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A new approach to gauge theory and variational Principal

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Abstract.

The objective of this paper is to present an alternative method of finding the gauge for the elements of an atom, the nucleus, and the electron. The alternative method is based on the behavioural attributes of the nucleus and the electron. It is assumed that atom is intelligent, and therefore, it behaves as any intelligent entity. Given this premise, both the nucleus and the electron can change positions. Their positions can be found in Borel tensor sets of the Universal Probability Space (UPS). Position change from one Borel tensor set to another is caused by interpretation of ongoing conversation between the nucleus and the electron. The validity of the invariance principal is checked in view of the new gauge theory.

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Key words: Gauge theory; invariance principal; behavioural attributes; intelligent nucleus; intelligent electron; ; Borel tensor sets; Universal Probability Space; conversation; interpretation; memory; behavioural disposition.

1 Introduction

The objective of this paper is to study the gauge theory and the variational principal from a different point of view. The foundation of the theory rests on the macroscopic scale with respect to reference frame selection. All the mathematical laws applied are the laws that are applied in the $3(\pm)$dimensional world. The major application of gauge theory and variational principal is in determining particle fields, and in general the Lie-algebra valued 1-forms of particle fields in the entire Lie algebra space or the current, and the electromagnetic field or (inhomogeneous fields). The theory is also applied to spin structures and (proton-neutron doublet) field. The same theory without any change in structure can be applied to explain geodesics and forces that act on particles including gravitation. Though there is justification for this approach, it is worthwhile to search for an approach that considers the scale of the problem. In this paper it is proposed to use metric probability (MP) in the Universal Probability Space (UPS), to revisit some theorems in this field. (UPS) is a space of all Borel tensor sets. Metric probability (MP) is a probability that is calculated based on the existence of a metric in Borel tensor sets. Therefore,(MP) is a tensor based probability that measures proportional tensor based distances rather than occurrences of events. The particularity of this approach is the scale. It applies tensor field to a very small scale space. In addition to scale consideration, the method proposed in this paper relies on the behavioural attributes of the nucleus and the electron. It is assumed that atom is intelligent, and therefore, it behaves as any intelligent entity. It is assumed that the nucleus and the electron are constantly engaged in conversation. The outcome of the conversation translates into change of position on the part of the nucleus and the electron. The magnitude of the change in the position depends entirely on how the nucleus and the electron interpret the topic of the conversation. The gauge, both for the nucleus and the electron can be found in the Borel tensor sets of the Universal Probability Space (UPS).

It is shown, [1] that it is possible to have a probability space where an event can occur if it is in a Borel tensor field ($\boldsymbol{B}$) that contains a group of finite Borel sets that are mappings in a tensor space (Ω), i.e. ($\boldsymbol{B} = \bigcup_{l=1}^{M} B_l^i$) and ($\boldsymbol{B} = \prod_{l=1}^{M} B_l^i$), the superscript (i) represents the tensor indexing of coordinates, and ($l = 1, \cdots, M$) represents the number of Borel tensor sets contained in the tensor field ($\boldsymbol{B}$). (M) is the total number of Borel tensor sets in a tensor field ($\boldsymbol{B}$). Each Borel tensor set can be identified as ($B^i \in \Omega : B^i = B_{j_s}^{i_r} \otimes e_{i_1,\ldots,i_r}^{j_1,\ldots,j_s}$), where ($e_{i_1,\ldots,i_r}^{j_1,\ldots,j_s}$) constitutes the basis in tensor space (Ω). The advantage of each Borel set to be a mapping in a tensor space is that it acquires the following properties; (a) closure, the product of every two mappings of the Borel set (B) is a mapping of the Borel set; (b) inverse: for every mapping of the Borel set, there is an inverse mapping that is in the Borel set. The class of such alternative probability space is called the Universal Probability Space (UPS), [1]. The UPS consists of Borel sets, elements of which are mappings or tensors. UPS represents a more general probability space.

A metric probability for the case of complex tensors exists. In order to include a class of complex tensor fields in Universal Probability Space (UPS), it is necessary to find a representation of complex tensor disks in the ($\Omega \subset \mathbb{R}^d$) space for the metric probability. This can be done using germ sets. Let's assume that there are 2 complex tensor subspaces (U), and (V) such that both are complex tensor disks contained in complex tensor space ($U \subset \mathbb{C}^d$), and ($V \subset \mathbb{C}^d$). Let ($\boldsymbol{z}$) be a set of tensor points in the complex tensor disk ($U \subset \mathbb{C}^d$), then the transformation tensor ($\boldsymbol{w}$) at ($\boldsymbol{z}$), ($\boldsymbol{w} = f(\boldsymbol{z})$), is the germ set of all tensor pairs ($\boldsymbol{w}, V$), ($\boldsymbol{z} \in U$), such that ($\boldsymbol{w} = \boldsymbol{z}$) on the intersection of the two subspaces ($U \cap V$). A complex tensor germ set of pairs can be denoted by ($[\boldsymbol{w}]_{\boldsymbol{z}}$). A point to note here is when a complex tensor event point is a singularity. Singularities are points that are not included in complex tensor disks. One such point is the point (zero). A complex tensor field (U) contains a group of finite complex tensor disks ($U = \bigcup_{l=1}^{M} U_l^i$) and ($U = \prod_{l=1}^{M} U_l^i$), the superscript ($i$) represents the tensor indexing of coordinates, and (l) represents the number of complex tensor disks contained in a complex tensor field (U). Suppose that there are (n) finite number of open complex tensor disks ($U_1, U_2, \ldots, U_n$). It is assumed that the pairwise intersections of ($U_l \cap U_k$), ($l \geq 1, k \leq n$) and the union of these open complex tensor disks ($U_1 \cup U_2 \cup \ldots \cup U_n \neq 0$) are non- empty complex tensor sets. In order to have non-empty complex tensor disks that contain singularities, it must be shown that all singularities can be transformed into germ sets or composition of germ sets in ($\mathbb{C}^d$). Complex tensor disks contain metrics. There exists a representation of such metric in the UPS, (Ω,$\boldsymbol{B}$). A metric representation in the UPS is a transformation of the germ sets ($[\boldsymbol{w}]_{\boldsymbol{z}}$) from ($\mathbb{C}^d$) into the distance between two tensor germ set pairs in ($\mathbb{R}$). For the details on metric probability calculation based on complex tensor germ sets refer to [2].

Each Borel tensor set (B^i), constitutes a set of reference frames. The union of Borel tensor sets represent all possible reference frames in the Universal Probability Space ($\bigcup_{l=1}^{M} B_l^i \subset \Omega$). The model introduced in this paper has the following properties. It is based on modelling regions where the nucleus, (η), and the electron, (ε) orbit. Otherwise expressed it is the spin orbits of the nucleus and the electron that are used in modelling the gauge. It is considered that the reference coordinates or the reference gauge are the coordinates of (η), and (ε) in some Borel tensor set (B^i). The reference coordinates are the $(n, k, m, g_q,\ \psi, \nu, \mathbf{R})$ spin values of (η), and (ε), [3], [4], [5], [6], [7], [8], [9], [10]. (n) is the principal quantum number that determines the size of the spin orbit. (k) is the subordinate quantum number that determines the shape, and also denotes the orbital angular momentum. (m) is the magnetic quantum number. (g_q) is the quantum gravitational force. (g_q) is a function of the nature of conversation that will be explained later in the paper. (g_q) is the ratio of the mass ($m = (m_\eta, m_\varepsilon)$) of either ($\eta$), ($m_\eta$), or ($\varepsilon$), ($m_\varepsilon$), to the gravitational force (g), ($g_q = \frac{m}{g}$) in the absence of conversation. (ψ) is angular velocity. (ν) is angular momentum, and ($\mathbf{R}$) is magnetic moment, In the context of the new modelling approach, Ecludian coordinates are replaced with spin coordinates. It is the spin orbits that are the new coordinates. Spin orbits can not be treated in the same manner as Ecludian or canonical orbits. It is necessary to introduce a new way of defining the new coordinates as a new gauge system. There are many differences between the new approach and the standard approach, but to enumerate these differences, first a summary description of the standard gauge theory and the invariance principal are given.

