The displacement of any material point must be accompanied by the displacement of another point by the same amount in an opposite direction*". For two isolated points it might be argued that it does not matter if one point made the entire move and the other stays a foot, as the outcome would be the same. This is clearly not the case, since in reality we will have many more points and our rule should apply to every pair of them.

Since mass is composed of many material points of the same value, and motion is to be discrete, the displacement of ten points one distance can be compensated for by the displacement of one point ten times that distance in the opposite direction, and our equivalent statement of action and reaction becomes; "*The sum of mass times displacement is zero at any point and along any direction*". In other words, the center of mass of an isolated system of points never moves. We can also see that as time is now just a number, differentiation of the displacement with respect to time gives; "*The sum of mass times velocity (linear momentum) is zero at any point and along any direction*", and differentiating again gives; "*The sum of mass times acceleration (force) is zero at any point and along any direction*". Thus we see that it is possible to recover both the second and third Laws of motion of Newton from a simple rule of displacement. We take this to be a strong support of the correctness of this postulate as a rule of displacement.

Our rule of displacement, which we shall call the "*balanced displacement*" (BD) rule, may be considered as the equivalent of Newton's first law of motion since it tells that points can not change their state of motion independently... if a material point moves, another must also move by the same amount and in the opposite direction, and things can then stay like this forever as long as the BD rule is true. The BD rule also provides a neat explanation of the source of inertia of massive bodies. It is simply a balanced displacement requirement. As if the world is sitting on a knife edge and moving anything must be done symmetrically to keep the balance .

Displacement can be resolved into three directions, the first along the separation distance between two moving points plus two components normal to this direction. The two normal components combine to define the spin direction of the doublet. The doublet particle can have left or right hand spin property. Such spin, once initiated, will continue unchanged since the BD rule works correctly all the time– that is until an interaction occurs with another group of points.

The displacement along a radial line separating two moving points can have two directions; to the inward and to the outward directions. This produces the attraction and repulsion type effects. The probability for material points to take any one of six possible motions along three perpendicular directions is presumably equal, this provides a plausible reason for the existence of antiparticles, and the fact that antiparticles can be anti in all their attributes and have the same mass. Thus we have by now two types of coupling constants and two different spins — all new variables and all discrete, since they can only take the values ($+/-$ a constant) representing each of the two opposing directions. Larger values of charge, spin etc must now be in multiples of this constant value.

An interesting conclusion of all this is that the sum of displacements of all material points in the universe is zero at any time and hence the center of mass in the universe never moves. It is also not hard to see that as a result of the BD rule being applicable to every two points separated by a distance, there is a universal entanglement situation of every single point mass in the universe. If we now imagine doing a back play of all the events of displacements that has occurred since the start of time, we may reach the original point start(the big bang point!). The clear impossibility of such undoing, should tell us that it is impossible to go back in time. We could also say here that time must have started with the first motion and will only stop when everything else stops moving.

As pointed above, the BD rule can give us a neat explanation of inertia which some believed it to be a property of matter and others to be due to the effect of distant masses (the Mach principle). In the present setup we see that it is a result of the symmetry of displacement — i.e. a property of space and matter together with distant and near masses all involved. One interesting example to make the picture clear is the case of the rotation of a thin disc in isolation. Every two diametrically opposed points of the disc follow happily the BD rule and, as such, constitute a self contended system that will, if not disturbed, remain as it is for ever. If we move the disc along the axis of rotation, we must create a movement of other masses equivalent to that of the disc in the opposite direction — as in propelling it with the gases of a rocket for example. The rotational motion of the disc remains unaffected in this case. If we now try to move the disk on a curved path, we need to provide an equivalent opposite motion to the curving and rotating material points of the disc in its new complex motion, and it is this that shows as the gyroscopic effect.

