

Measurement Theory

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Abstract Several significant questions, problems, and uncertainties have been raised with regard to the fundamental foundation of physics and its underlying mathematical structure – which concern even its validity on the most precise levels – which have hitherto remained unresolved; matters at the very heart of measurement itself, which constitutes the basis of precise science. Since these matters underlie methods of observation, deduction, and analysis, they are beyond the scope of such means of investigation in external application and the results derived, and can only be resolved by a theoretical framework which underlies them. The purpose of this work is to analytically establish the correct theoretical structure which necessarily provides precisely such a reliable, definitive foundation. That an answer and resolution may be found to all questions, problems, and matters of uncertainty concerning these most fundamental subjects, as well as to present a foundation of ultimate explanatory and functional simplicity with direct application to all of physics, upon which the validity and ultimate success of these subjects depend in their entirety. This is a task accomplished axiomatically by analytically addressing the fundamental, irreducible common denominator of all systems of measurement and mathematical theory, and resultantly presenting the derivations of such an organization as a matter of logical consequence; the *irreducibility* principle of which allows there to exist no more fundamental a foundation possible.

Keywords Generator, Irreducible, Quantity-less, Symmetry

1. Mathematical Structure

1.1. Foundation

Measurement has a *source*; a measure is a grouping, it is a direct statement of “how much” of a given basic “element” there exists; this principle applies to all measurement – even all plurality – that there is in existence a fundamental underlying irreducible element which is common to all degrees of measures as the basis – this may be called *the fundamental principle of measurement*. For the ultimate general case of sheer multiplicity itself, there then exists a principal common identity which as the source generates all measures as its function – a function of itself – and is then common to all possible measures. As its function it therefore operates upon itself, in individual sequence, to produce a different, distinct designation of sequence each operation – this general common entity may be referred to as the generator, G , and its operation upon itself as $G(G)$; its axiomatic identity as a self-operator meaning that each operation is a form of identity – which produces an “extension” of itself each operation – the extent of measurement. Each operation produces a new distinction; each distinction in sequence then defines an order – each new entity being a new quantity of order.

Since this entity is the source of quantity, it must itself logically precede quantity, the quantity-less; in presently used numeric terms, this is the 0, and the identity of G is then 0 – the quantity-less is the exact identity of the irreducible; the complete reduction of which to no quantity allows no further possibility of a more fundamental element. 0 then operates upon itself to produce distinct quantities of order, and the first is the 1, produced by $0(0)$. 2 is $0(0(0))$, 3, $0(0(0(0)))$, and so on[1]. Each operation is the same – symmetric – and therefore capable of producing an infinity of numbers (deriving the axiom of infinity as a corollary of operation identity). In relation to these principal orders of natural numbers, an inverse mutual operation is allowed by the symmetry of such operational order which produces $(0)0$ ($1/2$), $((0)0)0$ ($1/3$), and so on – whereas irrationals are infinite in nature, and are not finite measurable designations unless limited to a specified extent (just as infinity itself is not a specific number). This entire process is identical to presently used number systems, for example binary is determined by an amount of 0 place-markings [0, 1, 10, 100 . . .] and more so for unary [1, 11, 111, 1111 . . .] is equivalently 0, 00, 000, 0000 . . .]; this is also analogous to geometry’s designation of measures entirely by 0-dimensional points. Each new distinct designation of order constitutes an axiomatic unprovable proposition, providing the most direct basis for such – each constitutes the basis of proof itself actually; even of quantity.

Measure operations such as addition are a higher-order

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application of operation – allowed by the symmetry of operation and elements of operation – and may be denoted as a higher level operation $()_1$:

$$0(0(0))(0(0(0(0))))_1 = 0(0(0(0(0(0)))))) = 2 + 3 = 5 \quad (1)$$

the equation principle is itself a form of symmetry; the mutual inverse operation of subtraction allowing the definition of negative quantities simultaneously by symmetry of operation and element of operation. Multiplication/division are a yet higher operation of $()_2$, and exponentiation/root-extraction, $()_3$, consistently, concisely organizing all fundamental measurement operations – these higher-order operations upon 0 effectively cancel all operation, and particularly for the inverse operation of division, the entire possibility of an operation is negated as inversion applies only to extensions of 0 and not itself.