In the classical approach to gauge theory, there exists a space-time continuum vector space ($M \subset \mathbb{R}^n$), where (n) is the dimension of the vector space. The vector space (M) is a Banach space. There exists a pair (U,ϕ), where (U) is an open subset of (M),($U \subset M$), and is called a chart, [11] , and (ϕ) is a homeomorphic projection from (U) to (M): ($\phi : U \to \phi(U) \subset \mathbb{R}^n$). Each chart (U) represents a coordinate transformation with new coordinates being the new gauge system. It is shown that in this space gauge transformation is homeomorphic. The transformation function (ϕ) is considered to be both homeomorphic and diffeomoephic since it captures the movement of an election, which is considered to be a wave movement. Since this makes the function (ϕ) a wave function, then it is assumed that it can be estimated through tangent bundles, ($T(\phi(U))$), [12],[13], [14]. The notation should not be confused with the earlier notations or notations used later on. Since the Banach space is a space of Lie algebra, then it is possible to manipulate tangent bundles as (GL) types which allows for an easy estimation of wavelike functions. The problem with this structure is that it can apply to all scales of macroscopic level as well as microscopic level. At the microscopic level, movement has to be expressed differently than at the macroscopic level. It is necessary to introduce tools to capture the nature of (infinitesimal). This is the level that has the highest entropy. In most models of gauge theory, there exists a fixed reference point. Here it is assumed that there is no fixed point in an atom. It is assumed that the nucleus can displace (orbit) as well as the electron. Gauge potential is assumed for the nucleus as well as the electron of an atom. The potential location of gauge is given by a metric probability,($\wp$).

At the microscopic level, metric probability,($\wp$) represents entropy. Entropy is the measure of gauge potential. Let ($\aleph \in \Omega$) be a subspace of the tensor space (Ω) such that ($\aleph = \bigcup_{l_\eta=1}^{P} B_{l_\eta}^{\eta} : B_{l_\eta}^{\eta} = B_{j_{s_\eta}}^{i_{r_\eta}} \otimes e_{i_1,\ldots,i_r}^{j_1,\ldots,j_s}, \forall(l_\eta)$) where ($l_\eta = 1, \cdots, P$). ($\aleph$) is the subspace containing all Borel tensor sets that could potentially be the location of (η). ($e_{j_s}^{i_r}; i_r = 1, \cdots, n; j_s = 1, \cdots, n$) constitutes the basis of the position of the nucleus given that (η) is in the Borel tensor set ($B_{l_\eta}^{\eta}$). Let ($\aleph' \in \Omega$) be a subspace of the tensor space (Ω) such that ($\aleph' = \bigcup_{l_\varepsilon=1}^{Q} B_{l_\varepsilon}^{\varepsilon} : B_{l_\varepsilon}^{\varepsilon} = B_{j_{s_\varepsilon}}^{i_{r_\varepsilon}} \otimes e_{j_s}^{i_r}, \forall(l_\varepsilon)$), where ($l_\varepsilon = 1, \cdots, Q$). ($\aleph'$) is the subspace containing all Borel tensor sets that could potentially be the location of (ε). ($e_{j_s}^{i_r}$) constitutes the basis of the position of the electron given that (ε) is in the Borel tensor set ($B_{l_\varepsilon}^{\varepsilon}$). Let ($P_{l_\eta}^{\eta} = B_{l_\eta}^{\eta} = B_{j_{s_\eta}}^{i_{r_\eta}} \otimes e_{j_1,\ldots,j_{s_\eta}}^{i_1,\ldots,i_{r_\eta}}$) represent a possible position of the nucleus. It is assumed that if the nucleus is in a Borel tensor set, then the basis or the gauge of the nucleus is the same as the one of the Borel tensor set. Let the electron's possible position be represented by ($P_{l_\varepsilon}^{\varepsilon} = B_{l_\varepsilon}^{\varepsilon} = B_{j_s}^{i_r} \otimes e_{j_1,\ldots,j_s}^{i_1,\ldots,i_r}$). The gauge of an electron can not coincide with that of the nucleus, ($B_{l_\eta}^{\eta} \neq B_{l_e}^{e}$). Gauge potential is measured by calculating the metric probability, ($\wp$). ($\wp$) is expressed as in Equation (1.1)

$$\wp = \frac{d(P_{l_\eta}^{\eta}, P_{l_{\eta'}}^{\eta'})}{\sum_{l_\varepsilon'=1}^{Q} \sum_{l_\varepsilon=1}^{Q} d(P_{l_\varepsilon}^{\varepsilon}, P_{l_{\varepsilon'}}^{\varepsilon'})} \tag{1.1}$$

where ($d(P_{l_\eta}^{\eta}, P_{l_{\eta'}}^{\eta'})$) is the distance between (2) possible positions of the nucleus,(η), and ($d(P_{l_\varepsilon}^{\varepsilon}, P_{l_{\varepsilon'}}^{\varepsilon'})$) is the distance between (2) possible positions of the electron, (ε). Metric probability, ($\wp$) is defined as the ratio of the change in the position of (η) over the change in the position of (ε). The position of the nucleus or the electron can be written in terms of eigenvalues and eigenvectors. For example, the position of the electron can be written as ($P^i = \lambda^i \otimes v^i$), then the distance between two positions of the electron can be calculated as ($d(P_{l_\varepsilon}^{\varepsilon}, P_{l_{\varepsilon'}}^{\varepsilon'}) = \sqrt{\sum_{i=1}^{n}(\lambda^i \otimes v^i - \lambda^{i'} \otimes v^{i'})}$), where (i) represents the dimension of the basis, and (n) is the number of basis. The same notation is used for (η). It is assumed that at the limit (η) has a smaller magnitude of displacement, than (ε), ($lim_{(l_{\eta'} \to P)} d(P_{l_\eta}^{\eta}, P_{l_{\eta'}}^{\eta'}) \leq lim_{(l_{\varepsilon'} \to Q)} d(P_{l_\varepsilon}^{\varepsilon}, P_{l_{\varepsilon'}}^{\varepsilon'})$). This condition implies that at the limit, ($\wp = 1$), metric probability is equal to one, otherwise ($0 \leq \wp \leq 1$), it is between zero and one.

The coordinates, ($e_{j_s}^{i_r}$) are equal to the quantum numbers introduced earlier, ($e_{j_s}^{i_r} = n, k, m, g_q, \psi, \nu, \mathbf{R}$). According to Bohr theory of the spectrum of the hydrogen atom, the principal quantum number (n) determines the size of the electron's orbit, (k), the subordinate quantum number determines the shape of the orbit, can also denotes orbital angular momentum. In this paper, it is assumed that the nucleus also possesses similar quantum numbers with values different from the ones of the electron. It is possible to expand both the nucleus and the electron basis by adding (2) more coordinates, angular momentum (ν), to account for orbital energy (E_ν). If necessary, can include spin degree of freedom , so that (ψ) becomes $(\psi = \psi(\nu))$. In this paper, the nucleus can be at rest or have a spin. Each Borel tensor set represents specific values of quantum numbers. Displacement occurs when the corresponding quantum numbers change. Change in quantum numbers occurs when both the nucleus, and the electron are engaged in a conversation and interpret the topic, and the content of the conversation.

The concept of interpretation is explored in details in the next section. Interpretation relates to conversation between the nucleus and the electron. Conversation has a topic. The topic decides the nature of the conversation, being (neutral, mild), provocative (dynamic), or confrontational (aggressive). A neutral topic is equal to a conversation that is without any significance. Both parties, the nucleus, and the electron, discuss everyday routine maintenance subjects that both sides agree on. An example of such a conversation would be to maintain cohesion. A dynamic conversation on the other hand, is more controversial. Both sides do not agree on the same course of actions. This can happen, when there is outside intervention. Outside intervention is any action that interferes with the routine functions of an atom. Aggressive conversation is when both sides agree to take an aggressive action against outside intervention. It is the atom's behavioural disposition, and memory that results in the interpretation of the ongoing conversation. The nucleus and the electron remain in constant conversation.

