N° 11 July - Juillet 2014 العدد الحادي عشر جويلية

AL-MUKHATABAT

المخاطبات

LOGIQUE – EPISTEMOLOGIE – PENSEE SCIENTIFIQUE

منطق- ابستمولوجيا- فكر علمي

LOGIC - EPISTEMOLOGY - SCIENTIFIC THOUGHT

ARABESQUES

نقوش عربية

Revue trimestrielle, trilingue (Français-Arabe-Anglais), à comité de lecture
Pour la Logique, l'Epistémologie et la Pensée scientifique

مجلة فصلية محكّمة تنشر البحوث ذات الصلة بالمنطق و فلسفة العلوم و الفكر العلمي
باللّغات العربية و الفرنسية و الإنجليزية

Quarterly, Trilingual (English-Arabic-French), Peer reviewed Journal
For Logic, Epistemology and Scientific Thought

Fondateur et Directeur de rédaction
مؤسّس المجلّة و مدير التحرير

Hamdi Mlika
mlika_hamdi@yahoo.fr

E-mail البريد الالكتروني
almukhatabatjournal@yahoo.fr

ISSN 1737 – 6432

Editorial Board الهيئة العلمية Comité scientifique

AL-MUKHATABAT

Peer reviewed Journal accepting for publication philosophical papers on logic, analytic philosophy, epistemology, defined in a very broad sense to include philosophy and history of formal and informal logic, theory of knowledge, philosophy, history and sociology of sciences and techniques, anlytic aesthetics, epistemology of medecine, philosophy of design, architecture, and technology, scientific anthropology… The aims of the Journal are promoting dialogue between cultures, improving scientific methods into philosophical thought and encouraging logical and epsitemological creativity. Papers submitted must not exceed 30 pages (normal size), including references, footnotes and bibliography. They are accepted in Arabic, French and English. Authors should provide the journal with a copy of the paper together with an abstract in English and in French. Authors are notified of the final verdict of the referees: they are notified as to the acceptance or rejection of his/her paper for publication within a period of three months. The articles published in this Journal are the possession of their authors and all rights of publishing are reserved by them.

المخاطبات

مجلّة فصلية محكّمة تنشر المقالات الجيّدة ذات الصلة بالمنطق و فلسفة العلوم و الابستمولوجيا و تاريخ العلوم و الفلسفة التحليلية و الفكر العلمي و توظيف المناهج العلمية في كلّ الإختصاصات الإنسانية.
تقبل المجلّة البحوث باللّغات الثلاث العربية و الإنجليزية و الفرنسية. و يجب على الباحث أن يزوّد المجلّة بنسخة من بحثه على عنوانها الالكتروني و الذي لا يجب أن يتعدّى 30 صفحة مع ملخّص له بلغة البحث و ترجمته إلى الإنجليزية و الفرنسية.
يتمّ عرض البحوث على نحو سرّي على محكم أو أكثر من المختصّين و يتمّ ابلاغ صاحب المقالة بقرار الهيئة العلمية للمجلّة في أجل لا يتعدّى ثلاثة اشهر.
تبقى حقوق البحث محفوظة بصورة كليّة لصاحبها، و يعني إرسال نسخة منه السماح للمجلّة بنشره.

AL-MUKHATABAT

Revue à comité de lecture, trimestrielle et trilingue, publie des articles inédits de Logique, d'Epistémologie et de pensée scientifique au sens large incluant la philosophie et l'histoire de la logique, la logique formelle et argumentative, la théorie de la connaissance, la philosophie, l'histoire et la socologie des sciences, l'anthropologie scientifique, l'esthétique analytique, la philosophie de la technologie, l'épistémologie de la médecine, la philosophie du design et de l'architecture, etc. Les articles sont soumis de façon anonyme à deux membres du comité scientifique de la Revue pour les évaluer. L'envoi d'un document à la Revue veut dire que l'auteur l'autorise à le publier. L'article reste la propriété pleine de son auteur. Il doit être envoyé sous format doc et PDF, ne dépassant pas 30 pages (notes et bibliographie incluses), accompagné d'un résumé en anglais, en arabe et en français. La revue vise à mieux familiariser les lecteurs aux subtilités de la pensée scientifique et à favoriser les approches argumentatives, épistémologiques et logiques dans le traitement des problèmes éthiques, sociaux, politiques, cognitifs, anthropologiques, pédagogiques, religieux, métaphysiques, etc., comme base pour instaurer un dialogue authentique et fructueux entre les cultures du Monde.

Table des matières فهرس Table of Contents

Présentation du Numéro 11 / Juillet 2014

Nous sommes très heureux de vous annoncer la parution du numéro inaugural de la revue AL-Mukhatabat dans sa version papier. Nous tenons avant tout à remercier M. Moncef Chebbi, Directeur d'**Arabesques Editions,** qui a bien voulu accepter de publier la revue. C'est un acte de volonté, de confiance et de courage de sa part que nous tenons à saluer.
Ce onzième numéro marque une nouvelle étape dans la marche de la revue. Il vient donner aux objectifs déjà mis en pratique dans les dix numéros numériques précédents, une nouvelle mobilité au cœur du monde complexe de l'édition, du savoir, des arts et de la culture. Nous sommes donc heureux de relever ce nouveau défi, armé par le même esprit qui nous a animé lors des précédents numéros: nous avons en continu tenu à interpeller nos lecteurs sur l'urgence de renforcer l'étroite relation entre philosophie et pensée scientifique et assoir ces deux expressions inaliénables de l'intelligence humaine sur des bases logiques, argumentatives et épistémologiques multiples ainsi que sur les réquisits d'un esprit scientifique. Esprit qui a su, à travers l'histoire propre des diverses disciplines dans lesquelles il s'est forgé, surpasser les limites de ses versions empiristes et positivistes pour s'éléver vers des espaces de pensée et de construction où l'imagination, la liberté et la subjectivité des agents cognitifs se conjuguent sans aucun problème. Et cela avec les postures modélisatrices d'une pensée de la complexité profondément créative et solidement installée dans l'interculturalité.