1.2. Extended Applications

Fundamental arithmetic has been axiomatically established, and higher branches of mathematics are based upon higher-order generalizations thereof. Algebra is the generalization of elements allowed by symmetry of application – including of operation, defining number fields with the symmetric properties of commutativity and associativity, even “groups” – set theory – and all its axioms of the empty set, extension, union, choice . . . [2] which are categorically equivalent to the encompassing singular identity of 0 and its self-referencing and ordering operation, which organizes all plurality and then all possible elements – proceeds as a generalization of such elements in relation to one another; also deriving functional correspondences. The generator principle may be generalized as well to apply to sets of functional relations – due to the equivalence of such a direct correspondence – in which case G is generalized as a set operator which governs the defining general correspondence relation – ratio – of dependent and independent variables for infinitesimally continuous functions, which are measurably complete by inclusion of inverse extension, and their relation of ordering as a 0 operator – as the independent variable of measure-order-generation is reduced by inverse-extension-process to its source, the 0, with the corresponding effects in the dependent variable – to produce the derivative and limit axiomatically and properly; for the function f , this is symbolized by $0(f)$ – generalized by degree with respect to a particular variable x as $0_x()_n$ – the symmetry of an operation based upon the generator principle allows the definition of the inverse operation of integration naturally (the fundamental theorem of calculus), which may be symbolized as an infinity operator, $\infty(f)$.

Geometry is the designation of measures within coincident parameters – sets of “dimensions” of extension, from the *origin/source*, 0 – which may be symbolized by 0, $0[0]$, $0[0[0]]$, $0[0[0[0]]]$. . . (giving a point, line, plane, space . . . respectively). Each dimension allows an arbitrary scale by symmetry – equivalent to the original postulates of Euclidean geometry – and this dimensional separation

provides parallelity inherently – a right angle is the basis of a two-dimensional intersection, thus a line intersecting two others at a right angle indicates a dimensional separation (universally symmetric non-coincidence) of the lines, corresponding to the infinity of Pythagorean triplets arithmetically as parallelity derives the Pythagorean Theorem; variants are then cases of differential, tangential dimension in which parallelity is locally preserved.

A line is a one-dimensional object; a triangle is the most fundamental two-dimensional object – a single point relative to another two which form a line; this point forms a two-dimensional extension of the line, automatically defining an altitude of right angle intersection, and since this is identical for each point each of their altitudes then mutually extends through a common point of intersection to produce the whole figure, deriving the orthocenter theorem. The Pythagorean Theorem follows from the extension of the endpoints of a line to a point two-dimensionally – due to their intersection at a right angle – giving a two-dimensional equivalence measure to the line in terms of the individual (leg) extensions – which cumulatively count to a sum – for a , b , and initial line (hypotenuse) c , this translates as

$$a^2 + b^2 = c^2 \quad (2)$$

for the original line having at most two endpoints, this correlation of dimensions then can exist at most for two in the most fundamental measures of extended dimension, the natural numbers (Fermat’s Last Theorem). The fundamental theorem of algebra simply counts the number of separate dimensional measures (solutions) of a polynomial equation – then given by the exponents’ maximum degree – the arithmetical generators of all exponentiation being naturally limited to the most basic positive and negative arithmetical quantities, by the measurable completion of such inverse extension, and then the complex number field; the fundamental theorem of arithmetic merely acknowledges that prime numbers are by definition the irreducible generators of all multiplication; similarly, all branches of mathematics and their elementary theorems follow from such basically defined principles, which as elaborations of plurality and calculation are by ultimate reductionism categorically determined to be entirely properties of extension of the fundamental principle of measurement.

2. Physical Structure

2.1. Fundamental Measures

Mathematics is most directly applied to the science of physics, which is based upon a necessary principal measure of linear order – the basis of measurability – corresponding to time, delineating a measurable event at each instant, the set T – which determines time as a measure itself to be one-dimensional and (as a result of its universally symmetric ordering) sequentially irreversible. T as a measure of alteration and change is inversely though equivalently a static, functional sheer potential for change to occur,

defining energy (E); energy is then manifested in time as such effected change and distinction in the form of mathematical point-to-point displacement as space (S) – in a thus unified space-time.