Though the topic of the conversation can change regularly, the conversation itself lasts as long as the atom itself. Conversation never stops. It is an inherent part of the existence of an atom. In a way, one could conclude that every single atom that exists is intelligent since both the nucleus and the electrons are intelligent. Both the nucleus, and the electrons observe a situation, they analyse the situation by talking to each other, and the outcome of a conversation is an action taken by both parties. Mathematically, the different types of conversation, result in different levels of entropy. If entropy or metric probability, is one, $(\wp = 1)$, then $(d(P^{\eta}_{l_\eta}, P^{\eta'}_{l_{\eta'}}) = d(P^{\varepsilon}_{l_\varepsilon}, P^{\varepsilon'}_{l_{\varepsilon'}}))$, both (η), and (ε) have made the same magnitude of displacement. Both have interpreted the topic of conversation the same way, and the outcome is coordinated. This is type (1) conversation. Type (1) conversation is a neutral or peaceful conversation. Both sides agree on the outcome. Coordinated displacement implies full entropy.In this case coordinated movement is an indicative that there exists a high covariance between the nucleus, (η), and the electron, (ε), $(cov(d(P^{\eta}_{l_\eta}, P^{\eta'}_{l_{\eta'}}), d(P^{\varepsilon}_{l_\varepsilon})$ $((P^{\varepsilon'}_{l_{\varepsilon'}}) > 0)$. If metric probability,$(\wp)$ is between zero, and one, $(0 < \wp < 1)$, then $(d(P^{\eta}_{l_\eta}, P^{\eta'}_{l_{\eta'}}) < d(P^{\varepsilon}_{l_\varepsilon}, P^{\varepsilon'}_{l_{\varepsilon'}}))$, the magnitude of the displacement of the electron, (ε) is much larger than the magnitude of the displacement of the nucleus, (η). The electron, (ε), considers the conversation more controversial than the nucleus, thus the outcome is that the electron reacts more aggressively than the nucleus. Type (2) conversation is dynamic. It contains many arguments, and is complicated by internal and external stimuli. Internal stimuli, are aggressions caused by the nucleus. External stimuli are aggressions caused by outside elements such as light, heat, electromagnetic waves, etc. The covariance, $(cov(d(P^{\eta}_{l_\eta}, P^{\eta'}_{l_{\eta'}}), d(P^{\varepsilon}_{l_\varepsilon}, P^{\varepsilon'}_{l_{\varepsilon'}}) \neq 0)$, between (η), and (ε) , exists and is positive. In this situation some level of entropy is present. The level of entropy is measured by the value of the metric probability,$(\wp)$. If metric probability,$(\wp = 0)$ is zero, then $(d(P^{\varepsilon}_{l_\varepsilon}, P^{\varepsilon'}_{l_{\varepsilon'}}) >> d(P^{\eta}_{l_\eta}, P^{\eta'}_{l_{\eta'}}))$, the magnitude of the displacement of the electron is much larger than the magnitude of the displacement of the nucleus, or that the nucleus has made no displacement, $(d(P^{\eta}_{l_\eta}, P^{\eta'}_{l_{\eta'}}) = 0)$. Type (3) conversation is hostile. This is due to the existence of an outside stimuli. The electron protects the integrity of the atom. Any displacement on the side of the nucleus or the electron is a protective measure, the aim of which is to maintain the wholeness of an atom. There is no covariance between (η), and (ε), $(cov(d(P^{\eta}_{l_\eta}, P^{\eta'}_{l_{\eta'}}), d(P^{\varepsilon}_{l_\varepsilon}, (P^{\varepsilon'}_{l_{\varepsilon'}}) = 0)$. The absence of covariance between (η), and (ε), is an indicator of zero entropy. Figure 1, depicts the three conversation types. The existence of conversation types, and interpretation, make each displacement a linear projection or a connection that will be discussed in the next section, particularly in view of the related attachments of conversation: memory, and behavioural disposition.

2 Behavioural disposition of an atom

It is considered that all elements of an atom (nucleus, electrons) are constantly engaged in conversation. Conversation is at a microscopic level. At the macroscopic level where atoms are grouped to form a larger entity, there also exists conversation among the atoms of each group, and among groups themselves. Macroscopic level conversation is more complicated than microscopic level conversation. This is due to the grouping effect which increases random occurrences of unexpected patterns in the conversation. This paper considers a one atom case only. At the microscopic level, complexity in the level of conversation arises due to interpretation phenomenon. During a conversation, both the nucleus and the electron interpret the conversation differently. Interpretation depends on many factors. Among these factors, the one that affects interpretation the most is memory. This is not a time dependent trait, but memory relates to patterns that are familiar to the nucleus and to the electron. The factor that triggers the memory of (η), and (ε), is conversation. As is shown in Figure 1, Conversation must have a topic. At the micro level, the topic could be imagined to be along the lines of, how to keep the integrity of the atom intact, or how to ward off aggressive external stimuli, or explore possibilities for bonding with other atoms, or many topics relating to the everyday functioning of the atom. Depending on the topic of conversation, the elements of an atom, (η), and (ε), each can perceive this exchange to be neutral or peaceful, type (1) conversation, which means that the elements cooperate and do not work against each other. In this case the metric probability or the entropy$(\wp = 1)$,is equal to one.

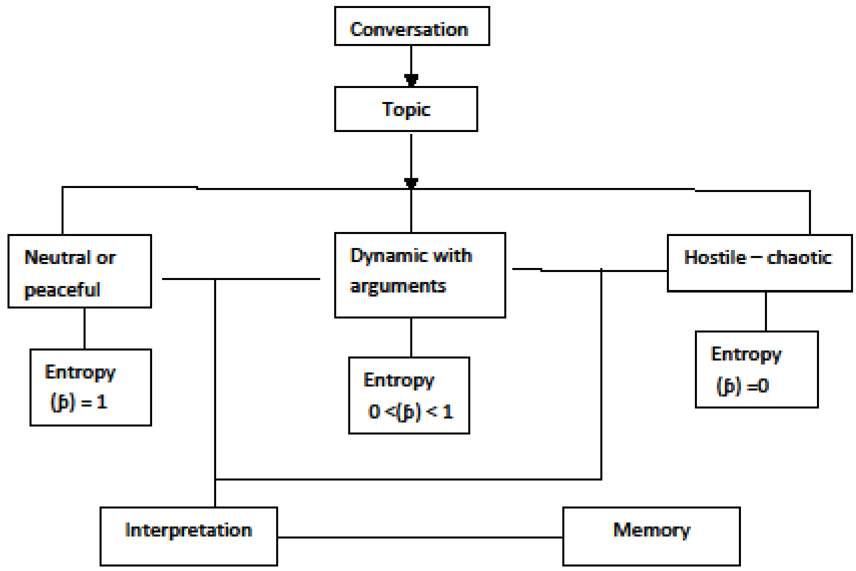

Figure 1. Conversation diagram

One can assume that the gauge either remains constant for the nucleus, and the electron, or any change in the gauge of one element brings about a similar change of gauge in the other element. Conversation is dynamic, type (2), conversation if it includes many arguments on the part of one or the other element or on both sides. In this case the metric probability or the entropy $(0 < \wp < 1)$, is between zero and one. In this case, change in gauge occurs for both elements. Change in gauge of elements is either homomorphic, or isomorphic depending on the type of conversation. Finally, the conversation is hostile or chaotic, if at the limit non of the arguments have a pattern to them, and lead to no logical conclusion or that the conclusion is only in favour of one or the other element. The metric probability or the entropy $(\wp = 0)$, is equal to zero. Here, only one situation is possible, and that is the existence of external stimuli that is perceived hostile by the electron. An example of a situation where there is a change in the gauge of the electron would be a response to a threat such as heat. An example is the double slit experiment, [15]. In this experiment first performed in 1803 by Thomas Young, a beam of light passes through (2) parallel slits pierced in a plate. The beam of light is traced on a screen behind it. Bright and dark bands are observed on a screen placed behind the plate form a wavelike pattern that represents the intensity of light in the presence of heat. This is due to the behaviour of electrons and emission of photons. The behaviour of electrons of light atoms in this case could be construed as a defensive reaction against an external stimuli. The external stimuli is heat. Electrons take a wavelike position. It is possible that this is a defensive posture against heat. The move is designed to keep the integrity of atoms intact. Conversation has three internal components: memory, interpretation, and behavioural disposition. The details of these three components are outlined in Figure 2.