Nous tenons à saluer tous ceux qui y ont apportées leurs contributions et à exprimer nos sincères remerciements à tous les membres du comité scientifique qui trouvent toujours le temps, la hauteur d'esprit et la générosité d'évaluer les contributions, garantissant ainsi à la revue une qualité scientifique conforme aux normes internationales. C'est à eux tous sans exception que je voudrais dédier ce numéro inaugural dans sa version papier, particulièrement à Zoubaida Mounya Benmissi, Claudine Tiercelin, Christiane Chauviré, Nic Fillion, Denis Vernant, Hichem Messaoudi, Roshdi Rashed, Joseph Vidal-Rosset, François Nicolas, Samir Abuzaid, Nic Fillion, Henrik Lagerlund, Amirouche Moktefi, Fabrice Pataut, Hasssan Elbahi, Mathieu Marion, Djamel Hammoud, Michel Paty, Shahid Rahman, Dale Jacquette, Bernard Vitrac, Pascal Engel, Lazarabe Hakim Bennani, Gilbert Hottois, Hany Ali Moubarez, David Papineau, Jacques Riche, Youssef

Tibesse, Peter Simons, sans oublier bien sûr notre regrettée Angèle Kremer-Marietti (décédée en Novembre 2013) qui a eu à plusieurs reprises l'élégance de nous envoyer ses textes à publier, trouvant souvent le temps de corriger, avec patience, brio et sens du détail, maintes contributions publiées et qui aurait été sans doute très heureuse de savoir que la revue est enfin publiée sur papier.

Avant de conclure cette brève note éditoriale, nous tenons, dans le même esprit, à remercier le Professeur Charles Parsons de l'Université de Harvard qui a tenue une vieille promesse faite à la rédaction, à savoir de publier dans les pages de la revue l'un de ses textes inédits sur la question du structuralisme en philosophie des mathématiques. En mettant sa promesse à exécution, il pointe vers ce qui est incontournable de nos jours dans le métier de Professeur de philosophie, qui, bien qu'il soit menacé de disparaitre dans des sociétés en pleine transformation, résiste encore et toujours grâce à de tels gestes hautement significatifs dans leur portée éthique.

Hamdi Mlika

Sousse, Le 09 Juillet 2014

The Unified Equation of Gravity and QM: The Case of Non-Relativistic Motion

Samir Abuzaid

(Engineering Consultant, Cairo)

Résumé Nous proposons de simplifier le problème de la théorie Quantum-Gravity unifiée en traitant en premier lieu le cas simple des équations non-relativistes de la gravité et de la Mécanique quantique. Nous montrons comment cette unification des deux formalismes non-relativistes peut être réalisée à travers le postulat relié à la mécanique classique et quantique selon lequel chaque corps naturel est composé de ***N*** particules finales identiques. Cela inclut les particules élémentaires existant dans le modèle standard comme les quarks, les photons, les gluons, etc. En outre, nous montrons que ce résulat ouvre une nouvelle voie vers une équation généralisée du Quantum-Gravité qui prend en compte les effets à la fois de la vitesse et de l'accélération.

Mots-clefs **:** Théorie Quantum-Gravity, équation non-relativiste, unifcation, équation généralisée du Quantum-Gravity.

ملخّص نقترح تبسيط مشكلة النظرية الموحدة للجاذبية وميكانيكا الكم من خلال التعامل أولا مع الحالة البسيطة الخاصة بالمعادلات غير النسبية للجاذبية وميكانيكا الكم. ونبين أنه يمكن إنجاز توحيد المعادلتين غير النسبيتين من خلال فرضية كلاسيكية/كمية مشتركة هي أن كل جسم طبيعي يتكون من عدد ***N*** من الجسيمات النهائية المتماثلة. وهذا يتضمن الجسيمات المسماة حاليا "أولية"، مثل الكواركات، الفوتونات، الجليونات، الخ. بالاضافة إلى ذلك، نبين أن هذا يفتح طريق جديد نحو المعادلة العامة للجاذبية وميكانيكا الكم والتي تأخذ في الاعتبار كل من تأثير السرعة النسبية والتسارع العالي .

كلمات–مفتاح : النظرية الموحّدة للجاذبية و ميكانيكا الكمّ، معادلة غير نسبية، توحيد، معادلة عامة للجاذبية و ميكانيكا الكمّ.

Abstract We propose to simplify the problem of the unified theory of Quantum-Gravity through dealing first with the simple case of non-relativistic equations of Gravity and Quantum Mechanics. We show that unification of the two non-relativistic formalisms can be achieved through the joined classical and Quantum postulate that every natural body is composed of ***N*** identical final particles. This includes the current 'elementary' particles of the standard model such as quarks, photons, gluons, etc. Furthermore, we show that this opens a new route toward a Generalized Equation of Quantum-Gravity that takes the effects of both of velocity and acceleration into account.

Keywords: Unified theory of quantum-Gravity, non-relativistic equation, unification, Generalized Equation of Quantum-Gravity,

Samir Abuzaid : The Unified Equation of Gravity and QM: The case of Non-relativistic Motion. pp. 87-107.

1. Introduction

Today we have no explanation for the postulate of the constant speed of light. We have no explanation for the phenomenon of Lorentz transformations due to high velocities relative to the speed of light. We have no explanation for the concept of mass as well as its effects represented by time dilation and curvature of free fall paths. We have no explanation for inertial forces that resist acceleration due to external forces. We have no explanation for the appearance of the discrete nature of fundamental interactions that is termed the Quantum. We have no explanation for the particle/wave dual nature of Quantum particles. And we have no explanation for the probabilistic behavior of Quantum particles.

These seven basic phenomena represent the basic fundamental unexplained postulates of contemporary physics upon which the whole construction of contemporary physics is established and upon which it has achieved its unprecedented success. These unexplained fundamental phenomena are described through the three well-known fundamental theories: classical Newtonian Mechanics (CM), the general theory of relativity (GTR) and quantum mechanics (QM). However, these three fundamental theories are radically different in its nature and incompatible in its mathematical formulations. For example inertia is a controversial concept in GTR, curvature of space-time has no place in QM, and the wave/particle duality has no place in CM and GTR. Carlo Rovelli describes such a situation as that our understanding of the physical world is currently badly fragmented. In spite of its empirical effectiveness, he maintains, fundamental physics is in a phase of deep conceptual confusion (Rovelli: 2007, 187).