Energy is the measure of quantitative potential for distinct change to occur by its nature, and its measurement generator then must be non-zero – empirically confirmed to be a lower limit \hbar – likewise energy is the principal, contingent extensional measure produced by time's generation and is thus limited to principally ordered, non-zero natural number extensions thereof. Energy as the inverse of time is then related to it in equation form as

$$E = \hbar/T \quad (3)$$

generated extensionally as

$$E = n\hbar/T \quad (4)$$

to derive the equivalent relation (of differentials)

$$\partial_E \partial_T \geq \hbar \quad (\text{or } \hbar/4\pi) \quad (5)$$

(energy's inverse periodicity to time providing the additional denominator), which properly and logically derives the basis of quantum physics[3].

The most fundamental form of energy (on the quantum level) is then generatively propagated from one point in time to another periodically in the form of spatial displacement (though increase of scale obeys generalized laws contingent on classical displacement and position), which means that the generator $\mathbf{0}(E)$ corresponds directly to the generator of all such potential spatial dimension $\mathbf{0}(S_D)$, which is equivalent in time to an infinity of one-dimensional displacement "paths" spatially differentially limited from one location in time to another. This derives the quantum path integral formulation axiomatically, in terms of the $\mathbf{0}$ action Hamiltonian/Lagrangian, \mathbf{H}/\mathbf{L} , a direct result of the $\mathbf{0}$ value of $\mathbf{0}(E)$, which is conserved as a most basic and vanishing measure. Energy action \hbar is directly contributed to each path – in terms of the periodic complex exponential identity – in established terms as

$$\langle S_I | e^{-iHT} | S_0 \rangle = \infty_S e^{i \int_{[0,T]} L(S(T)) / (\hbar/2\pi)} \quad (6)$$

[4], a formulation which rather than being a property of infinite extension reversely arises from the spatial action of quanta over space that are in the form of infinitesimal differential limit extensions; this gives mathematical rigor to the path integral's basic S term as it is actually the source which generates all measurable spatial dimension[4], determining the path integral formulation to be ultimately the correct one, eliminating quantum absurdities – and the many-worlds interpretation.

These particulate limit points arise as collectively summed and averaged integrated phenomena whose inverse symmetry to time allow the application of concepts of frequency and interactive interference (waves), which arise as modes of their mutual interaction, and only in such a way do such waves actually exist – location potentials whose quantity may be interpreted as "probability" – identically

these basic measures of energy are only manifested as particulate phenomena through a limiting form of interactive measure[3]. The indeterminate property of quantum probability is then a direct reflection of periodic historical measurement, as measurably determined outcomes are ultimately those which have necessarily occurred with measurable certainty, or have already measurably occurred, undetermined outcomes reflecting what is yet to occur (the future); the indeterminacy reflected directly on the most precise quantum scale is actually that of the momentary process of the indeterminate future of timed measurement itself.

As limits of energy these particulate infinitesimal designations possess an additional limiting, restrictive form of measurement designation – which thus takes on only minimally basic distinguishing quantitative evolution in the form of discrete half "rotations" – that of "spin", which as an intrinsic quantum particle property independent of linear spatial propagation then must coincide with angular momentum.

2.2. Extended Properties

Energy as the symmetric inverse of the set of time possesses properties coincident to it as the ordered basis of measure; time's invariance of ordering produces an invariant collective quantitative potential of energy, thus it is conserved – equivalent to stating that time's symmetry produces energy conservation – mathematical symmetries produce laws due to the equivalence of generator symmetry ("sameness") and resultant extensional measure invariance.

Time's invariant and causally unsurpassable ordered progress extends to that of historical energy and its spatial displacement propagation which necessarily coincides with it – the invariant, unsurpassable, confirmed, empirical speed of light, c (the proper derivation of the relativity principle). Spatial displacement is only relative to other spatial displacements in the form of fundamental "interaction", which then requires an initial measure dimension – generator and neutral mediating reference frame between interactions – the dimension of distinct measurable propagation, and mutually an independent dimension with which to distinctly, measurably interact; producing three coincident, identical extended dimensions of spatial interaction, $\mathbf{0}[x[y[z]]]$ or (x, y, z) – which are distinct from separate, particulate, intrinsic compact forms, which shall be addressed.