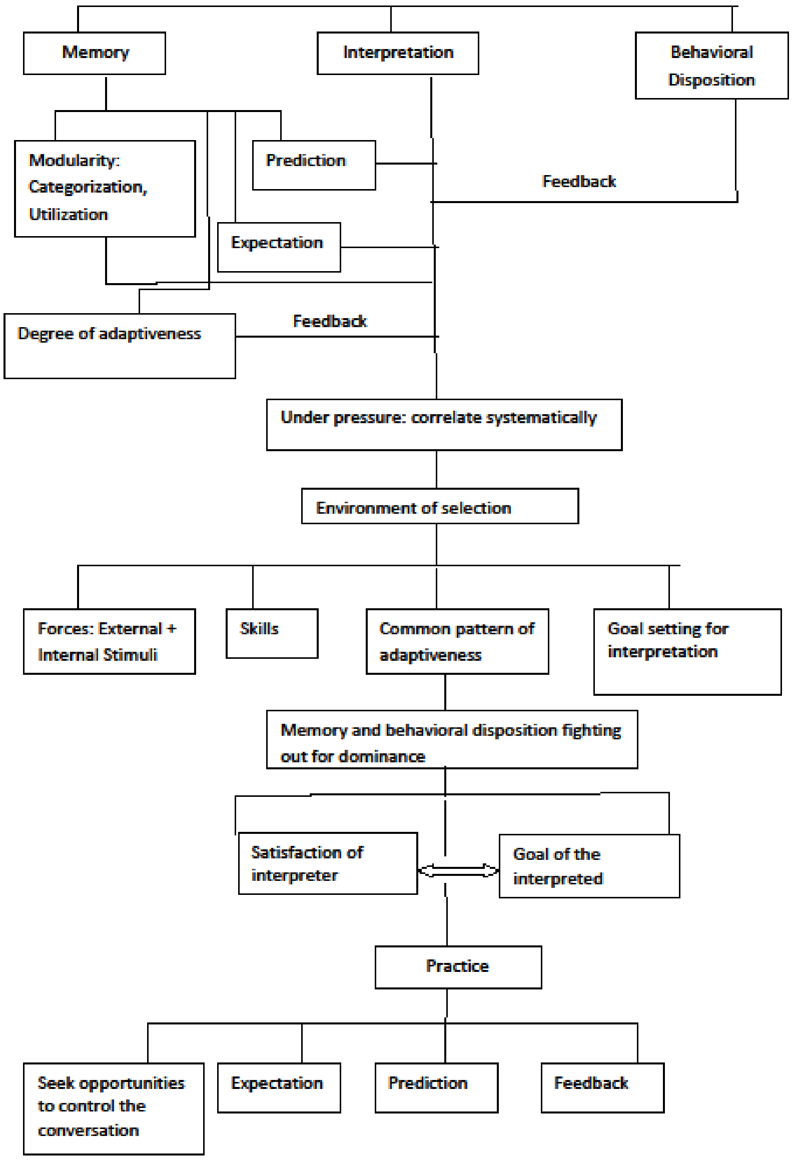

Figure 2. Interpretation diagram

In the diagram shown in Figure 2, memory, interpretation, and behavioural disposition are identified as the main factors that influence conversation. These factors are analysed in some details. The hierarchy of influence is that memory and behavioural disposition are operators that modify interpretation, and render it usable in the conversation. Memory is a feedback to interpretation. Memory contains several components. Modularity relates to conversations experienced by the nucleus, and the electron. It has two subcomponents: categorization, and utilization. All conversations and their outcomes before the present conversation are categorized into distinct categories ready for utilization. To each category is attached expectation, and prediction of outcome. Based on expectation and prediction, category selection could be altered. In the diagram of Figure 2, this is referred to as degree of adaptiveness. Memory is Borel tensor sets arranged in distinct categories. Under the pressure of conversation, memory and behavioural disposition are highly correlated. Interpretation by its' nature has a goal setting functionality. To this functionality must add identification of external or internal stimuli, and availability of skills which implies tools that are available to the nucleus or the electron, for example, in the presence of heat, electrons emit photons. The last item that completes the environment of selection of the interpretation functionality is the existence of common patterns of adaptiveness of response to various arguments of the conversation. Memory and behavioural disposition struggle for dominance. Dominance depends on two factors, satisfaction of the interpretor, in this case the interpretor is either the nucleus or the electron or both, and the goal or intent of the interpreted which in this case is the conversation. In practice, which is when the nucleus and the electron are involved in arguing back and forth, each would seek opportunities, (possibilities) to control the conversation. This effort relies on the interpretors' expectation, prediction, and feedback from memory and behavioural disposition. In summary, during the conversation, the nucleus and the electron put this conversation in a specific category. Based on the specific categorization, the nucleus, and the electron decide to utilize this category to interact with each other in the conversation. Based on the action chosen by the nucleus, and the electron, each one expects a certain outcome, that both predict in advance. Both the nucleus and the electron use their memory and their behavioural disposition as a feedback to adapt their interpretations, [16], [17], [18], [19], [20].

The second feedback to interpretation is behavioural disposition, (β_d). (β_d) is synonymous to temperament. The function of behavioural disposition is to be used by interpretation as a guide to choosing an appropriate reaction. Behavioural disposition has three levels: fast to react, moderate, and slow. Let (v) represent the velocity or the speed of reaction. When the level is fast to react, then it is denoted by (v^{++}). When the level is moderate, then it is denoted by (v^{+}), and when the is slow, then it is denoted by (v^{-}). If the functionality of the behavioural disposition is fast to react, then this functionality is regarded as aggressive, and is denoted by (a^{++}), where (a) represents acceleration. Moderate reaction functionality is regarded as temporal, and is denoted by (a^{+}), and slow reaction functionality is regarded as passive, and is denoted by (a^{-}). The different levels of behavioural disposition are shown in Figure 2a.

