
Demonstrating the Basic Equivalence of a Wide Class of Fundamental Theories of High Energy Physics and Quantum Cosmology Via Transfinite Number Theoretical Fine-Tuning

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Abstract – Using the technique of transfinite harmonization of E-infinity theory, i.e. number theoretical fine-tuning we demonstrate the correctness and basic equivalence of a host of leading fundamental theories of high energy particle physics and quantum cosmology, notably: ‘tHooft-Weltman-Wilson dimensional regularization, Gross et al Heterotic superstrings, loop quantum gravity, von Neumann-Connes pointless noncommutative geometry, Penrose fractal tiling universe and fractal Cantorian spacetime theory. We conclude that the golden mean number system is a quasi-transfinite turing golden computer that can handle all numbers and non-numbers like zero and infinity in addition to distinguishing between being and nothingness and then ends up with the right exact solution. Thus the work explains cosmic fine tuning via the golden mean number system of nature and constitutes that way a nonconstructive mathematical proof of this fact.

Keywords – Golden Mean Harmonization Group, Number Theoretical Fine-Tuning, Equivalence of Certain Fundamental Theories in High Energy Physics and Cosmology, G. ‘tHooft Dimensional Renormalization, D. Gross Heterotic Superstrings, Noncommutative Geometry, Penrose Fractal Tiling, Transfinite Golden Computer, Golden Mean Number System.

I. INTRODUCTION

The present work may represent a major attempt to link a great deal of subjects in physics and cosmology and weld them into a single entity with a central idea [1-43]. The best way to understand where the present work is coming from, as well as where it is going to, is to first address a few utterly simple and basic points which we put here in the form of questions that one may pose to himself as part of an internal monologue and for which we may have a spontaneous, natural answer:

- a. Is it possible to conceive the great developments in science in the modern sense with Roman numbers [1-2] being the only system known to humanity?
- b. Is it not plausible that without the ancient invention of the zero by the Indian mathematicians [1-2] and Muslim scholars subsequently embracing this new efficient notation and counting procedure [1-2], which prompted the Italian Fibonacci to write his famous book [1-4] Modern European Mathematics could not have ever taken off?
- c. Is it not true to say that a modern pocket calculator that could not deal with non-rational numbers such as π [1-6] could not be of much use and does not deserve to be called a calculator in the first place?

We think that the preceding three simple, in fact trivial questions leads us to the inescapable conclusion that without an efficient means to compute using an efficient number system, modern science could not have been realized on our planet [6-20]. Further more we may ask again a deceptively trivial question regarding ‘laborato-

-ry' equipment:

- d. What is the real output of a non-trivial actual experiment in falsifying or confirming a theory? At the end of the day, in the simplest of terms, is it not a number? If the number agrees with that found using the theory, then the theory is confirmed and in the negative case, the theory is refuted, is it not?

Contemplating the previous trivial set of four questions and the tentative answers that they evoke, one is really surprised how is it possible that in some scientific cultures the word 'numerology' is used when disdain and contempt is expressed towards a 'theory' and its author (s) [3, 4]. For a serious scientist who is not linked to 'fashion' as Sir R Penrose would put it [13], one must ask where this disrespect linked to 'numbers' could have come from when the opposite should have been the case. Thus disregarding the confusion between number theory and numerology we have to go back to the history of science to know that numerology was the successor of the cosmic music of numbers [1], [6], which was a major and influential theory developed by the great Greek scholars of mathematics in Alexandria, Egypt namely Plato and Pythagoras [1-2], [6] and which continues to survive even in our modern times as a guiding light as visible from not only the work of engineers like Buckminster Fuller (see Ref. [10], page 131) but also those looking for practical connections between numbers and patterns like the great Israeli chemist and engineer, Nobel Laureate Dan Shechtman (see Ref. [10], page 243), the discoverer of quasi crystals [10]. Remarkably the great mind Shechtman was not deterred in his research by the opposition of a formidable opponent and awesome personality of a double Nobel Laureate prize winner, Linus Pauling. Thus even a fleeting but educated look at what is called 'numerology' in the time of Abbasid Caliphate in Baghdad [1-2] or the $E8E8$ 496 dimensions needed for string theory [9], [11], [13] all apart from the ϕ^6 Immirzi parameter [30-32], [34] of loop quantum gravity [9], [11] and the popping up of the golden mean everywhere in theoretical physics [24-34], black holes cosmology [30-31] should really have put to rest for ever such prejudice and superficial adjectives used to deter young scientists to search freely in any direction they think, including the paradise of number theory [17], [19] and the golden mean number system [21-31] from which modern scientist should not be evicted to paraphrase a famous uttering about the work of G. Cantor due to another giant of mathematics, David Hilbert [1-2], [12].

The present work should be seen in the background limelight of the afore mentioned facts and as such we are recommending here the necessity of using the golden mean number system [21-34] as a magical tool to unify physics and cosmology theories literally effortlessly [26-28] and all apart of a certain fine-tuning that we will discuss at the very end of this work [40-43].

II. A DOWN TO EARTH PHYSICAL PARADIGM FOR THE 'MIRACULOUS' UNIFYING POWER OF E-INFINITY CANTORIAN SPACETIME THEORY

How is it possible that using the golden mean number system all possible theories can go in and out of each other in a way that at the beginning surprised and baffled us but on the other hand, when the entire theory is seen in the light of taking our introduction seriously, one must be stunned that we did not see the obvious from the very beginning and the author is addressing these remarks to himself, literally from his own experience. We think in retrospect it was too obvious to be noticed, or is it too hard to resist the mainstream and the theory of large numbers [8-15] where this number is the number of scientist working in the mainstream [11], [13], [20] direction. Could this be something which Prof. Lee Smolin [11] was trying to put his finger on or is it what Prof.