Spatial particles traveling at identical constant rates of measure cannot distinguish one another measurably in spatial interaction – as a result of their indistinct velocities – thus there must exist a sub-light speed mode of energy interaction; and this is found in matter having mass. Mass is then a direct form of energy, the quantitative potential of which to exist then being mathematically absolutely inverse to the constant of light speed in a ratio – doubly as an accelerant, differential quantity $\mathbf{0}_m$, generalized as m , dependent on its rate of motion – functionally described in relation to energy then (in the most basic rest state) as

$$m = E/c^2 \quad (7)$$

mass's relative velocity then producing relativistic effects in its energy measure components, space and time; with proportionate contractions and dilations in terms exactly relative to its propagation ratio to that of light speed[5]. Mass as a form of energy is a measure of quantifiable potential – and its principal measurement standard – and thus must be a uniformly quantified (only positive) quantity with a quantum lower limit nature, axiomatically deriving the positive mass gap principle – which is ultimately a direct consequence of the sequential irreversibility, and non-negativity, of time; and thus energy, and its extended property, mass. Matter's distinguishing nature as the foundation of interaction – which is specifically manifest in the quantum property of a distinguishing half spin; single for freely independent particles, which are mutually arranged distinctly in opposites, multiple for bound ones, and integral (inverted/reversed) for the non-interactive – is also the source of the exclusion principle.

Matter is cancelled by antimatter to conserve the amount of energy that produces its interaction – particularly universally at limit spatial points in their mutual annihilation – and this process is measured by historical energy interactions as “messenger” particles, producing the “forces” – which thus are necessarily unified by nature – as well as the entire evolution of the universe. The nature of energy interaction based on the attraction to the mutual annihilation of the force charges of matter and antimatter can be either attractive or repellent – equally mutual – determining an interaction force produced solely by the direct, mutual contribution of each energy charge measure, and – equivalently – the inverse of their mutual spatial distance from each other at an instant in time – standardized by a constant of dimensional analysis – to give

$$K(E_1/S)(E_2/S) = K(E_1E_2/S^2) \quad (8)$$

thereby deriving the inverse square law and its application to such forces; predominantly the most overarching force of distance, the empirical electromagnetic[6], of which the weak nuclear force is a manifestation at a distance limit – the strong force another variant. As a property of mutual attraction this principle may apply to a classical gravity formulation – when gravity is generalized in an elementary manner as a classical limit.

Gravity itself is the collective organization of matter in time by grouping, which proceeds from the symmetry of time and energy, causing a necessarily equal distribution of energies collectively in time. This gives a greater cumulative energy – or mass – measure a proportionally greater time – and then space – metric, which is generalized in a quantitative manner directly in the most fundamental field equation of general relativity as the relationship between the space-time and stress-energy tensors

$$G_{ab} = kT_{ab} \quad (9)$$

the equivalence principle is the symmetry of the moving object and the measurement field that measures it to move at

all; the physical invariance principles of general relativity, such as general covariance (coordinate system invariance), are additionally measurement symmetry properties[7].

2.3. Generalizations

Classical physics is a generalized limit approached in which quantum and relativity effects become relatively infinitesimal and thereby relatively negligible; the most fundamental mode of measurement and observation is that of massive objects in motion, each having a distinct quantity of momentum as mass/energy's effects are sequentially designated by spatial displacement in time as a functional relation $S(T)$ – properly deriving momentum to be the principal coordinate designation of material motion. Since time is symmetric in its ordered progress universally as the underlying basis – with extension to its corresponding spatial displacement – there exists the principle that

$$\mathbf{0}(S(T)) = 0 \quad (10)$$

for matter naturally – that is, constant velocity, if unaltered by “external” influence, remains constant – the definition of force then proceeding from the non-zero mathematical variation from such inertia

$$F = m[\mathbf{0}(S(T))] \quad (11)$$

the third classical law of the conservation of momentum being identical to the conservation of mass/energy and inertia.

The general equations of electromagnetism are another consequence of the $\mathbf{0}$ operator – due to the equivalence of the differential limits of spatial effects and energy charge – as it takes on the form of the divergence operator – which may be symbolized by denoting the number of coordinates, o , $\mathbf{0}$ operates on as ${}_o\mathbf{0}(\)_n$ – for the electric – \mathbf{E} – and its auxiliary (relativistic counterpart) magnetic – \mathbf{H} – space fields in the most basic vacuum state as

$${}_3\mathbf{0}(\mathbf{E}) = 0 \quad (12)$$

$${}_3\mathbf{0}(\mathbf{H}) = 0 \quad (13)$$

and as it takes on the form of the matrix determinant curl operator which may be symbolized by ${}_{[o]}\mathbf{0}(\)_n$ – with fields \mathbf{E} and \mathbf{H} adjusted by spatial constraint constants to become \mathbf{D} and \mathbf{B} , respectively – to give

$${}_{[3]}\mathbf{0}(\mathbf{E}) + \mathbf{0}_T(\mathbf{B}) = 0 \quad (14)$$

$${}_{[3]}\mathbf{0}(\mathbf{H}) - \mathbf{0}_T(\mathbf{D}) = 0 \quad (15)$$

the latter a 0 action equivalent of the electric force, the former its reverse auxiliary counterpart – the higher-order formulations of these equations constituting the more precise quantum “Yang-Mills” theory.