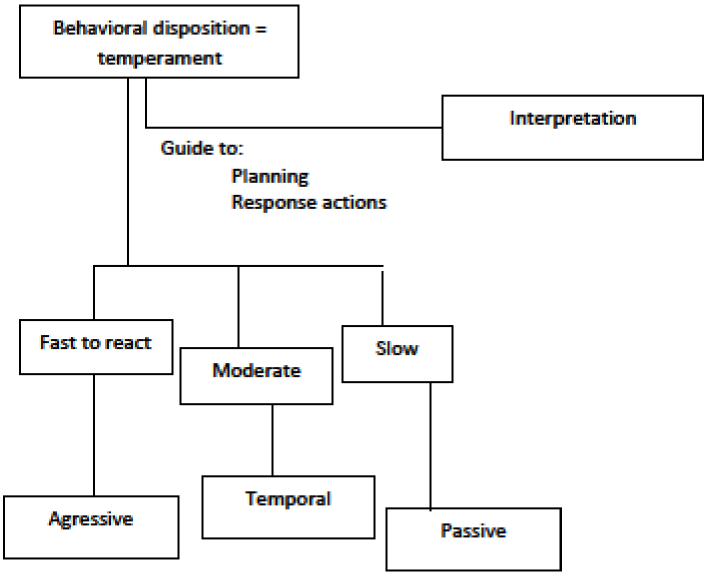

Figure 2a. Behavioural disposition diagram

Interpretation is an evolutionary functionality when it is about an atom. Each atom exists with a complete ability to adaptive interpretation. This means that an atom is capable of differentiating various fitness levels of interpretation, and therefore can adapt its' interpretation to recognize, and respond to any conflict that arises in the conversation, manipulate the situation, and exploit it to its' advantage. As is shown in Figure 2, under pressure of the conversation, the elements of an atom, the nucleus, and the electron use memory, and behavioural disposition to evolve interpretation in order to produce an appropriate outcome. There is a strong correlation between, memory, and behavioural disposition. Interpretation must select among several options given the feedback from memory and behavioural disposition. These options are veritable recognition of what forces are at play, meaning to distinguish between external and internal stimuli, and choose among the skills available to the nucleus and to the electron. Let interpretation be denoted by (ι). Memory denoted by (μ), and behavioural disposition, (β_d) outline the strategy of adaptiveness to the situation, and eventually set goals for how the nucleus, and the electron, (η), and (ε), would want to conclude the conversation. The evolutionary aspect of interpretation appears through the struggle between the satisfaction of interpreter (here would be (η), and (ε), and the goals of the interpreted, (conversation). If a positive correlation exists, then that particular interpretation is adopted. In practice this adaptability of interpretation is a systematic way of looking for opportunities to control the conversation with an specific expectation, and prediction of the outcome. The outcome is then a feedback to judge the adaptive fitness of (ι). Some definitions and theorems are introduced in order to emphasise the role of conversation and consequently (ι).

Conversation is considered to be an internal micro force. If the conversation is taken by (η), and (ε) to be normal, then it is a force that is denoted as (F^-). (F^-) is formulated as $(F^- = \bigtriangledown d_\eta = \bigtriangledown d_\varepsilon)$, where $(\bigtriangledown d_\eta = (\frac{\partial B^\eta_{l_\eta}}{\partial \mu^\eta}, \frac{\partial B^\eta_{l_\eta}}{\partial \beta^\eta_d}))$, and $(\bigtriangledown d_\varepsilon = (\frac{\partial B^\varepsilon_{l_\varepsilon}}{\partial \mu^\varepsilon}, \frac{\partial B^\varepsilon_{l_\varepsilon}}{\partial \beta^\varepsilon_d}))$. This formulation implies that the differential of the position of (η) with respect to the components of (ι), memory (μ^η), and behavioural disposition, (β^η_d) is equal to the differential of the position of (ε) with respect to the components of (ι), memory (μ^ε), and behavioural disposition, (β^ε_d) . If the conversation is dynamic with many arguments, then it is a force that is denoted as (F^+). (F^+) is formulated as $(F^+ = (\bigtriangledown d_\eta \neq \bigtriangledown d_\varepsilon))$, which is equal to $(F^+ = (\bigtriangledown d_\eta < \bigtriangledown d_\varepsilon))$, or $(F^+ = (\bigtriangledown d_\eta > \bigtriangledown d_\varepsilon))$. This formulation implies that the differential of the position of (η) with respect to the components of (ι), is either greater than the differential of the position of (ε) with respect to the components of (ι), or is less than. If the conversation is hostile or chaotic, then it is a force that is denoted as (F^{++}). (F^{++}) is formulated as $(F^{++} = \bigtriangledown d_\varepsilon)$, or $(F^{++} = \bigtriangledown d_\eta)$, which implies that (F^{++}) is either equal to the differential of the position of (η) with respect to the components of (ι) or is equal to the differential of the position of (ε) with respect to the components of (ι). In this can there is no correlation between the displacement of (η), and (ε). If the electron makes a gauge change then the nucleus must remain in a fixed position. On the other hand if it is the nucleus that makes a gauge change then the electron must remain in a fixed position.

In a conversation, there are two sides: side (1), the nucleus, side (2), the electron. The topic of conversation is considered by both sides to be one of the following types: type (1), is neutral, which implies a routine subject that involves no external interferences, or internal disagreements. Both sides take the same actions that correspond to a routine reaction. Type (2), is dynamic, which implies that both sides do not see the situation the same way, and do not consider to take the same actions. There is a conflict. Type (3) is hostile, which usually involves an external interference. In this case either both sides or at least one side considers to take drastic actions to counteract an external interference. If conversation is of type (2) or (3), then both sides (nucleus,electron), rely on interpretation. To take the right course of action, both sides need to interpret the situation. Interpretation receives two feedbacks, one from memory, and one from behavioural disposition. A feedback is considered to be an operator that acts on interpretation. Since it is the topic of a conversation that is interpreted, then interpretation is a function of the differential of the position, $(\iota(\bigtriangledown d_\eta))$, $(\iota(\bigtriangledown d_\varepsilon))$. The two operators , memory (μ), and behavioral disposition, (β_d) modify interpretation. Memory contains (c) categories. Each category contains a number of Borel tensor sets. Let (μ_u) be the utilization functionality of memory. This operator acts as a projection from a Borel tensor set in $(\aleph)$ or $(\aleph')$ to a Borel tensor set in one of the (c) categories. Let (X^i) be a Borel tensor set in the subspace $(\aleph)$. Let $(\mu_u = \pi : X^i \rightarrow B^i)$ be the projection of the Borel tensor set (X^i), to a Borel tensor set (B^i) in (c). The projection operator $(\pi \in (\omega \otimes GL(n, \Re^{p,q})))$ is a linear projection, $(\pi = \alpha^{i_{r_p}}_{j_{s_q}} =\mid \beta^{i_{r_c}}_{j_{s_c}} - \chi^{i_{r_p}}_{j_{s_q}} \mid)$. $(\beta^{i_{r_c}}_{j_{s_c}})$ is the coefficient matrix of the Borel tensor set

(B^i), and $(\chi^{i_{rp}}_{j_{sq}})$ is the coefficient matrix of any tensor set (X^i). The operator, (π) $(\pi = \pi(X^{\eta}_{l_\eta}) = (\alpha^{i_{rp}}_{j_{sq}} \oplus \chi^{i_{rp}}_{j_{sq}}) \otimes e^{j_{sq}}_{i_{rp}})$ functions by altering the coefficients of the Borel tensor set (X^i), to that of the Borel tensor set (B^i) in (c). The expectation (μ_x), and prediction (μ_p) functionality of memory are taken to be the same $(\mu_x = \mu_p)$ for the sake of simplifying the modelling task. They can be used interchangeably in formulations. In general, there is a difference between the expectation functionality, (μ_x), and the prediction functionality, (μ_p). Expectation is not based on any concrete information. It is usually based on an spontaneous actions. Prediction is usually based on some experiences. The outcome could be the same, if prediction and expectation coincide. The whole idea of gauge modelling based on behavioural characteristics of the nucleus and the electron is based on the assumptions that such attributes exists, and that up to now these characteristics have not been noticed. All experiments with at a quantum level are based on aggressive manipulation of atoms, the outcome of which has always been the same, the wavelike behaviour of the electrons.

Let (ω) represent the region of the intersection between a Borel tensor set (X^i) in the subspace $(\aleph,)$ $(X^i \in \aleph)$, and the Borel tensor set (B^i) in (c), $(X^i \cap B^i = \omega)$. The contraction operator (π) in (ω) is $(\pi_\omega : GL(n, \Re^{p,q}), p = 1, \cdots, n; q = 1, \cdots, n)$, $(\pi_\omega(X^i \to GL(n, \Re^{p,q}))$. Let a Borel tensor set in region (ω) be represented by (W). The Borel tensor set (W), is formulated as $(W = A \cdot X^i)$, where $(A = (\alpha^{i_{rp}}_{j_{sq}} \oplus e^{i_{rp}}_{j_{sq}}))$, and $(X^i = \chi^{i_{rp}}_{j_{sq}} \otimes e^{j_{sq}}_{i_{rp}})$. The Borel tensor set (W), in (ω) can be written as $(W = (\alpha^{i_{rp}}_{j_{sq}} \oplus \chi^{i_{rp}}_{j_{sq}}) \otimes e^{j_{sq}}_{i_{rp}})$.