2.3 The inverse square laws

The interaction between two isolated material points can only be a function of the separation distance — because of isolation. Such interaction, as a result, becomes homogenous in the coordinates — that is to say there can be no preference of one coordinate to the other. For such cases we quote few lines from [8] "... the multiplication of a Lagrangian by a constant does not effect the equation of motion. This fact makes it possible, in a number of important cases, some useful inferences concerning the properties of the motion without the necessity of actually integrating the equation of motion. Such cases include those where the potential energy is a homogenous function of the coordinates, i.e. satisfying the condition $U(ar^1, ar^2, \dots, ar^n) = a^k U(r^1, r^2, \dots r^n)$, where a is a scaling constant, k is the order of the potential function and n is the number of coordinates". This then lead the reference to the following conclusion "If the potential energy of the system is a homogenous function of degree k in the (Cartesian) coordinates, the equation of motion permits a series of geometrically similar paths and the times of the motion between corresponding points are in the ratio $t'/t = (l'/l)^{1-k/2}$, where l'/l is the ratio of the linear dimensions of the two paths". To follow our notations, put r for l', t' for t to get $r = Kt^{2/(2-k)}$, where $K = l'/(t')^{2/3}$ is a coupling constant and is made up of the values of the radius and the time of one rotation "of a standard doublet in our case" and r is the separation distance between the two points.

There are only two values for k [8] that result in a bound motion. These are $k = (-1, 2)$. The first gives $r = Kt^{2/3}$ and the second leads to a spring type force or what is known as a "space oscillator". The space oscillator case can be shown to be not a new case and occurs in a field of inverse square when the displacement is small, the region is small with a large number of interacting particles [8]. The first case (the two third power formula) is one form of the famous Kepler third law of motion and if differentiated twice gives the inverse square law $d^2r/dt^2 = (-2/9)K/r^2$ in confirmation of our starting assumption. In [5] this form of the inverse square law (involving time only) was used to predict the motion of many point particles with a notable gain on computing time. The quantity $(-2/9)K$ is the coupling constant of the interaction which takes the value of the universal gravitational constant $K_g = (-2/9)K = G$ for gravity forces or the Coulomb coupling constant $K_e = 1/4\pi\epsilon_0$ for electrostatic forces. The value of G is therefore calculable(in principle) from the dimensions of the doublet used in the dynamic scaling of the problem — when this is known.

The values of the coupling constant for the gravitation and electrostatic forces come from our arbitrary definitions of the units of mass and charge. By now we had four constants; the speed of light c, the Planck's constant h, the gravitational constant G and the permittivity of free space ϵ_0. Our arbitrary physical units from which these are derived are the meter, the second, the kilogram and the Coulomb.

When we have more than two material points, vector superposition of forces, velocities and displacements must be used, with the force (= acceleration since we have equal mass) for each pair calculated separately then added for the lot. For N material points, there are $N - 1$ interacting pairs of points as we exclude the interaction of a point with itself. If N is large, $N - 1$ can be replaced with N. For the case of a large collection of points that are effectively *sitting at the same point*, the center of mass of any such body obeys the same rules of motion given above, since mathematically the two are equivalent. The final interaction force is a resultant of the interaction of all pairs in each collection and will thus be a multiple of the total number of interacting pairs, or equivalently by the product of the masses of any two interacting groups having the same center of mass. This reproduces Newton's law for gravitational interaction and the Coulomb charge interaction and the product of the two masses/charges will appear in the coupling constant.

2.4 The size of a doublet

Take the case of pairs of points with an attractive force locked in doublets to form particles. These doublets will have fixed masses(by assumption) and also fixed spin velocity since the tangential speed of all the material points making a doublet is fixed at c at all times. It has a fixed radius also since the speed of the constituents are fixed and the coupling constant is also fixed. This creates a particle with fixed and well defined properties. Since the product of the mass of two point masses $2\delta m$, the speed υ, and the radius of the doublet r is given by; $2\delta mcr = \delta mcd$, where $d = 2r$; has the units of energy and time (or that of angular momentum) and is the same as that of the Planck's constant, we conclude that a limit must be placed on the smallest allowable doublet, giving $\delta md = \hbar/c$, where $\hbar$ is the reduced Planck constant. This also suggests that (δmd) is a new fundamental physical unit involving mass and distance combined together (= $3.5177{\times}10^{-43}$ kg m). The numerical value of this constant (or equivalently of the Planck's constant) comes from our arbitrary choice for the unit of mass in addition to that of distance and time used earlier. The quantity $(\delta mcd = \hbar)$ is the angular momentum and also the spin of our doublet particle and it is the unit of measurement of spin. As we have now a lower bound on spin, the orbital momentum of any one or more particles can only be a multiple of this value $\hbar$.