Physical properties such as fields themselves proceed from the equivalence of spatial and energy differentials – the additional invariance properties of which are entirely consequences of measure symmetry – properties in general such as vectors – as well as scalars and tensors – proceed from mass/energy conservation – by symmetry – in spatial displacement, which is generally the invariance of such

physical law in its coincident extension to spatial (energy) evolution.

2.4. Specific Organization

The coincidence of particulate energy manifestation and its interactive spatial dimension of displacement measure determine the interaction of fundamental material particles to likewise possess a threefold generation of distinct energy measure – distinguished by order of magnitude – each interactive manifestation possessing an inverse, oppositely charged counterpart to collectively conserve energy action – distinct from their innate antimatter partners – which being generalizations of spatial extension likewise possess generalizations of spin distinction – a scheme empirically manifested in the interaction of the oppositely charged leptons and hadrons (and their energy-conserving un-charged, neutral variants), each additionally distinguished by generalizations of interactive opposite spin manifestation in the form of “isospin” which is specifically evident for hadrons as they are the distinctly interactive half isospin variation, leptons being the counter integral form; this form of isospin being an intrinsic particle characteristic distinct from the secondary algebraic characteristic of weak isospin, as shall be addressed – the distinct manifestations of each translating as “flavor” symmetries, which as fundamental symmetries form $\mathbf{0}$ group – “Lie” – algebras of the fundamental – unitary, $U(n)$ – variety[8].

The properties of spin’s generalized analog of isospin include its organization of such half spin particles relative to one another in interaction – principally in opposites for hadronic quarks – fundamentally bound by their mutually determining spin interaction, which at the generative source of extended dimensional interaction that is isospin exemplifies its threefold extensive property – which is manifest specifically as “color” with sole application to interactive half isospin quarks to the exclusion of their integral leptonic counterparts – axiomatically deriving the strong force interaction – the equivalence of which with spin’s analog of isospin is empirically determined by the exclusive property of color interaction with particles of distinct intrinsic isospin.

The strong force’s strength supremacy follows from the property that half spin itself is the minimal and then ground base physically quantifiable measure – as evidenced by the fact that all fundamental measures must be greater than or equal to such spin, $\hbar/4\pi$, as it is the quantity of minimized (half) distinction – which corresponds to the exact value of the quantum ground state measure, zero-point energy. The ground base nature of half spin, which then extends to its higher generalization of intrinsic isospin as the foremost ground base of interactive measure – superseding all other forms – also then makes it evident that quantum non-locality follows from the half spin of a free particle being minimally – and in time instantly – discrete and relationally preserved, a property the identity-preservation of which supersedes causal propagation through space – analogous to the manner

in which the interactive strength of the strong force supersedes that of the spatial displacement forces. Likewise follow from such interactive precedence the confinement property of quarks and the solely direct interactive nature of the strong force, these properties extending naturally to intrinsic isospin’s overriding mechanism of spatial extension, “color”. Additionally, color is a distinct interactive property the gauge symmetry of which determines its measurable distinction to be purely relative to interaction – then requiring confinement as its measurement property.

Mathematically, the quantum field governing the most encompassing, overarching, generalized force of distance of these quantum properties in the fundamental symmetry group $U(1)$ is governed by a single principle:

$$\theta_F = 0 \quad (16)$$

an identity of the stationary action principle in quantum form, which is a direct reflection of the foundational nature of 0 to all precise measurement.

The theoretical principle of supersymmetry is innately confirmed by the wholly symmetric nature of measurement and particulate phenomena themselves; itself an extension of the spin group whose purpose for establishment was the theoretical incorporation of the strong force – a framework mathematically confirmed by its proper definition of unification with the strong force at a specific limit point contingent on the extended effects of spin – thus dictating the existence of superpartners for these families of particles, from whose variety the potential to produce dark matter is derived.