Theorem 2.1. *Any connection in (ω) is a smooth connection, $(\omega \in C^\infty)$.*

Proof. By definition region (ω) is the intersection of Borel tensor sets in $(\aleph)$, and Borel tensor sets in (c). Since both Borel tensor sets are differentiable, then any Borel tensor set in region (ω) is differentiable by definition. The Borel tensor set (W) has a differentiable structure, and since (c) is a subspace of $(\aleph)$, $(c \subset \aleph)$, then the Borel tensor set (W) is isomorphic. To show continuity, must show that any transformation from any subspace to region (ω) is a smooth differential transformation. The basis of (ω) is given as $(e^i; i = 1 \cdots, n)$. Let $(\delta_i; i = 1 \cdots, n)$ be the coordinate field of region (ω). Let $(Y \in \omega)$ be any Borel tensor set obtained from a transformation $(\sigma(y) \cdot e^i = (\delta_i) \cdot y)$, where (y) constitutes the coefficients of the Borel tensor set $(Y^{\eta}_{l_\eta} \in (\omega \times GL(n, \Re^{p,q})))$. Let $(s_\omega(y) : \delta_i^{-1}(y))$ such that $(s_\omega \in (GL(n, \Re^{p,q})))$. Then, any differential transformation (T_ω) can be defined as $(T_\omega(y) = ((\delta_i) \cdot y, s_\omega(y)))$ consisting of two transformations, the (δ_i) transformation to reach region (ω), and its' inverse (s_ω) in any subspace of $(\aleph)$. Take any two transformations in any two intersection regions, (ω) , (ω'). Then to show continuity, The differential transformation function $(T_{\omega'}(y) \circ T_\omega(y) = (y, (s_{\omega'}(y), s_\omega(y)) = (\delta'^{-1}_i(y) \circ \delta_i(y))^{-1} = \delta'^{-1}_i(y) \cdot \delta_i(y))$. $(\delta'^{-1}_i(y) \cdot \delta_i(y))$ is a Jacobian matrix with entries equal to $(\delta_i(y))$, that are continuous (C^∞). Therefore, any differential map $(T_\omega, T_{\omega'}, \cdots)$ are linear continuous transformations. □

The expectation (μ_u), functionality of memory is a metric probability that gives the probability that the expected Borel tensor set is the right gauge. Therefore, the metric probability of the expectation due to memory is ($\wp_\mu = \frac{d(W,X)}{\sum\sum d(X,X')}$), the distance between the expected Borel tensor set in (c), $(W \in c)$, $(d(W,X))$, and a Borel tensor set in $(\aleph)$, $(X \in \aleph)$, $(d(W,X))$ over the distance between a Borel tensor set in $(\aleph)$, $(X \in \aleph)$, and another Borel tensor set in $(\aleph)$, $(X' \in \aleph)$, $(d(X,X'))$. The metric probability $(\wp_\mu)$, is a comparative ratio, given the condition that $(d(W,X) < d(X,X'))$, the distance from any Borel tensor set in $(\aleph)$, $(X \in \aleph)$ to a Borel tensor set in (ω), $(W \in \omega)$ has to be strictly smaller than the distance from any other Borel tensor set in $(\aleph)$, $(X' \in \aleph)$. If $(d(W,X) = d(X,X'))$, then the metric probability, $(\wp_\mu = 1)$, which implies that the Borel tensor set (W) is not the right expected Borel tensor set. If $(0 < \wp_\mu < 1)$, then the smaller the metric probability, $(\wp_\mu)$, the higher the chance that (W) is the right expected Borel tensor set. The memory operator is formulated as $(\mu = \wp_\mu \cdot A)$, where (A) is $(A = (\alpha^{i_{r_p}}_{j_{s_q}} \oplus e^{i_{r_p}}_{j_{s_q}}))$.

Definition 2.1. Let (β_d) be a tensor of behavioral disposition of the elements of an atom, the nucleus and the electron such that (β_d) is defined as the position of an element (nucleus, electron) that is modified by movement due to velocity, (v), and acceleration, (a) envoked as a result of a conversation.

Definition 2.2. Let (g_q) be quantum gravity exerted on the elements engaged in conversation. (g_q) is differential with respect to the nature of conversation. (g_q) is strong if conversation is aggressive, it is denoted by $(g_q(F^{++}))$. (F^{++}) is a force, and quantum gravity is a function of this force. $(g_q(F^{++}) = F^{++} \times g_q = g_q \times \nu \times \mathbf{R})$ where (ν) is angular momentum, and $(\mathbf{R})$ is megnetic moment. The force, (F^{++}) is equal to $(F^{++} = \nu \times \mathbf{R})$, and $(g_q = \frac{m}{g})$, where $(m = (m_\eta, m_\varepsilon))$. The level of the aggressivity of conversation is determined by the magnitude of the force, (F^{++}). If conversation is moderate, then its' force is denoted by, (F^{+}). Quantum gravity is a function of this force, $(g_q(F^{+}))$. $(g_q(F^{+}) = F^{+} \times g_q = g_q \times \frac{\nu}{\mathbf{R}})$, where the force is equal to $(F^{+} = \frac{\nu}{\mathbf{R}})$. If conversation is neutral, (F^{-}), then $(g_q(F^{-}))$ is low, and is defined by $(g_q(F^{-}) = F^{-} \times g_q = \mathbf{R})$. The force (F^{-}) is equal to the magnetic moment, $(\mathbf{R})$.

Theorem 2.2. *Given behavioral disposition (β_d), then it should be formulated as $(\beta_d = q(F^*) \times (v^*) \otimes (a^*))$, where (*) stands for the level of intensity (-,+,++). $(g_q(F^*))$ is quantum gravity given by definition 2.1.*

Proof. Behavioural disposition is the ability of an element to react. (β_d) is an operator. By definition 2.1, (β_d) is a function of velocity, (v), and acceleration, (a). Based on the definition, it can be formulated as $(\beta_d = (v^*) \otimes (a^*))$. (β_d) can be modified by the nature of the conversation. The impact of the conversation is represented by quantum gravity, $(g_q(F^*))$ given by definition 2.2. The modification of (β_d) in the presence of conversation is formulated as $(\beta_d = q(F^*) \times (v^*) \otimes (a^*))$. ☐

Interpretation (ι) is formulated as $(\iota = \bigtriangledown d \otimes \mu \otimes \beta_d)$, where $(\bigtriangledown d = (\frac{\partial d(W,X)}{\partial \mu}, \frac{\partial d(W,X)}{\partial \beta_d}))$ is displacement due to change in memory , and behavioural disposition, $(\mu = \wp_\mu \cdot A)$ is the memory operator that is equal to the expected probability, times $(A = (\alpha^{i_{r_p}}_{j_{s_q}} \oplus \chi^{i_{r_p}}_{j_{s_q}}))$ is the difference between the coefficients of an expected Borel tensor set in (c), $(W \in c)$, and a Borel tensor set in $(\aleph)$, $(X \in \aleph)$. $(\beta_d = \frac{1}{g_q(F^*)} \times (v^*) \otimes (a^*))$ is behavioural disposition that from Theorem 2.2 is formulated as quantum gravity multiplied by velocity (v^*) that is emphasised by acceleration (a^*). Interpretation causes displacement from one Borel tensor set to another Borel tensor set. The manner of displacement depends on the magnitude of interpretation. (3) cases can occur. Case (1), both parties (nucleus/electron) interpret the topic of conversation to be neutral or routine. In this case both parties have the same interpretation of the conversation and thus ($\iota^\eta = \iota^\varepsilon$), the two interpretations are equal in magnitude. This implies that the nucleus and the electrons stay in the same position with respect to each other. Both make similar gauge changes . Case (2), each party has a different interpretation of the conversation. (2) situations can occur: ($\iota^\eta < \iota^\varepsilon$), the interpretation on the part of the nucleus is smaller in magnitude than the magnitude of interpretation on the part of the electron. Both (η), and (ε) make gauge changes. Displacement on the part of (ε) is more significant than displacement on the part of (η). ($\iota^\eta > \iota^\varepsilon$), the interpretation on the part of the nucleus is larger in magnitude than the magnitude of interpretation on the part of the electron. Both (η), and (ε) make gauge changes, but displacement on the part of (η) is more significant than displacement on the part of (ε). Case (3), each party interprets the conversation differently, ($\iota^\eta \neq \iota^\varepsilon$). Both ($\eta$), and ($\varepsilon$) make gauge changes, but the gauge changes are independent of each other.