This leads to the natural conclusion that contemporary science despite its current tremendous success, is in need of a unified view to nature, both on the level of its fundamental building blocks and its fundamental laws that govern motion and change of such fundamental entities. However, in general, our current efforts are mostly directed toward unification of the fundamental theories of physics, namely GTR and QM, in what is termed the theory of Quantum-Gravity.

Given such a general picture, we propose to deal with the current problematic on both levels: the unified fundamental building blocks of nature and the unified fundamental laws of physics. Moreover, we propose to break down the problem into two steps. The first deals with the problem in the classical non-relativistic limit, and the second deals with it taking into consideration the effects of velocity and acceleration into account. The advantage of such a scheme is that the first step is considered as the special case for the second. Hence, a unified picture for both of the classical and quantum realms in the special case will be also applicable in the general case.

As such, this division allows us in the first step to concentrate on the fundamental building blocks while at the same time we avoid highly complicated mathematical formulations. Having established our results for the special case, which is the non-relativistic motion, we can then extend our results to the general case that takes velocity and acceleration into consideration.

Therefore, we divide this paper into five sections. In the second section we introduce in brief the current view for the problematic of unification of the classical and quantum realms. This exposition shows clearly the need for a unified underlying reality. In the third section we show that within the classical limit it is possible to unify both of the quantum and gravitational fields through the postulate that every natural body is composed of a definite number N of identical individual final particles. In section four we present the consequences of such a postulate on our contemporary picture of the physical world. And, finally in the last section, we show that such a new unified picture that applies to the classical limit opens a new route toward a general theory that unifies both of the classical and quantum realms, in all cases of motion.

Since we have here three categories of natural bodies, namely, classical bodies, quantum systems, and the proposed final particles, in order to avoid possible confusion, we chose to keep the term particle for the three categories. Hence, we implement the terms classical particle, for the first, quantum particle for the second, and the term final particle for the third.

2. The problem of unification of Gravity and QM

In their preface for the proceedings of the Regensburg conference devoted to the search for a unified framework of quantum field theory and general relativity, Felix Finster et al. (2012: vii), outline the Problematic of the theory of Quantum-gravity. They point out that on the one hand, the standard model of particle physics is formulated as a quantum field theory on a fixed Minkowski-space background. On the other hand, since Einstein developed general relativity, gravity is considered as a dynamical property of space-time itself. Hence space-time does not provide a fixed background, and a back-reaction of quantum fields to gravity, i.e. to the curvature of space-time, must be taken into account. They, then, state the current situation that it is widely believed that such a back-reaction can be described consistently only by a (yet to be found) quantum version of general relativity, commonly called *quantum gravity*. Quantum gravity, they add, is expected to radically change our ideas about the structure of space-time. To find this theory, it might even be necessary to question the basic principles of quantum theory as well. (Finster et al: P. vii).

On the other hand, Carlo Rovelli (2007) defines Quantum gravity (QG) as the problem of finding a theory that describes the quantum effects on gravity. These effects, he maintains, escape the currently accepted physical theories of quantum mechanics (QM) and quantum field theory (QFT), general relativity (GR), and the standard model of particle physics. However, these theories, according to Rovelli, become meaningless in the regimes where relativistic quantum gravitational effects are expected to become relevant. These effects are not currently observed; they are negligible at currently accessible scales and are expected to become relevant only in extreme physical regimes. For instance, he points out, they should govern the end of the evaporation of black holes, the beginning of the life of the Universe near the Big Bang, and any measurement involving an extremely short length scale (~ 10^{-33} cm, the "Planck scale") or a very high energy. "Quantum gravity" is the name given to the theory to- be-found that should describe these regimes. (Rovelli:1287).

However, despite concentration on unifying these two fundamental theories, the scientific community has recognized the need for a deeper unified picture of reality that transcends unification of GTR and QM. In his interview with several leading philosophers of physics and physicists, Maximilian Schlosshauer (2011) poses the question about the general understanding for the need of deeper views to the foundation of nature. The answers are quite impressive.

Časlav Brukner declares that he is convinced that our contemporary concepts of space and time will appear to future generations as naïve and silly (Schlosshauer: 263); Christopher Fuchs uncovers his feeling that it's too early to answer this question in any sensible way (Schlosshauer: 264); GianCarlo Ghirardi expresses that he is now starting to believe that a radically different approach might be called for (Schlosshauer: 265); Daniel Greenberger thinks that there are parts of quantum theory that we do not understand at a very simple level (Schlosshauer: 266); Lucien Hardy thinks that a theory of quantum gravity will look very different from both quantum theory and general relativity (Schlosshauer: 267).

Tim Maudlin, in the same issue, comments that the interesting thing is that any answer to these questions will be surprising. If gravity is unlike the other forces because of its connection with space-time, then the attempt to model a theory of gravity along the lines of the theories of electromagnetism and the weak and strong nuclear forces may be misplaced. But if gravity isn't special in this way, then the apparent central insight of general relativity is lost. And if the distinction between the spatiotemporal and the material breaks down, then we need an entirely new framework of physical structure (Schlosshauer: 268).

Moreover, David Mermin guesses that an understanding of the connection between gravity and quantum mechanics will have to await new input and perspectives from the foundations of both disciplines (Schlosshauer: 268). From another perspective, Lee Smolin thinks that the key issue is the role of time and that a complete unification of quantum theory and space-time physics is not possible in a cosmological setting without a framework in which there is a real global time (Schlosshauer :269). Finally, Wojciech Zurek sees that quantum states and space-time may have intertwined origins at some deep level, presumably deeper than relativistic field theory. Problems with quantizing gravity, as well as black-hole thermodynamics, he asserts, support this suspicion (Schlosshauer 271-272).

Similar views are introduced in literature. Callender and Huggett (2004: 5), for example, state that developing quantum gravity will require technical and philosophical revolutions in our conceptions of space and time. Butterfield and Isham (2004: 60) confirm the need to start from the beginning with a radically new theory. For the basic ideas behind general relativity and quantum theory, they add, are so fundamentally incompatible that any complete reconciliation will necessitate a total rethinking of the central categories of space, time, and matter.

