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ON THE UNIFIED FIELD THEORY

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Abstract
Einstein had failed to formulate a unified field theory which will give a complete picture of the universe. The author here describes a way of viewing the universe a la the unified field theory, which may also be regarded as a theory of everything.

Our physical world is evidently still far from understood and our interpretations of nature can be expected to be changed in the future. Several scientists have already overturned Einstein's postulation of the invariance of the velocity of light - these few scientists reasoned that the velocity of light is not constant but variable, a contradiction of the well-accepted tenet that the velocity of light is invariant at all inertial frames. Some scientists are even resurrecting the ether which Einstein had banished. Superstring theories, which had been neglected in the past, are now the "in" thing, being regarded by many scientists as beautiful, or, elegant, and a possible theory of everything.

Einstein had not been able to formulate a unified field theory or equation which explains the connection between the four forces of nature, namely, gravity, weak nuclear force, strong nuclear force and electromagnetism. Our purpose here is to see how a unified field theory may succeed.

We first look at the role of gravity in nature. Gravitation has always been thought of as a pulling or attracting force, just like the force of attraction between two magnets. Can gravitation and magnetism be different manifestations of the same thing? One scientist had postulated that gravity is not a pull but a push that emanates from the sun. Even if gravity is a push, how are we to tell? So far, gravitational forces are seen as forces of attraction only, while magnetic and electric forces are forces of attraction and repulsion. Is it not possible for a gravitational force of repulsion to exist in our universe? Is it also not possible for there to be such a thing as nuclear fields? These missing links may be awaiting our discovery. Their discovery can give rise to a new unified field theory.

Gravity can be described by the following formula:-

$$F = G \frac{M_1 \quad M_2}{R^2}$$

where F is the gravitational force of attraction, G is the gravitational constant, M_1 and M_2 are the masses of two objects and R^2 is the distance between masses.

Before Newton discovered gravity, nobody had known it existed or had thought that there was such an attractive force. Einstein in his General Theory of Relativity interpreted it as a curvature of the space-time continuum, a geometrical form. Can gravity be the fifth dimension, in addition to the four dimensions of General Relativity comprising of the three physical dimensions and the time dimension, as Theodor Kaluza had suggested, which impressed Einstein greatly?

The author however will prefer to interpret the dimensions of the physical world as infinite, i.e., a Hilbert space. It depends on how we view the physical world, on our mental inventiveness, and is thus subjective. This is a reasonable interpretation because quantum particles in the micro-world, unlike the objects in the macro-world whose actions or movements are evidently more predictable (but even objects in the macro-world can be unpredictable when there is turbulence or chaos), are comparatively unpredictable where their actions or movements are concerned and can only be predicted if at all in a probabilistic fashion. We will never be able to know for certain where a quantum particle will turn up next. Moreover quantum particles are capable of being at two different places at the same time, and, also capable of instantaneous travel or teleportation, which is "spooky" and incomprehensible. It is therefore not unreasonable to propose a field equation involving infinite dimensions, signifying both the infinite, unpredictable directions and distances traversed by the quantum particles, including their interaction and the possible discovery of new particles and the associated anti-particles, and the relatively finite, predictable (though at times chaotic and unpredictable) directions and distances traversed by the larger objects of the macro-world, perhaps coupled with a probabilistic operator for the quantum particles, if this is possible. According to modern quantum mechanics, all possible physical states of a system correspond to space vectors in a Hilbert space. An infinite-dimensional Hilbert space will also fit in with the theory of the existence of an infinite number of parallel universes which are connected with each other through worm-holes.

It is thought that quantum particles are free from the effect of gravity, which seems only to have a negligible effect on them. In the macro view, the quantum particles Þ of the micro-world can be described mathematically as elements of the larger objects ŋ of the macro-world, being the building-blocks of the latter: Þ Є ŋ. This implies that like the latter they will be affected by gravity too.