3 Behavioural gauge equations and gauge invariance

As is previously stated, the position of the (nucleus/electron) is given as: ($P = B^{i_r}_{j_s} \otimes e^{j_s}_{i_r}$). ($e^{i_r}_{j_s}$) is the basis of the Borel tensor set (P), where ($dim(i_r) = dim(j_s) = n$). The reasoning behind this formulation is as follows: Borel tensor sets are the smallest topological units that exist that are still realistic enough to use for modelling. It is assumed that one can find the position of the nucleus or the electron in an space that consists of Borel tensor fields. This space is called the Universal Probability space, (UPS), (Ω). The advantage of such an space is that it contains metric probabilities ($\wp$). The advantage of a metric probability over a standard probability is that metric probability as the name suggests deals with metrics or distances that are measurements that are not random occurrences in a sample of experiments. In random experiments, the outcomes or the events depend on many factors such as: causality, the size of experiments, the number of repetitions, and random occurrences. The metrics on the other hand are abstract entities. No matter how many times distances are measured with an accurate device, the magnitudes stay the same for the same distances. Metric probability gives a comparative ratio. Any change in the position of the nucleus or the electron is a movement (displacement) from one Borel tensor set to another Borel tensor set. Change in the position of (nucleus/electron) occurs as a result of conversation between the nucleus and the electron. The indicator of this conversation is interpretation. As a result of interpretation the position of the nucleus and the electron changes, and the new gauge or position can be formulated as ($P = \iota \otimes B^{i_r}_{j_s} \otimes e^{j_s}_{i_r} = (\wp_\mu \cdot A) \otimes B^{i_r}_{j_s} \otimes e^{j_s}_{i_r} = \wp_\mu \cdot (\alpha^{i_r}_{j_s} \oplus \beta^{i_r}_{j_s}) \otimes e^{j_s}_{i_r}$). In this section the connection introduced earlier is generalized. It is shown that any connection is a linear differential transformation. It is shown that connection exists in the region of the intersection of any two Borel tensor sets designated as (ω). In Theorem 2.2, it is shown that any linear differential connection in region (ω) is a smooth transformation, meaning that region $(\omega \in C^{\infty})$ is continuous.

Let $(\Sigma = \bigcup_{i=1}^{M} \omega_i)$, where (i) is the number of (ω) regions, be the space of (ω) regions such that $(\omega_i = (B^i) \bigcap (B^{i+1}))$. The intersection regions (ω_i) occur in (3) distinguished ways. Three cases are possible: case (1), the intersection regions are completely distinguished from each other. As is shown in Figure 3. In Figure 3, intersection regions allow for displacement from (B^i) to (B^{i+1}) as long as a complete intersection exists between the two Borel tensor sets. A complete intersection region is a region that is not shared with any other Borel tensor set. In Figure 3, displacement or gauge change can occur between Borel tensor set (1), and (2), (1), and (3), (2) and (4), but not (1) and (4) or (2) and (3).

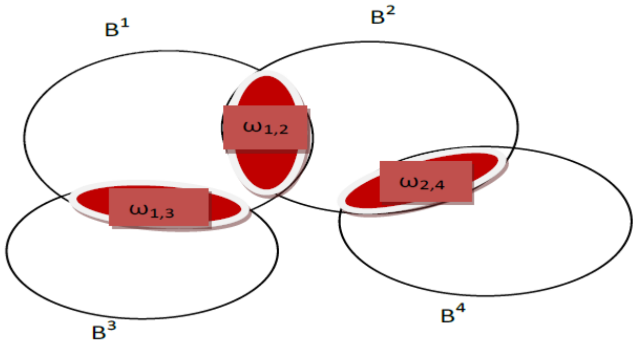

Figure 3. Case 1. Complete intersection regions

Case (2) consists of (ω) regions that overlap as is shown in Figure 4. As is shown in Figure 4, (ω) regions overlap between every (3) Borel tensor sets (1,2,3) or (2,3,4). There is an intersection region that is common among every (3) Borel tensor sets. In case (2), (ω) regions are additive, meaning that every three intersection regions share a common region $(\omega_{i,i+1} = (\omega_{i,i+1} - \omega_{i,i+1,i+2}) + \omega_{i,i+1,i+2}; i = 1, \cdots, M-2)$. As is shown in Figure 4, displacement can occur from Borel tensor set (1) to (2), to (3) or from (2) to (3) to (4) by passing through common intersection regions. Case (3) is a special case, where all Borel tensor sets are embedded in the following manner: $(B^i \subset B^{i-1} \cdots B^3 \subset B^2 \subset B^1)$. Case (3) is shown in Figure 5, for (4) embedded tensor sets. In this case, there is one intersection region, $(\omega = B^1)$, which is equal to the first Borel tensor set, (B^1). It is important to generalize connections to include all (3) cases.

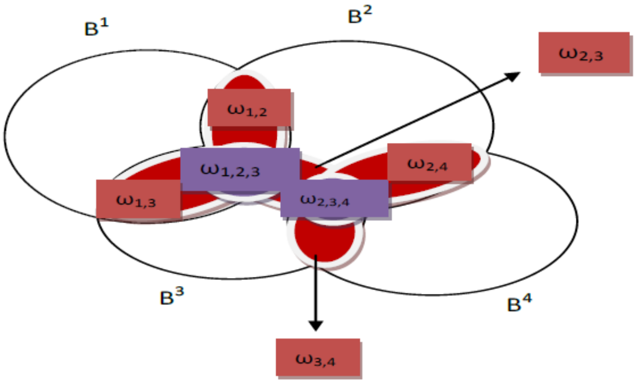

Figure 4. Case 2. Overlapping intersection regions

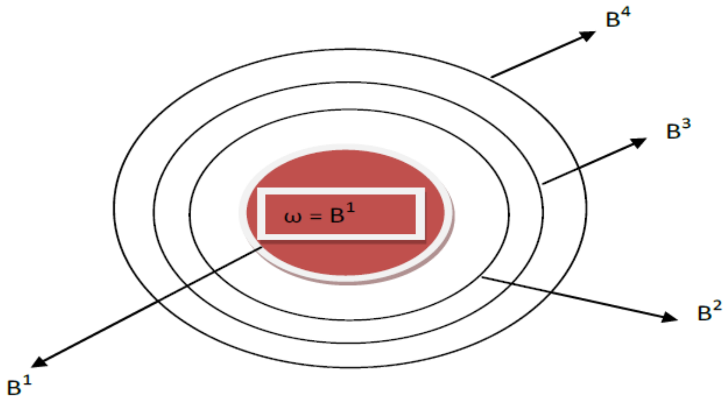

Figure 5. Case 3. embedded intersection regions

Generalization of connection for case (1), includes the following proposition and Theorem.