Roger Penrose, from another perspective, confirms these conjectures and introduces two basic requirements for such efforts to succeed. He believes that there are powerful reasons for expecting a change. Such a change would, in his view, represent a major revolution, and it cannot be achieved by just ‘tinkering’ with quantum mechanics. Yet, the necessary changes must themselves be thoroughly respectful of the central principles that lie at the heart of present-day physics. The very tightness of the quantum formalism is a reason for both of these requirements (Penrose, 2004: 791).

These opinions of such leading experts in the field express in different ways the following: 1) Current theories of unification of GTR and QM are not successful due to inconsistency between the two. 2) Current views of the fundamentals of physics are not sufficient (' it's too early to answer this ', 'there are parts of quantum theory that we do not understand', 'any answer to these questions will be surprising', etc.). 3) The need for a novel view (the need for a 'new input and perspective', 'new theoretical tools', 'radically different approach', 'both theories have intertwined origins at some deep level', etc.).

These views, as we see, culminate to the need for a new underlying level of existence. In clear words Roger Penrose states that: 'If the ‘road to reality’ eventually reaches its goal, then in my view there would have to be a profoundly deep underlying simplicity about that end point. I do not see this in any of the existing proposals' (Penrose, 2004: 1033 – 1034).

Butterfield and Isham (2004: P. 60) describe the idea of a new underlying level in that both classical general relativity and standard quantum theory emerge from a theory that looks very different from both. Such a theory would indeed be radically new. So the kind of theory envisaged here would somehow be still more radical than that; presumably by not being a quantum theory, even in a broad sense – for example, in the sense of states giving amplitudes to the values of quantities, whose norms squared give probabilities.

These views refer in general to the need to explore new routes in which the basics of either or both of the theories of Gravity and QM are questioned. And we show in the following that such an ambitious aim can be achieved through the postulate of the individual final particle we defend in this paper.

3. The Non-Relativistic Unified Equation

As mentioned above, we explore the possibilities of unification of Gravity and QM through advancing the postulate that every natural body is composed of a definite number of final particles. As well known, this postulate represents a central concept in the classical scientific revolution in the modernist era, in what is termed then the corpuscular theory of matter[1]. In this theory the final indivisible identical particles has been termed atoms. This term refers to the Greek philosopher Democritus, who called the

[1] See details in Gaukroger (2006). "The Emergence of a Scientific culture".

smallest unit the *atomos* (literally 'not able to be cut'). (Lederman and Teresi : 1993, 3).

The term 'final particle' is implemented here in order to avoid the expected confusion that would appear if we keep the term 'atom'. From one side, the term 'atom', as we use it today, refers to a specific form of construction of matter at a specific level of nature (the atomic level). These atoms are composed of 'sub-atomic' micro particles (the well-known formation of electrons, protons and neutrons) that can be in turn further divided. On the other hand, the final particle presented here represents a sub-quantum particle that exhibits probabilistic behavior as much as every other quantum particle.

Since these final particles are identical, then each final particle has an identical mass, denoted here as $\bar{\mu}$, which can be reasonably taken as the unit mass. And since every natural body is composed of a definite number N of such final particles, then the total mass of the body m will be equal to the product of such a unit mass by the total number of the final particles, hence,

$$m = N\bar{\mu} \qquad (1)$$

This view is not in any sense in contradiction with contemporary scientific views. For example, Martinus Veltman (2003: 13) confirms such a view by stating that for all we know electrons and quarks are elementary particles**,** which means that in no experiment has there anything like a structure of these particles been seen. It is of course entirely possible, he adds, that particles that are called elementary today shall turn out to be composite.

Moreover, the view that contemporary elementary particles may be composed of more fundamental particles is implicit in the current dissatisfaction of the Standard Model. Roger Penrose (2004, p. 745) states that "As I see it, Nature's true scheme for particle physics has not yet come to light". In a more recent exposition of the current state, Abdelhak Djouadi (2011: 20) points out that despite of its success in describing all data available today, the Standard Model is far from being considered to be perfect in many respects.

From another perspective, Lederman and Teresi (1993: 2) state that during the earliest moments after the creation of the universe in the Big Bang, there was no complex matter as we know today. This, they add, is because the searing heat of the early universe did not allow the formation of composite objects. They conjecture then that there were perhaps one kind of particle and one force – or even a unified particle/force – and the laws of physics.

In the following we show that such a postulate, at least for the case of non-relativistic motion, turns out the well-known Schrödinger equation into a general equation for both of quantum and classical bodies.

3.1. The Unified formula of gravity and QM

The postulate that matter is associated by a quantum wave was first introduced by De Broglie (1924), where the plain quantum wave is given by,

$$\psi(\vec{r},t) = A_0\, e^{i(k.r-wt)} \qquad (2)$$

Following Moses and Vadim Fayngold (2013:45) the general form of $\psi(\vec{r},t)$ is given by,

$$\psi(\vec{r},t) = \Phi(\vec{r},t)e^{i\varphi(\vec{r},t)}$$

with $\Phi(\vec{r},t)$ and $\varphi(\vec{r},t)$ being real functions of r and t. Therefore, we can rewrite eq. (2) as follows,

$$\psi(\vec{r},t) = A_0\,(\vec{r})e^{i(k.r-wt)} \qquad (3)$$

$A_0\,(\vec{r})$ is the amplitude of the wave. $k = 2\pi/\lambda$ and $w = 2\pi/\tau$, λ is the wavelength and τ is its period that are given by

$$\lambda = \frac{h}{mv} \quad \text{and} \quad \tau = \frac{h}{\frac{1}{2}mv^2} \qquad (4)$$

The equation that governs motion and interaction of such a wave has been introduced by Schrödinger (1926) as follows,

$$i\hbar\frac{\partial\psi(\vec{r},t)}{\partial t} = -\frac{\hbar^2}{2m}\nabla^2\psi(\vec{r},t) + V(\vec{r},t) \qquad (5)$$

Where, m is the mass of the particle and $V(\vec{r},t)$ represents potential of external energy field. For a free particle, Schrödinger equation becomes,

$$i\hbar\frac{\partial\psi(\vec{r},t)}{\partial t} = -\frac{\hbar^2}{2m}\nabla^2\psi(\vec{r},t) \qquad (6)$$