3 Further results

3.1 Heisenberg uncertainty

Since $\delta m\upsilon d = \hbar$ can be rewritten as $pd = \hbar$, where $p = \delta m\upsilon$ is momentum for one material point, we get (putting Δx for d) the uncertainty principle of Heisenberg usually written as $\Delta p \Delta x = \hbar$. Accordingly, the uncertainty principle refers to the smallest possible angular momentum in nature. As material points always move at c and must have some effective size, it is only natural that there is a minimum radius for the circle of rotation of a doublet. For larger masses, Δx is smaller according to this principle. This need not cause any contradiction. It can be taken in this setup to represent the region inside which the center of mass of all doublets is likely to be located. It becomes smaller as the mass increases, very much like the uncertainty (scatter) in the average of a large number of collected data growing smaller and smaller as the number of data points is larger. Interestingly when this is extended to take the mass of the entire universe, it becomes equivalent to saying that the center of mass of the universe is firmly fixed at a point.

3.2 Einstein mass and energy conversion

As all points making a doublet particle move at the speed of light, the kinetic energy in any doublet must be a function of c^2 and accordingly we can write $E = mc^2$, with m defined as the number of doublets in any larger particle. As we have two point masses in any doublet particle, the more general formula $E = 0.5m\upsilon^2$ for kinetic energy is still valid if applied to a single point constituent of a doublet.

3.3 Planck's energy of radiation

For points moving with a speed c around a circle or escaping out of it, we have $c = \omega r$, and $mvr = mc(c/\omega) = h/2\pi$ using the results above. Using $\omega = 2\pi f$, we have $fh = mc^2$ or $E = hf$. This is Planck relation for the energy of radiation of frequency f. Also if we put $p = mc$, we get $E = cp$ for points moving at c. This is the momentum-energy relation for a particle with infinitesimal mass (zero mass in the literature).

3.4 Einstein's relativistic mass

Since points forming a doublet can have two motions — one along a circle with velocity c and one along the center line with velocity v (less than c), the ratio of the kinetic energy of the doublet particle to its total energy must be like $(v/c)^2$, *i.e.* $E_k/E = (v/c)^2$ since both quantities refer to the same set of masses. Also, as we had $E = mc^2$, we get $E_k^2 = E^2(v^2/c^2) = (E^2/c^2)v^2 = p^2c^2$, which then gives the relation for the total energy as $E^2 = E_0^2 + c^2p^2$. This is the well known relativistic formula for the total energy of a particle in terms of its rest energy and kinetic energy. Here it is derived using the simple doublet structure alone.

3.5 Bohr's energy levels

For a group containing n doublet particles bound together, the single doublet formula given above in the form; $mvd = \hbar$ becomes $m_n vd = n\hbar$ giving the well known Bohr formula for the spin of bound electrons. This formula, despite its success in being very close to experiment, has been criticized as not being based on a model. The doublet model as explained above can be given in support of this very useful, simple and experimentally correct formula. The Bohr formula is normally combined with the centrifugal force expression $F_c = mv^2/r$ and static electric force $F_e = e^2/4\pi\epsilon_0 r^2$ [9] to derive another expression for the energy levels in an atom (and other bound structures) in the form $r_b = (n^2/Z)(4\pi\epsilon_0 h^2/m_e e^2)$, where Z is the total charge of an atom and n is an integer multiple of the spin of the atom. For a single charge atom like hydrogen and lowest spin level corresponding to $n = 1$, we get the Bohr radius $r = r_b = \epsilon_0 h^2/\pi m_e e^2 = 5.2917{\times}10^{-11}$ m. This formula has been declared wrong, in some of the literature, because it predicts the spin squared as $n^2\hbar^2$ rather $n(n-1)\hbar^2$ as predicted by the wave function theory of quantum mechanics (which has a better agreement with experiment). In the author opinion this is an unfair conclusion, since in any n discrete interactions, a particle does not interact with itself(as given above), leaving only $n(n-1)$ interactions that should replace the n^2 term in the Bohr formula and bring it inline with the corresponding quantum formula.