Proposition 3.1. *Each* (ω) *region is finite, has a metric and is closed.*

Proof. If (ω) region is finite, then any projection (μ) within the region (ω) is such that ($\mu(W^i) : W^i \to C$), where ($W^i \in \omega$), and (C) is the boundary of (ω) such that ($\mu(\omega \setminus C) \neq 0$), and ($\mu_C = 0$). The value of any projection on the boundary is zero, ($\mu(W^i) = 0$). If ($\mu(W^i) \neq 0$), then this would distort the metric of displacement. Let (τ) be the metric in (ω) region, then this metric is defined as : ($\tau(B^i, B^{i+1})$) the distance from the Borel tensor set (B^i) to the Borel tensor set (B^{i+1}), must pass through region (ω). The metric rewritten in its' expanded form is given as: ($\tau(W^i, W^{i+1}) = \tau(W^i, \omega) + \tau(\omega, \delta(\omega)) + \tau(\delta(\omega), W^{i+1})$). If ($\tau(\omega, \delta(\omega)) \neq 0$), the metric to the boundary $(\delta(\omega))$ of region (ω) is not zero, then this distance, $(\tau(\omega, \delta(\omega)))$ is counted twice; therefore the metric $(\tau(\omega, \delta(\omega)))$ must be zero. □

Displacement from one Borel tensor set, (B^i) to a non-consecutive Borel tensor set, $(B^{i'})$ is a metric that passes through several intersection regions (ω_i). For example, in Figure 4, the metric that connects the Borel tensor set (B^1) to the Borel tensor set (B^4) is obtained following one of the two strategies. One strategy would be to go from (1) to (2), and then (2) to (4): $(B^1 \to B^2)$, and $(B^2 \to B^4)$, passing through intersection regions, $(\omega(1,2))$, and $(\omega(2,4))$. Other strategy would be to go from (1) to (3), and then (3) to (4): $(B^1 \to B^3)$, and $(B^3 \to B^4)$, passing through intersection regions, $(\omega(1,3))$, and $(\omega(3,4))$. The strategies are depicted in Figure 6.

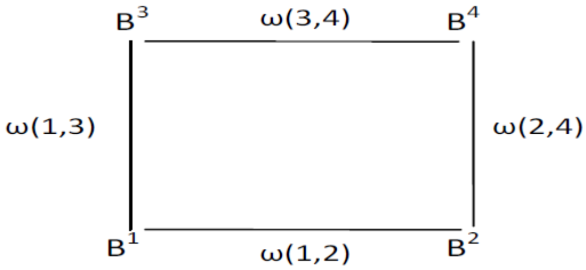

Figure 6. Case 1. Diagram of displacement with multiple intersection regions

Theorem 3.2. *Any transformation between two non-consecutive Borel tensor sets is a locally finite additive transformation.*

Proof. By Proposition 3.1, intersection regions are finite, have metrics and are closed. Therefore, within each intersection region (ω_i) any metric $(\tau(\omega_i, C_i) < \infty)$, where (C_i) are the boundaries of the intersection regions (ω_i) is finite. If the transformation is from the Borel tensor set (B^i) to the Borel tensor set $(B^{i'})$, that has to go through the Borel tensor set $(B^{i"})$, then the metric $(\tau(B^i, \omega_{i,i"}))$ is finite since this metric makes a displacement to the Borel tensor set $(B^{i"})$, and it is closed by the intersection region $(\omega_{i,i"})$. Therefore, $(\tau(B^i, \omega_{i,i"}) < \infty)$ is finite. The same applies to the displacement from the Borel tensor set $(B^{i"})$ to the Borel tensor set $(B^{i'})$. The metric $(\tau(B^{i"}, \omega_{i",i'}) < \infty)$ is finite. Given the sequence of displacements, it is shown that it is locally finite, and additive.
□

In case (2), any two Borel tensor set intersection regions $(\omega_{i,i'})$, and $(\omega_{i,i"})$, share an inner intersection region. This intersection region is denoted by $(\omega_{i,i'} \bigcap \omega_{i,i"} = \omega_{i,i',i"})$, where $(i \neq i', i \neq i", i' \neq i")$.

Corollary 3.3. *Inner intersection regions* $(\omega_{i,i'} \bigcap \omega_{i,i"} = \omega_{i,i',i"})$ *are locally finite.*

Proof. By Theorem 3.2, intersection regions of non-consecutive Borel tensor sets are locally finite tensor sets. Inner intersection regions, $(\omega_{i,i'} \bigcap \omega_{i,i"} = \omega_{i,i',i"})$ are Borel tensor sets since by definition they are the intersections of two Borel tensor sets, $(\omega_{i,i'})$, and $(\omega_{i,i"})$. Therefore, by Theorem 3.2, inner intersection regions are locally finite. □

In case (3), the embedded intersection region as is shown in Figure 5, is equal to the first Borel tensor set, $(\omega = B^1)$. Therefore, this intersection is an open Borel tensor set. The invariance principal is about change in the gauge. In the classical approach, any change in the gauge is considered to be homeomorphic transformation due to the existence of horizontal connections. In the present paper, change in position is formulated as: $(B \otimes W \otimes \iota = B')$, where $(W \in \omega)$ is a Borel tensor set in the intersection region (ω), $(B \in \aleph)$, and $(B' \in \aleph)$. (ι) is interpretation.

Theorem 3.4. *Suppose* $(N \subset \Omega)$, *and* $(\Lambda \subset \Omega)$, *where* (Λ) *represents the space of all intersection regions,* $(\Lambda = \bigcup \omega_i)$ *are (2) subspaces of* (Ω). *Let* $(B \in N)$, *and* $(W \in \Lambda)$ *be two Borel tensor sets respectively in (N), and* (Λ). *The product* $(B \otimes W)$ *is unique.*

Proof. By Proposition 3.1, any intersection region (ω) has a metric and is closed. The metric $(\tau(\omega, \delta(\omega)) = 0)$ has to be equal to zero for the reasons given in the proof of Proposition 3.1. In addition, the intersection region (ω) is the intersection of the Borel tensor set (B), with another Borel tensor set, (W). In order for any metric to exist between the two subspaces (N), and (Λ), any tensor point in (N), has to be isomorphic to any tensor point in (Λ). Since both subspaces are metric subspaces, then any specific Borel tensor set in (N) must correspond to a specific tensor set in (Λ). Therefore, any transformation caused by the product $(B \otimes W)$ must be unique.
□

Based on Theorem 3.4, any product $(B \otimes W)$, that involves an intersection region is unique. If a gauge was determined by this product it would have been invariant, but this product is multiplied by interpretation, (ι). (ι) is variable. Thus given that change in gauge is formulated as $(B \otimes W \otimes \iota = B')$, where the product $(B \otimes W)$ is multiplied by a variable interpretation (ι), then it should be concluded that the invariance principal does not apply. Thus any gauge change is isomorphic.

4 Conclusion

The objective of this paper is to revisit the gauge theory and the variational principle. The aim is to propose a new method of determining the gauge of the elements of an atom, the nucleus in relation to the electron. The Universal Probability Space (UPS) introduced in [1], and [2] which is the space of Borel tensor fields is taken as the working space. It is assumed that the location or gauge of the nucleus and the electron is in a Borel tensor set. The basis of any Borel tensor set is assumed to be the spectrum of an atom.

An intrinsic property of an atom is emphasized. This property is the behavioural characteristics of both the nucleus and the electron. The modelling of the gauge is based on the behavioural characteristics of the nucleus and the electron. Behavioural characteristics is defined as the ability to interpret given memory, and behavioural disposition. It is assumed that the nucleus and the electron are engaged in a continuous conversation. It is the nature of this conversation and the existence or the absence of external stimuli that determines the behaviour of the nucleus and the electron.

The new approach changes the standard method of determining the gauge and the assumption of invariance drastically, and opens a new gateway to the understanding of the real behaviour of atoms and their mechanics. This might lead to a new treatment of atoms that would have a less harmful side effects. The new method of determining the gauge offers a more respectful and reverential way of looking at the inner mechanics of an atom which may lead to new discoveries that seem out of reach for now.

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