According to Einstein's theory of gravity, the hypothetical quantum of gravity, the graviton, which is a spin-2 boson, interacts extremely weakly with other matter, far more weakly than neutrinos; it is so weak that no instruments so far have been able to detect it. In the supergravity extension of this theory of gravity, the graviton finds a superpartner, the gravitino, which is a spin-3/2 fermion. Under local supersymmetric transformations these two particles transform one into the other. When quantum calculations were carried out using supergravity theory, it was discovered that the infinities which plagued the earlier gravity theory with only the graviton were now being cancelled by equal and opposite infinities produced by the gravitino. This is evidently the result of the deeper consequence of the presence of supersymmetry. Though it is not certain whether the supergravity theory is completely renormalisable, this "softening of the infinities" appears to be a step toward a viable theory of quantum gravity. As simple supergravity theory includes only the graviton and the gravitino, this hardly corresponds to the real world with its many particles. Most of those who have worked on supergravity feel that some crucial idea is still missing. Without this crucial idea the theories simply do not describe the real world.

How do we make supergravity theory realistic? If we can solve this problem, we can have supergravity theory as a completely unified field theory. It has been shown that the principle of local supersymmetry is so restrictive that only eight possible supergravity theories exist, which are each labeled by an integer N = 1, 2 . . . 8. Supergravity theory shares the same features with its progenitor, the Theory of General Relativity, namely, conceptual power and mathematical complexity. Perhaps, by postulating the existence of a single master supersymmetry we can have a unified field theory that accounts for the whole universe.

The following is Einstein's equation for General Relativity:-

$$G_{im} = -\mathbf{K}(T_{im} - 1/2g_{im}T)$$

This beautiful equation expresses the curvature of space-time. The left-hand side refers to a set of terms which characterise the geometry of space, while the right-hand side refers to a set of terms which describe the distribution of energy and momentum, i.e., the left is the geometry side, while the right is the matter side. Reading from left to right is space-time telling mass how to move, while reading from right to left is mass telling space-time how to curve. In General Relativity, there is neither absolute time nor space and gravitation is not a force, or, pull between one object and another but a property of space and time. All this represents a great conceptual leap by the theory's creator, Einstein. As for the coordinate system of Einstein's General Theory of Relativity it has no basis in reality and is only a mental construct used to describe the space-time continuum of the General Theory of Relativity.

A suggestion of the author is to change the left-hand side of the equation, the geometry of space, which is here a four-dimensional space-time continuum, into an infinite-dimensional space, a Hilbert space:-

$$G_{imH} = -\mathbf{K}(T_{im} - 1/2g_{im}T)$$

What kind of geometrical form can represent this infinite-dimensional space? One geometrical form of this nature can be an infinite number of Moebius Strips which are intricately intertwined and linked with each other (with each Strip being cut lengthwise into several narrower strips which are connected together at narrow points, which represent parallel universes). Another such geometrical form can be an infinite number of Moebius Strip-like cylindrical objects (which have no edges, are hollow and with openings for accessing the hollow, and are in effect three-dimensional, unlike the two-dimensional Moebius Strips, and infinite in all directions, which may be called Moebius Cylinders) intricately intertwined and linked with each other. There are likely to be other equally or more convoluted geometries which this infinite-dimensional space can have. It is thought that since we are only able to move around in the three large, observable spatial dimensions comprising of length, breadth and height, and one of time, all other dimensions must be very small and thus invisible to us, being curled up in a multidimensional space (this very small, invisible, curled up multidimensional space may represent the invisible micro-world of the quantum particles).

The failure in deriving the unified field theory is the failure to derive an equation which will link our visible macro-world with the invisible micro-world of the quantum particles, which will link the gravitational force with the weak nuclear force, strong nuclear force and electromagnetism, an equation which should encapsulate the totality of information about the universe.

One may wonder when a unified field equation will be found? However, without a good understanding of gravity and its link with the quantum world, this unified field equation will not be able to come by. This unified field equation will link both the macro-world and the micro-world through gravity, which will be the common denominator for both. Once the experimental confirmation of the existence of the graviton, the hypothetical quantum of gravity, is achieved, we should be surer of obtaining a unified field equation that accounts for the whole universe, which may be supported by the existence of a single master supersymmetry. Superstring Theory now appears to pave the way towards achieving this difficult goal.

Can there be some yet to be discovered universal laws which govern everything that exists in the universe? It is difficult to tell but it will be very useful to know these laws. To many, God may be the "Universal Law". As this Universal Cause is not acceptable scientifically, another set of such universal laws which are indubitable and acceptable should be discovered.

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