All primary forces then determined to exist axiomatically are the spatial displacement forces – the electric and its limiting case of the weak – and the spin force – the strong nuclear interaction – in terms of their cumulative organization of energy as gravity.

2.5. Extended Organization

The weak nuclear force itself represents the uncertainty principle – which wholly determines its range and field of action – applied to the spatial displacement force of electromagnetism in which such specific limiting distances of action and dispersal determine an exponentially increased potential for energy content. This causes the fluctuation of matter particles into existence as force messengers in a triad of energy-conserving charge, anti-charge, and un-charged variants. The weak force limit, in terms of energy, corresponds to a measure of zero-point energy of the electric force; the lower limit of its spatial effect – which negates the extended magnetic component as well as its spatial charge; determining it as a sheer energy measure, with the incorporation of the limiting $\hbar/4\pi$ factor, in the electric force formulation – with a corresponding zero-point of the associated current spatial vector operator – which is then an infinitesimal differential limit, which as the derivative (group generator) of an inverse spatial charge vector results in an inverse square; which thus varies mutually – giving

$$F = C(\hbar/4\pi T)(\hbar/4\pi T)\mathbf{0}_J(K_J) = C(\hbar^2/T^2)/16\pi^2\mathbf{0}_J(K_J) \quad (17)$$

the coincidence of which with the precise limit of spin energy $\hbar/4\pi$ requires this to be a force formula with specific limiting reference and application to the spin – strong – force charge – due to the equivalence of isospin and spin algebra, especially at such a precise limit point; thus the origin of weak isospin – and is then the direct unity point of the quantum forces – a weak coupling of strong charges – which as an equation of force corresponds to the mathematical variation from invariant current conservation – and resultant spatial action – formulated equivalently with the energy of strong force charge quanta g as

$$\mathbf{0}_J(S_J) = Cg^2/16\pi^2\mathbf{0}_J(K_J) \quad (18)$$

which equates to a non-conservation of strong force – baryonic – charge[9]; this mathematical correlation of the independent electroweak derivation proves the spin-based nature of the strong force, as well as proving supersymmetry at such a unity point – contingent on spin – producing a fundamental symmetry-breaking, spin-related (chiral) anomaly – and its algebra – the non-conservation of which as a necessary condition for the derivation of matter’s existence – through dominance over antimatter – is matter’s necessary origin point, the source of the equivalence between the equations of force unity and non-conserved strong baryonic charge – as the derivation of matter’s distinct existence is also necessarily that of its forces. This symmetry-breaking phenomenon of measurable distinction itself is then the mechanism by which the whole of material existence comes into being, such uncertain – indistinctive – scales forcing distinctly interacting matter into existence to preserve measurement; a process then not produced by fields but is rather the intrinsic property which produces measurable fields themselves – the same means also give a non-zero cosmological constant, which is minimized by supersymmetric spin cancellation.

This origination of interactive force charges themselves in the unified force equation – in relation to the most basic strong force – translates as a direct mathematical statement of quark confinement through the lack of baryonic conservation at the minimal limit of interactive spin and weak charge – determining a non-vanishing mutually interactive strong charge – which also results in the uniform presence of chiral symmetry-breaking – through its associated chiral anomaly – to strongly-interacting quarks; two principles the formulation of which are the final of the three properties thus established which axiomatically prove quantum strong force dynamics and the mathematical existence of Yang-Mills theory – with the inclusion of the positive mass gap, evident in the value of the zero-point spin energy.

Such a mechanism is then determined to be the origin of all material interaction, including the historical limit of the big bang in its matter/antimatter collision – an unlimited amount of such interactions are determined to exist as they only measurably exist relative to one another in interaction; resolving the paradox of the finite and the infinite (the

relative and the absolute), as all measure is ultimately determined by momentary process and relative interaction – and completely energetically cancelled as it is entirely a derivation of the matter/antimatter annihilation process[10].

A black hole represents the opposite end of the material interaction spectrum in which all the processes of matter come to a halt as gravitation causes time’s dilation to come to a limit point – the point of uncertainty – forcing a proportionate antimatter materialization of energy into existence which cancels its material counterpart in a continuous fluctuation of annihilation and pair re-emergence – a process equivalent to a localized, condensed, and inverse version of the radiation emitted externally from the boundary – as the resulting pure energy is gradually dissipated outward – the internal mechanism of gravitation in the center causing the time scale in which such quantum properties occur to be proportionately dilated with reference to space-time beyond the event horizon.