When a group of doublets form a larger structure, the volume of the new structure will intuitively depend on the number of doublets if these happen to occupy different volumes and not share the same center of rotation. This fits well with the observations about the nucleus of any atom being a function of the number of the nucleons only. The application of this fact lead to the one third power law for the radius of an atom R in terms of the atomic number A [9] giving $R = r_0 A^{1/3}$; where $r_0 = 1.4{\times}10^{-15}$ m is an experimental constant. For the nucleus of hydrogen $A = 1$ and r_0 becomes the diameter of a proton. We shall compare this value with that of the electron as calculated in the next section.

3.6 The fine structure constant

When the gravitational and magnetic forces are small, the electrical Coulomb forces $F_e = e^2/4\pi\epsilon_0 r^2$ for electrons are nearly equal to the centrifugal forces $F_c = m_e v^2/r$. In the case $v = c$; $r_e = e^2/4\pi\epsilon_0 m_e c^2 = 2.817{\times}10^{-15}$, giving the classic radius of the electron. This formula is normally derived in the literature (see [10]) from the potential distribution around the electron due to its charge using energy conservation. The present derivation relies on the doublet model alone. In a doublet however, we have two material points (two masses) contributing to the force which seems to suggest a different value for r_e, giving $r_e = 1.4010{\times}10^{-15}$ instead. This is probably more plausible as an electron radius, and it is to one's surprise, exactly the same as that for the proton as we found from the hydrogen nucleus in the previous paragraph. If this is correct, it indicates a similarity in the packing in both the electron and the proton despite the large difference in mass. One possible explanation is that this is the result of many doublets occupying the same volume and sharing the same center of rotation — increasing the energy content but not the size. Experimentally, the electron has, so far, behaved as a point charge with no internal details apparent. The proton on the other do have an internal structure.

If in the expressions for the centrifugal and static forces above, the velocity v is less than c, we could calculate v using $mvd = \hbar$ and obtain; $v^2 = e^2/2\epsilon_0 h$, and $v/c = e^2/2\epsilon_0 hc = 1/137.036$. This is the fine structure constant and it now points to the relative velocity of the electron in an orbit to that of light (or that of the material points in a doublet), and can therefore be looked at as a form of a packing factor. If the expression for the doublet radius is divided by the radius of the electron using $mvd_c = \hbar$; we get $d_e/d_c = e^2/4\pi\epsilon_0\hbar c = 1/137.036$, giving the "fine structure constant" again — now it is a clear packing factor. The quantity d_c is the Compton wavelength of the electron. The ratio of the Compton diameter d_c and the Bohr diameter d_b as found above gives $d_c/d_b = e^2/2\epsilon_0 hc$, that is the fine structure constant again — now representing the next level of particle packing. All these are well known results, but now we have a clearer reasoning for their existence– using expressions derived from the structure of the doublet alone.