From Eq. (1) above, $\boldsymbol{m} = \boldsymbol{N\bar{\mu}}$, therefore Eq. (6) can be rewritten as,

$$i\hbar\frac{\partial\psi(\vec{r},t)}{\partial t} = -\frac{\hbar^2}{2N\bar{\mu}}\nabla^2\psi(\vec{r},t) \qquad (7)$$

And the characteristic values of the wave are given by,

$$\lambda = \frac{h}{\bar{\mu}Nv} \quad \text{and} \quad \tau = \frac{h}{\frac{1}{2}\bar{\mu}Nv^2} \qquad (8)$$

Since $\boldsymbol{N}$ represents the number of the composing final particles, then it may vary from one final particle to extremely great number of final particles, i.e., from $\boldsymbol{N}$ approaches unity ($\boldsymbol{N} \approx \mathbf{1}$) to $\boldsymbol{N}$ approaches infinity ($\boldsymbol{N} \approx \infty$). Since we define the category of classical bodies as that which lies between the chemical level (which contains several atoms or more) to huge stars, then we may reasonably identify it with the case of $\boldsymbol{N} \approx \infty$. The exact starting boundary that differentiates it from the quantum level may be arbitrary set in accordance to the required accuracy. The other limit is that of one final particle, which may be differentiated also arbitrarily from the quantum level according to the required accuracy. For the case of extremely great number of final particles that approaches infinity, such as in ordinary classical bodies, i.e. when we take $\boldsymbol{N} \approx \infty$, the characteristic values of the wave will be given by,

$$\lambda = \frac{h}{\bar{\mu}Nv} \approx \frac{h}{\infty} \approx 0$$

And,

$$\tau = \frac{h}{\frac{1}{2}\bar{\mu}Nv^2} \approx \frac{h}{\infty} \approx 0$$

This means that the quantum wave has zero wave length and zero period, and hence, the wave effectively vanishes. Substituting in Eq. (3) above we get,

$$\psi(\vec{r},t) \approx A_0(\vec{r})e^{i0} \approx A_0(\vec{r}) \qquad (9)$$

$$\text{Or,} \quad \psi(\vec{r},t) \approx \psi(\vec{r}) = A_0(\vec{r}) \qquad (10)$$

This means that the wave function becomes constant with respect to time and therefore its derivative with respect to time is equal to zero.

Consequently, the L.H.S of Eq. (7) $\frac{\partial \psi(\vec{r},t)}{\partial t}$ approaches zero, hence eq. (7) reduces to,

$$\mathbf{0} \approx \frac{\hbar^2}{2N\bar{\mu}} \nabla^2 \psi(\vec{r}) \qquad (11)$$

$$\mathbf{Or,} \qquad \mathbf{0} = \nabla^2 \psi(\vec{r}) \qquad (12)$$

This is the well-known Laplace Equation that governs the forces of gravity, the solution of which gives the classical gravitational field,

$$g = \frac{GM}{r^2} \qquad (13)$$

This result is not surprising. For, according to Kellogg (1967: 211), solutions of Laplace's equation are always Newtonian potentials, so that in studying the properties of such solutions, we are also studying the properties of Newtonian field. On the other hand, Helms (2009: 7), points out that Potential theory has its origins in gravitational theory and electromagnetic theory. The common element of these two is the inverse square law governing the interaction of two bodies.

3.2. The unified meaning of the wave function

Despite that the unified formula presented above is extremely simple, nevertheless, it represents a highly complex picture for subatomic realm. For, this unified formula is based on the postulate that every quantum particle, including photons, is composed of a definite number $\boldsymbol{N}$ of final particles. Therefore, these final particles have to be endowed with the same feature of wavy random motion that characterizes all subatomic particles. In such a case description of the random motion of only one quantum particle becomes a complicated process that describes the probabilistic distribution of its composing final particles in space.

On the other hand, if the quantum wave equation (i.e. Schrödinger equation) that governs quantum field is viewed as a general case for Laplace equation, which governs gravitational field, then we should present a unified meaning for the 'wavefunction' of both fields.

We know from classical mechanics as well as GTR, that the gravitational field is interpreted as the effect of mass. Following (Rindler, 2006: 230), the gravitational field of non-rotating spherical mass in vacuum calculated through Schwarzschild's metric of GTR, is given by

$$g = |grad\Phi| = \frac{d\Phi}{dl} = \frac{d\Phi dr}{drdl} = \frac{mc^2}{r^2}\left(1 - \frac{2m}{r}\right)^{-1/2} \quad (14)$$

Where $m = \frac{GM}{c^2}$ and M is the mass of the body, substituting we get,

$$g = \frac{GM}{r^2}\left(1 - \frac{2MG}{rc^2}\right)^{-1/2} \quad (15)$$

For the case of small values of the ratio M/r (i.e. for large values of r) we get the classical field,

$$g = \frac{GM}{r^2} \quad (13)$$

Therefore, if we seek a unified meaning for the general case, which is Schrödinger equation, then we should consider also that the quantum field is the effect of mass of the quantum particle. This is translated quantitatively as follows,

Since the field given in eq. (13) is a solution for the equation of the wavefunction $\psi(\vec{r}, t)$ in the special case of $N \approx \infty$, and since G is a universal constant, therefore the function $A_0\,(\vec{r})$ in eq. (9) above represents variation of the mass with distance (r). And if eq. (9) represents a special case of the general equation (which is Schrödinger equation), then the function $A_0\,(\vec{r})$ represents also variation of mass in eq. (7), and hence mass is quantized in the general equation of the wave.

Moreover, if we adopt a unified meaning for the function $\psi(\vec{r}, t)$ in eq. (7) above, as expressing the variation of mass, then we should take into consideration motion of the composing final particles (which collectively represent its total mass) of the quantum particle.

Here we associate a specific 'probabilistically' measurable value for the wave phase, which is mass density. However, the current position of the received view is that nothing we can measure defines the phase of a quantum wave for a single particle (Fayngold 2013:45). This difference reflects the new meaning given to the quantum wave that allows us to unify both of the classical and the quantum realms.