The measurable organization of energy then follows from such fundamental principles – the proton / neutron organization of quarks, spanning the threefold color spectrum to produce an equal electric attraction potential to that of their singular anti-charged counterparts, electrons, with the non-participation of the neutral electron-neutrino – deriving atomic structure – predominantly in terms of the first order particle family, the most readily produced in terms of energy – including the valence organization of spin-excluded electron orbital shells. This means that the sub-atomic structure of the known universe is axiomatically deducible, essentially in totality, *a priori* from the fundamental principles of measurement.

The work of physical unification through M-theory is the incorporation of a non-zero lower limit measure of spatial effect as a quantum necessity by virtue of the non-zero \hbar energy measure to account for its quantitative manifold spatial effects as “vibrations” in terms of lower limit dimensions; extra in number as an additional limit, which then requires an extra contextual 3 – quantized complex dimensions, which becomes 6 – and incorporating the unity of time’s dimensional connective effects with space as given by the path integral, to give 10 total dimensions of spatial action. The particular properties of particulate manifestations of energy in individually distinct form are then accounted for axiomatically in these terms.

2.6. Summary

In summation of the principal foundations which have been axiomatically established, a single underlying principle of unity properly derives all physical law and primary equations, the underlying principle of unification which governs all physical measurement in its myriad manifestations; physically, this underlying principle corresponds to what is known as the “conservation of energy” law, which relates the most fundamental source of physical measurement interaction – energy – to the fundamental measure – time – through the derived measurement source principle – $\mathbf{0}$ – in equation form as

$$0(E(T)) = 0 \quad (19)$$

This relation derives the classical laws of motion – energy’s manifestation as spatial displacement dictates the independent invariance of an object’s constant velocity through energy conservation; the other two laws of motion follow resultantly – the principles of general relativity – the constancy of light speed, the symmetric distribution of mass/energy in space-time, the additional invariance principles – as well as the laws of thermodynamics – equilibrium equivalence through the collective conservation of mutually transitive, invariant energy potentials; itself; entropy from time’s symmetric ordering and sequential irreversibility which are equivalently conservation; no absolute 0 temperature as a result of the invariant non-zero quantitative energy potential – and quantum physics – the path integral formulation, all conservation laws, matter/antimatter interaction and then the properties of the forces (including the equations of electromagnetism). In this proper context it is then determined that rather than merely being a property particular to specific systems, the conservation of energy is a universal absolute of all measurement itself, which ultimately allows the designation and definition of specific systems of measurement – and organizes the specific branches of physics through its properties of order.

This principle and its formulation may then be regarded as the “master (source) equation” of all physics from which all other equations and measures are generated as consequences and details, stating that measurement is preserved – the bases of measurement (time and energy) are invariant – and thus may be called *the fundamental law of physics*. It may also be simply denoted as

$$E' = 0 \quad (20)$$

stating that no energy (activity, measure) is ever created or destroyed – equivalently stating that all that measurably exists can only do so in consistently abiding by this measurement framework, the ultimate validation of the scheme of verification of scientific process – a law which is ultimately a consequence and identity of the fundamental principle of measurement itself, 0.

3. Conclusions

This body of fundamental theory and measurement provides the necessary, definitive (irreducible) axiomatic basis for all fundamental physical and mathematical – and generally scientific – concepts, resolving all problems of foundation and presents the most basic, comprehensible, and

powerful framework of deduction and analysis by nature, deriving the primary structures of each in a consequential (and most logical) manner with ultimate certainty. From their most fundamental principles to their most significant encompassing results – finally deciding all the formerly unresolved matters of each; such as: what are numbers? Quantitative extensions of the quantity-less 0. What is time? The principal basis of measurability. What is the quantum? A necessarily non-zero lower limit of quantitative potential. What is the ultimate source of measurement validity? The fundamental measurement principle (0) and its logical organization. What is the ultimate principle of physical unification? The fundamental law of physics; energy conservation. 0 is then properly generalized and understood as the basis and point of unity of logic, mathematics, and physics; the common identity to all measure and measurable existence, that of unification and certainty of knowledge – the universal theoretical basis of scientific reductionism, the necessary standard of verification – the *irreducible*, incapable of being any other way but as it is – the quantity-less, the lack of quantity of which determines there to exist none other than itself – the ultimate governing principle of all physical measurement and its manifest organization.

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