3.7 Planck's length scale

The Coulomb force between two point charges is given by $F_e = q^2/4\pi\epsilon_0 r^2$; and the magnetic force between two moving point charges is given by Ampere's law $F_m = \mu_0 q^2 v^2 / 4\pi r^2$. This can be modified using the identity $c^2 = 1/\epsilon_0 \mu_0$ to give $F_m = (q^2/4\pi\epsilon_0 r^2)(v/c)^2$. Thus if $v = c$ the electric and magnetic forces between two point charges are equal regardless of the value of the separation distance r or charge q, since they cancel out. This is very interesting because it allows the *packing* of doublets without having to overcome the huge electrostatic repulsion forces. This is an *asymptotic freedom* type condition. Such equality is normally broken as the particles go to form a doublet and the electric forces between different doublets become much stronger than the magnetic forces between them, since the speed of the center of a particle doublet is small and the magnetic forces between two doublets, becoming small compared to the electrostatic forces. The situation changes again for a very large collection of moving doublets wherein the magnetic forces become important again because of the shear number of participants (when correctly oriented) rather than the result of very high velocity. We observe this in our daily usage of the magnetic force wherein currents are the result of the orderly movement of a very large number of particles.We note here that Ampere's law is also derivable from the inverse square law when the charges are in motion.

When the electric and the magnetic forces are balanced at the velocity limit c, only gravity and centrifugal forces are left in play. Gravity force is given by $F_g = Gm^2/r^2$ and centrifugal forces by $F_c = mv^2/r$; equating the two and taking into account the Planck formula $mvr = \hbar$ with $v = c$, we obtain $r_p = \sqrt{G\hbar/c^3} = 1.616{\times}10^{-35}$ m. This is the Planck length scale and it gives the smallest possible dimension of any doublet structure. When the separation distance increases beyond this length, the equality changes and the centrifugal force becomes more dominant over gravity as in normal interactions. For large astronomical masses the picture changes again and gravity becomes strong and dominant because of the shear number of participating particles.

3.8 Spin and space quantization

In the presence of more than one doublet contained inside a larger particle, it is not unreasonable to think that space and size limitations allow the compaction of only a limited *integral* number of doublets. This leads to an angle quantization, if doublets shared the same spherical space and to volume quantization if doublets are in separate spheres. Angle quantization leads to the well known quantization of angular momentum and volume quantization gives the nucleus a size that is dependent only on the number of nucleons [9].

4 Final remarks

We have started with identical material points together with the continuous distances separating them and formed a 3D Euclidean space for any point in time. We have assumed that all material points have infinitesimal masses and move all the time at the characteristic speed of space and that of light c. The value of c comes from our arbitrary choice of the ratio of the units of mass and time. We formed doublet particles that have a (center of mass) speed from zero to that of light from every two point particles of suitable attributes. This simple construct produced a simple mechanism for the transformation between mass and energy and when further analyzed, produced the correct relativistic energy and quantum mechanical relations too.

Extra dimensions — all discrete are derived from the properties of the 3D space and the differentiable distances existing between any two material points in it — using the fact that through a single point in space one can have multiple paths of motion. The dimension of time is found to correspond to one such multiplicity– the number of rotations of a standard doublet counted at any one space point.

Velocity, acceleration, force, momentum and any variable dependent on time are found to be discrete as a result of the discreteness of time. This naturally lead to the Heisenberg uncertainty principle and the discrete energy and some other ideas associated with quantum mechanics. The need for discrete description of some of the basic variables of physics can be traced as far back as the Greek philosopher Zeno, who put paradoxes that threatened the rational basis of science till very recently. These were only recently resolved using arguments from calculus in which infinitesimal quantities can integrate to finite quantities in a limiting process. Making time discrete is another neat way to clear Zeno's paradoxes.

The process of timing is found to represent a gauging process of the dynamics of larger systems by those of a simpler system like a doublet. The dimensions of spin etc are created in connection with movements in the directions normal to the line joining any two material points. The inverse square laws are only the result of similarity in the motion of different size systems. The coupling constants in the two opposite directions along the line joining two material points can be ± 1 for repulsion and attraction. To work with individual charges, rather than the resultant outcome, is the square root of this giving; $\sqrt{-1} = \pm\, i$, to produce the desired effect of repulsion for similar charges and attraction for different charges, and $\sqrt{1} = 1$ to represent attraction only in the case of gravitational forces — since we do not have negative masses in nature as far as we know. Again if we are only concerned with the combined effect of two charges or two masses, then we only need to consider the real quantities ± 1 for the coupling constant for the gravitational and electrostatic forces.