In the simple case of a free quantum particle, matter is distributed in space in accordance to the probabilistic cloud of a probabilistic wave. In the case of a classical body, i.e. when ***N*** approaches infinity, these probabilistic waves vanish and we are left with the surfaces of equal potentials (or surfaces of equal probabilistic distribution).

We may state the results of introducing such a postulate in order to unify the two formulae of Gravity and QM in the following points:

1- Mass is quantized.
2- Quantum fields and Gravitational fields are one and the same phenomenon, which is an expression of distribution of matter in space. The only difference is that the second represents a limiting case for the first in which the wavy nature disappears.
3- Gravitational equipotential surfaces represent a continuous approximation to the case of the quantum particles. The later is characterized by surfaces of eigenvalues that are mediated by probabilistic values.

4. Consequences of the Unified Equation

At this point we have shown that if the body is composed of ***N*** final particles of unit mass, then Schrödinger equation becomes a general equation for both of gravitational and quantum fields. Moreover, we have shown that in such a case both of gravitational and quantum fields result from the effect of mass. This proves unification only formally and raises the question of the consequences of such a view to nature on both of the classical and quantum realms. Although this unified formula is proved quantitatively, its consequences will be introduced qualitatively as a means for a new route toward the complete theory of Quantum Gravity.

The joining link between the above quantitative analysis and the following qualitative analysis is the common classical/quantum nature of the final particle. For, since quantum particles are composed of such final particles, then the final particle should be endowed with the probabilistic features of the quantum realm. At the same time, since classical bodies are also composed of such final particles, then such particles have to be endowed with the power of attraction. The rest of the following qualitative analysis follows logically and consistently from such a basic unifying postulate.

As mentioned before, despite that the above derivation of the unified equation of Gravity and QM in the classical limits is simple, nevertheless it leads to a radically different but consistent view to natural bodies. For, in accordance to this analysis not only subatomic particles exhibit probabilistic behavior but also classical bodies. While, on the other hand, not only classical bodies exhibit gravitational (or attractive) 'apparent' instantaneous effects across space, but also subatomic particles. And both are based on the postulate of the individual final particle that is endowed with both features of probabilistic behavior and 'apparent' instantaneous gravitational effect. For great numbers of final particles that practically approaches infinity, this view leads to the continuous equipotential surfaces of gravitational field. And, for the range from many to great numbers of final particles that doesn't approach infinity, this leads to the picture that such equipotential surfaces are mediated by oscillating values of such a potential in space-time that we term as quantized.

This means that our aim when we solve for motion and interaction of natural bodies is to define the correct 'probabilistic' distribution of matter in space and time that results from both of the probabilistic behavior of the final particles of the bodies, on one hand, and its interaction with other masses of the universe, on the other. Such a probabilistic distribution is characterized by the formation of surfaces of equal probabilistic densities that are separated by characteristic length that separates its spatial formation and characteristic period that separates its temporal formation. Knowledge of such distribution allows us to calculate the effects of different bodies involved in interaction on each other, and hence define its 'probabilistic' dynamics. This leads to the conclusion that what really is quantized in QM is matter itself represented by its mass, and quantization of other variables (such as energy and momentum, etc) is a natural consequence of quantization of matter.

In practical situations this abstract picture leads to the appearance of what is termed the probability cloud of quantum particles. For, if the final particles of a specific quantum particle exhibit probabilistic behavior in accordance to the quantum wave, then we should expect the appearance of a matter/probabilistic cloud that fades away with maximum value around the center of motion of the collective final particles that compose the quantum particle.

For example, in the case of the electron that is tied to the atom, the electron as a whole (or the center of motion of the electron) moves at random within a specific range of levels of energy. Because such a range of energy is formed around the atom and doesn't allow the electron (i.e., the center of motion of the final particles) to move outside such a range it appears that the electron is revolving around the atom. However, the correct description of such a motion is that of a cloud of random motion the center of which is confined within such a specific level (or range) of energy.

On the other hand the composing final particles of the electron take the moving electron as their center of random motion. The motion of such final particles is at random all over the space and its density decreases rapidly with the distance in accordance to the laws of random motion and the gravitational effects of the atom. Therefore the final state of the electron takes the form of an undefined cloud composed of random final particles concentrated around the sphere shell that surrounds the atom at the region of the specified energy level of the electron.

If we were to compare such a picture to the contemporary picture in literature, we cite that described by Moses and Vadim Fayngold (2013). They maintain that in contrast to a tiny ball rolling along its orbit, the electron is “smeared out” over the whole orbit, like a wave on an elastic ring, which is vibrating with all its parts at the same time. In a way, the electron is spread out in the atomic space as music in a concert hall. Therefore, physicists nowadays rarely say “electron orbit.” Rather, they say “electron configuration,” “electron shell,” or “electron cloud,” even when referring to only one electron. In a state with definite energy, this cloud is axially symmetric and therefore its rotation around the nucleus produces only a steady current loop, which does not radiate (Fayngold: 37).

This comparison shows that the picture introduced here based on our qualitative analysis is completely compatible with the current picture of the subatomic realm.

4.1. The case of one final particle

As mentioned above, we have two limiting cases with respect to the number of the final particles of the body. In the general case, which is that of the Quantum particle, the surfaces of probabilistic distribution of matter are separated by its characteristic length and period within which the matter of the body extends forming the quantum wave. However, if the density of matter of the body becomes extremely great, such characteristic length and period of the wave, as shown above, approaches zero, and the surfaces of equal probability distribution become continuous. The other limiting case is that of one final particle. In such a case, having one final particle means that the number of the final particles will not vary between the surfaces of equal probabilistic density and therefore, again the wave vanishes. Hence, we are left with surfaces of equal probability density that are formed through a continuous gradient in accordance to Laplace Equation that governs such surfaces.

As such, quantitative analysis will show that one, or very few, final particles don't lead to the appearance of the phenomenon of the quantum. Therefore, we may legitimately consider its level as the fundamental level of nature.