Only four different forces are needed in the present setup. Two of the forces, the magnetic force and the centrifugal force result from the motion of the *sources* of the other two — that is masses and charges. The last two types of forces disappear at zero velocity. As we have identical point masses, the word "force" becomes not essential and can be replaced with just "acceleration". The mathematical ideas of superposition and center of mass are very useful and should be used for all vector quantities. Four numerical constants appear in the present formulation. At the same time, we have four arbitrary units to fix. Therefore we could assume that the two make two equivalent sets of values or figures.

A transformation from a singlet particle to doublet particle was taken to occur when two material points are locked in a circular motion to form a doublet. In the absence of external factors, this system is self preserving and eternal, since the two rotating points observe the rule of balanced displacement BD all the time and the linear speed is fixed at that of light all time by assumption. Further the coupling constant is fixed and this fixes the radius of the doublet. This made one doublet exactly similar to any other doublet in size, mass, magnitude of spin, but may differ in the other attributes like the sign of spin, sign of charge etc. This allows for creating antiparticles that are identical in mass, but have anti other attributes. The rule of motion in the form of balanced displacement BD is a generator of the three laws of motion of Newton as it leads directly by differentiation to the conservation of momentum and to the usual action reaction for forces. As the measure of time is discrete, all the quantities connected to time are discrete leading naturally to the Heisenberg uncertainty principle and Planck's discrete energy quanta.

The method of using fields rather than particles is not essentially different. Water is composed of particles, but it is describable in terms of a continuous field of pressure. Also a large number of particles with suitable coupling constants can be described using waves, and a group of waves can become concentrated to resemble a particle(the soliton). Particles however, constitute the simples and more natural model for construction of matter. The phenomenon of interference and others have been sighted in the past as arguments against the particle picture. The Newton's corpuscular theory of light, for example, was rejected by simply asking where the corpuscles go at points of zero amplitude in the interference pattern (the dark spots in the interference pattern). These and other objections, have long been shown to be false since interferences happen only at the surfaces of matter and the energy or photons or corpuscles are readily absorbed by matter itself — very much like hitting a body with two bullets from two opposite directions produces no apparent kinetic energy — it is simply transferred to the molecules in each of the two bodies.

Another problem of interest is that when all particles at sight are connected via deterministic laws, as in the present case, one may suspect the disappearance of the *free* will concept. It is a fact that at this moment I can stop writing this article if I wanted to. How a decision like this can be made if the destiny is decided by the fact that all material points in the *world are entangled* together by the balanced displacement rule and the motion of any material point as a result is decided by the fate of every other one. The author believes this problem is closely related to an earlier situation we met above, wherein material points can "decide" whether to have a left handed or right handed spin or some of the other opposing attributes. At the point of branching or multiplicity of choices of paths that are equally likely, it takes nearly "zero" energy to change ones mind, and this could be why we feel free to take decisions at a moment where more than one action route is possible. In other words, our free will decisions are mainly done on branching and cross roads situations.

Reference [4], considers further the idea of a doublet particle and the geometry of aggregate of doublets, and show that it is possible to use such building blocks to make more complicated pieces of condensed matter and that there is good evidence that the masses of the elements in the periodic table and those of the elementary particles of physics are well correlated with assumptions given for simple doublets.

The Pauli Exclusion Principle, which is a corner stones of modern physics, has not been considered here. This principle is also derivable from the geometry of space and symmetry.

Acknowledgements

The author acknowledges many useful discussions with Dr. J. Hemp (Oxford, UK) and encouragement of Prof. J. Gilson (QMC, London). This work is self supported and the author is very grateful to authors who allowed their work to be made available free on the web and to the wonderful information centers and search engines that allowed such information to reach everyone at the touch of a button.

Submitted on August 25, 2009 / Accepted on September 19, 2009

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