From eq. (8) above,

$$\boldsymbol{\lambda} = \frac{\boldsymbol{h}}{\bar{\boldsymbol{\mu}}\boldsymbol{N}\boldsymbol{v}} \qquad \textbf{and} \qquad \boldsymbol{\tau} = \frac{\boldsymbol{h}}{\frac{1}{2}\bar{\boldsymbol{\mu}}\boldsymbol{N}\boldsymbol{v}^2} \qquad (8)$$

Since by definition the velocity $\boldsymbol{v}$ is constant, and from definition both $\boldsymbol{h}$ and $\bar{\boldsymbol{\mu}}$ are constants, then the values of $\boldsymbol{\lambda}$ and $\boldsymbol{\tau}$ are constants. In addition, since we have only one final particle, then there will be no variation of the number of the final particles $\boldsymbol{N}$ with time, and hence no variation of the mass. Therefore, the function $\boldsymbol{\psi}(\vec{\boldsymbol{r}}, \boldsymbol{t})$ will not take the form of a wave, for the values of the function are always constant, and hence diminish as a wave. Therefore Eq. (7) becomes,

$$\boldsymbol{\psi}(\vec{\boldsymbol{r}}, \boldsymbol{t}) = \boldsymbol{k}\boldsymbol{A}_{\boldsymbol{0}}(\vec{\boldsymbol{r}}) = \boldsymbol{\psi}(\vec{\boldsymbol{r}}) \qquad (16)$$

This is the same result we get for the case of $\boldsymbol{N} \approx \infty$, and it leads to the same equation of motion, which is Laplace equation.

Hence, we are left in both of the two limiting cases with exactly the formula of Laplace equation for the case of steady-state for an individual final particle as well as great number of final particles, given above. Since Laplace equation is the equation that governs the gravitational field, then it becomes legitimate to consider the force of gravity as the most fundamental force in nature that existed before composition of both of quantum and classical particles.

4.2. The final particles in Nature

Apart from the formal unification of Gravity and QM in the non-relativistic limit through the postulate of the final particle, as well as its interpretation as expressing distribution of matter in space, it should be possible to find an indirect evidence of the existence of these final particles in nature. Since we propose that natural bodies are composed of such final particles, then we should seek evidence that proves composition of elementary particles, specifically, photons. Form another side, since from our analysis above the final particles are related to gravity, we should also seek evidence of such final particles from phenomena related to gravity.

4.2.1 The speed of light and gravitational waves

Since Einstein admitted the theory of the special relativity on 1905 the speed of light in vacuum is assumed to be constant and represent the maximum possible speed in the universe. From another side, the postulate of the final particle assumes that photons, which are the 'particles' of light, are not elementary but composite particles. In line of such a postulate we can't observe the final particles nor can we observe its speed because our 'current' tools are always more complex than such particles. However, since the final particles are elementary with respect to photons, then it is expected to have a faster speed than photons.

As such, we can't observe the complex nature of photons nor can we observe that it is not the maximum possible speed in the universe. However, since the final particles are related to gravity therefore we should expect that the speed of gravitational waves is faster than light by a very small amount that might be outside of our current measuring capabilities.

Therefore, observation of the speed of gravitational waves represents one of the basic tests of the postulate of the existence of the final particles in nature. And if we find that such waves are faster than light by an extremely small value, then this would count as an evidence of the existence of the final particles.

4.2.2. Dark matter and dark energy

Since we assume that all matter that we observe are constructed of unobservable composing final particles of unit mass, then we should expect indirect evidence of the existence of such fundamental particles. And since this postulate states that such final particles are endowed with the power of attracting other final particles of other bodies, hence the indirect evidence we should seek is the existence of unexplained gravitational forces. Moreover, if ordinary subatomic matter is composed of final particles, then the final particles should have abundantly existed before such ordinary matter, and hence it should far exceed the ordinary matter in its quantity.

In short, we should find in nature unexplained gravitational forces that emanate from unobservable material, in addition we should find that such unobservable material far exceeds in its quantity the observable material. As well known, we see in nature exactly such a situation in what is termed today 'dark matter' and 'dark energy'.

According to Lammerzahl (2007: 27) there are some problems in gravitational physics still lacking a convincing solution. The most important of such problems are dark matter and dark energy. Dark matter and dark energy constitute together around 95% of the matter of the universe. Dark matter, he explains, has been introduced in order to "explain" the gravitational field needed for the rotation curves and the gravitational lensing of galaxies. It also appears in the spectral decomposition of the cosmic microwave background radiation. Since no particle has been found which can be identified as constituents of dark matter, the notion ”dark matter” is just a synonymous for the fact that the gravitational field as seen by stars and light rays is stronger than expected from the observed possible sources. Similarly, recent observations of the Lyman-alpha forest lines indicate that the expansion of the universe is accelerating and that 75% of the total energy density consists of a mysterious Dark Energy component with negative pressure. (Lammerzahl: 28).

Therefore, we see in nature through very accurate experiments such predicted abundant original material of the universe that exerts gravitational forces without being liable to direct observation, which represents an indirect evidence of the proposed final particles.

5. A new route to Quantum-Gravity?

Fundamental theories of physics are mathematical constructions that describe motion of natural bodies under the effects of other bodies. These effects are termed in contemporary theory as fields. If we aspire to unify two theories it is mandatory to unify their fundamental entities as well as the nature of the fields they describe. In GTR gravitational field is based on dynamic space-time, which is a controversial entity that is described through mass and motion of natural bodies. On the other hand in QM quantum fields are based on the probabilistic behavior of the mysterious wavefunction. Therefore, we have two radically different natures for the fields of the two theories. Since the two theories describe two radically different fields then it is very much unlikely to be unified.

In order to introduce a unified theory for Gravity and QM it is essential to present a unified field that applies to natural bodies in both realms. Since GTR and QM are the two most successful theories of current physics, such a unified field should be compatible with both theories at the same time. In other words, it shouldn't be in contradiction with either of the current theories of GTR and QM.

In this work, we fulfill this requirement by introducing the unified classical/quantum postulate of the final particle. Such a particle exhibits classical features through the assumption that each natural body is composed of $\boldsymbol{N}$ final particles that are endowed with the power of attracting other final particles (which is the analogue of the concept of the indivisible atom in classical mechanics). At the same time such a final particle is endowed with the wavy probabilistic motion that characterizes the quantum realm.

Through such a postulate it becomes possible to calculate distribution of matter in space-time. This distribution plays the role of the unified field for both of classical and quantum realms. Through our knowledge of such distribution it becomes possible to calculate the effects of the body on other bodies through our existing laws of classical mechanics. For regular values of $\boldsymbol{N}$, which lie between many to great numbers of final particles that don't approach infinity, probabilistic nature for the distribution of the matter of the body in space-time appears, and hence, we become forced to use mathematical techniques developed in the theory of QM. On the other hand for the case of $\boldsymbol{N}$ approaches infinity, probabilistic variations of mass disappear and we can use classical mathematical techniques to solve for the effects of the body.

Hence, through such a postulate it was possible to advance the probabilistic distribution of matter in space as the unified field for both of Gravity and QM.

A complete theory of Quantum-Gravity has two basic expressions: 1) a unified picture of reality; 2) a unified formula that takes all cases of motion into account. In this paper we concentrated on the first expression through dealing with the non-relativistic limit of natural bodies. This circumvents the inevitable intricate mathematical constructions that are usually associated with any attempt to formulate a theory of Quantum Gravity. Hence, it was possible to unify Gravity and QM in the non-relativistic limit through admitting the postulate of the final particle. And therefore, it was possible to present the field of Gravity as a special case of the general formula of unification, which is Schrödinger equation associated with the transformation $\boldsymbol{m} = \boldsymbol{N\bar{\mu}}$.

This procedure led to admitting gravitational and quantum fields as one and the same phenomenon, and that what we are looking for when solving for motion of natural bodies is its probabilistic distribution in space. Such a distribution allows us to calculate the different effects of bodies on each other and therefore predict its probabilistic behavior in space and time.

Within the quantum level, we saw that our basic aim, when dealing with composite Quantum particles, is to find the way the composing final particles of the body are 'probabilistically' distributed and how it moves in space. This boils down to defining the characteristic values of the wave ($\boldsymbol{k}$ and $\boldsymbol{w}$) as well as the shapes of the surfaces of equal probability on the basis of the boundary conditions. Knowing the distances that separate surfaces of equal density (i.e. the wavelength), as well as the time that elapses for its formation (i.e. the wave period) we can define the values of the surfaces of equal relative density in time and space. Through our knowledge of the relative numbers of the final particles in such surfaces we become able to calculate the energy at such surfaces, and therefore calculate the forces of interaction at these surfaces with other bodies.In order to achieve a complete theory of Quantum Gravity it is essential to take the effects of 'relativistic' motion, i.e. uniform motion and uniform acceleration, on such a picture. Here gravitational effects of other bodies should be translated into acceleration in the same way as other basic forces of nature. Effects of relativistic motion, i.e. velocity and acceleration, should be apparent on two respects of such picture. First relativistic motion would affect the characteristic values of the wave ($\boldsymbol{k}$ and $\boldsymbol{w}$). Hence, it should be possible to calculate its 'new' values under such motion through our current theories of physics (GTR and QM). Second, motion affects and distorts the shapes of the surfaces of equal probability density that result from motion of the final particles of the bodies. This distortion should be also possible to calculate through our current theories. Therefore, it should be possible in principle to calculate the 'new' probabilistic distribution of matter in space under the effects of relativistic velocity and acceleration. And hence it should be possible to present the final form of the unified theory of Quantum Gravity on the basis of the formula given in this paper. This procedure circumvents the problem of the quantum back reaction on space-time, since the problem in hand is simplified into two separated steps. However, such a procedure requires formulation of the mechanisms of the probabilistic motion of the final particles in order to calculate the required probabilistic distribution of matter in space under relativistic velocity and acceleration. Since such a procedure doesn't exist in contemporary literature it represents a new route toward achieving a complete theory of Quantum Gravity.

REFERENCES

Butterfield, Jeremy and Isham, Christopher. 2004. ' Spacetime and the philosophical challenge of quantum gravity', in Craig Callender and Nick Huggett (eds.), *Physics meets philosophy at the Planck scale - Contemporary theories in quantum gravity*, Cambridge University Press, P. 33 – 89.

Callender, Craig and Huggett, Nick (eds.). 2004, 'Physics meets philosophy at the Planck scale - Contemporary theories in quantum gravity', Cambridge University Press – Cambridge.

Djouadi, Abdelhak. 2011. "The Higgs Mechanism and the Origin of Mass", in Luc Blanchet and Alessandro Spallicci and Bernard Whiting (eds.) 'Mass and Motion in General Relativity', Springer, P. 1 – 23.

Fayngold Moses, and Fayngold Vadim. 2013. 'Quantum Mechanics and Quantum Information - A Guide through the Quantum World', Wiley-VCH, Weinheim, Germany.

Finster, F., Müller, O., Nardmann, M., Tolksdorf, J., Zeidler, E. (eds.). 2012. 'Quantum Field Theory and Gravity - Conceptual and Mathematical Advances in the Search for a Unified Framework', Birkhäuser, Springer Basel AG

Gaukroger, Stephen. 2006. "The Emergence of a Scientific Culture – Science and the Shaping of Modernity, 1210 – 1685", Clarendon Press – OUP - Oxford.

Helms, Lester L. 2009. 'Potential Theory', Springer.

Lämmerzahl, Claus. 2011. 'Testing Basic Laws of Gravitation – Are Our Postulates on Dynamics and Gravitation Supported by Experimental Evidence?', in Luc Blanchet, Alessandro Spallicci and Bernard Whiting (eds.) 'Mass and Motion in General Relativity', Springer, P. 25 – 65.

Lederman, Leon and Teresi, Dick. 1993. 'The God Particle – If the Universe is the Answer, What is the Question?', Dell Publishing, N.Y.

Penrose, Roger. 2004. 'The Road To Reality - A Complete Guide to the Laws of the Universe, Jonathan Cape, London.

Rindler, Wolfgang. 2006. 'Relativity – Special, General, and Cosmological', Oxford University Press, Oxford.

Rovelli, Carlo. 2007. 'Quantum Gravity', in Jeremy Butterfield (ed.) *Philosophy of Physics – part B* , Elsevier P. 1287-1329.

Schlosshauer, Maximilian (ed.). 2011. 'Elegance and Enigma – The Quantum Interviews', Springer-Verlag Berlin Heidelberg.

Veltman, Martinus J. G. 2003. 'Facts and Mysteries in Elementary Particle Physics', World Scientific.