Sabine Hossenfelder [20] is currently decimating passionately on Youtube? The author thinks it may be a little of all that and in this context, let me introduce here the paradigm of lubricating old drawers and doors of old bookcases of which the author possesses too many. Surely each one of us has suffered from opening these objects when due to the passing of time and the weight of too many books, it went out of alignment and then nothing can help like some grease. Actually the same happens when one is tiling the floor of a bathroom [10], [13] which is related to the holographic boundary of our theory, namely Penrose fractal tiling [21-31]. The grease in this case is the mortar between the tiles and corresponds mathematically to the irrational small quantities we need for symplectic tiling [21-34], namely ‘tHooft’s renormalon $\phi^3(1 - \phi^3) = k$, Hardy’s entangleon [26-28] $\phi^5(1 - \phi^5) = k_o$ and Immirzi parameter ϕ^6 [30-31] and so on. Interestingly the technique to adding and subtracting small irrational quantities was developed in connection with the operator theory [35-38] by the great German-American mathematician Fritz John [38] to derive simple consistent equation for the elastic shells from the 3D elastic continuum [38] and was also the subject of many studies by W. Koiter [35], [38] and the present author in applied mechanics [35-38]. In the larger picture this is part and parcel of what the author calls the golden mean harmonization group, which is implemented automatically when we use the golden mean number system [6], [22-28], [30-43].

III. SHORT OUTLINE OF AN EXACT SOLUTION STRATEGY THAT IS PARADOXICALLY SIMPLER THAN ANY APPROXIMATE ANALYSIS

E-infinity Cantorian spacetime implying its golden mean number system is the example par excellence for the dictum that when you simplify, things become messy while going exact really does simplify things tremendously [21-31]. Let us start with $\bar{\alpha}_o = 137 + k_o$ which is the exact value of the E-infinity inverse electromagnetic fine structure “constant”. The exact relation to the dimension of the E8E8 exceptional Lie symmetry group of superstrings is given exactly by the relation [4], [25]

$$\begin{aligned}
 |E8E8| &= (3 + \phi)(\bar{\alpha}_o) & (1) \\
 &= 496 - k^2 \\
 &= 4959674775
 \end{aligned}$$

where $\phi = (\sqrt{5} - 1)/2$, $k_o = \phi^5(1 - \phi^5)$ and $k = \phi^3(1 - \phi^3)$. The difference between this exact transfinite value and the classical value (496) is a mere 0.006557 percent only which seems to be not worth considering. However let us take a rational approximation for $\phi \simeq 2/3 = 0.660$ and set $k_o = 0$. That way one finds

$$|E8E8| = 502.33 \tag{2}$$

which differs from the classical value by 1.26 percent, which is a relatively large deviation. However far more harmful than that is the fact that one would normally not even notice that there is a scaling relation between $\bar{\alpha}_o$ and $|E8E8|$. In fact it can easily be shown that as our “chain” of relations and computation goes on, the 1.26 percent error could become 50 percent and more an error in fundamental values. This is sufficient to cause a rift between theory and measurement constituting mild to severe discrepancies depending upon the question asked. In fact even if we do not take 2/3 as the first Fibonacci approximation of the golden mean ϕ [4] but only simply ignore the small value k_o or use the experimental value for $\bar{\alpha}_o$, we could encounter substantial errors. To explain

that nothing is more clear as in the case of the reconstruction, i.e. renormalization quantum field equation for $\bar{\alpha}_o$. In E-infinity theory this equation is exact and reads as follows [21-34].

$$\bar{\alpha}_o = (1/\phi) (\bar{\alpha}_1) + \bar{\alpha}_2 + \bar{\alpha}_3 + \bar{\alpha}_4 \tag{3}$$

where $\bar{\alpha}_o = 60$, $\bar{\alpha}_2 = 60/2 = 30$, $\bar{\alpha}_3 = 8 + 1 = 9$, $\bar{\alpha}_4 = 1$. Inserting in $\bar{\alpha}_o$ one finds our $\bar{\alpha}_o$ exact theoretical value

$$\begin{aligned} \bar{\alpha}_o &= 137.082039325 \\ &= 137 + k_o \end{aligned} \tag{4}$$

It is extremely important to notice how the sum of all $\bar{\alpha}_i$ where $1/\phi \rightarrow 1$ leads exactly to the theoretical dimension of the core of the theory, namely [21-34]

$$\begin{aligned} \sum_1^4 \bar{\alpha}_i &= 100 \\ &= (\bar{\alpha}_o) \text{ at } 1/\phi = 1 \end{aligned} \tag{5}$$

This condition $1/\phi = 1$ means setting $\phi = 0$ because $1/\phi = 1 + \phi$. On the other hand this 100 percent is really the sum of 4 Einstein spacetime dimensions plus 96 invisible and non-tangible dimensions pretty much like the time dimension or even worse, namely the 22 compactified dimensions, which together with the Einstein 4 make the 26 dimensions of Gross Heterotic superstring theory [34]. That means we are combining the old bosonic string 26 dimensional theory with the ten dimensions of superstrings by letting them run in different dimensions, namely [21-36]

$$26 - 10 = 16 \tag{6}$$

where the 16 are the famous Gross et al extra bosonic dimensions [34]. That leaves us, as we said earlier, with the 22 compactified dimensions representing dark matter and so we are left with $100 - 26 = 74$ dimensions representing pure dark energy and because the sum of the core dimension is 100 all these numbers could be translated immediately to cosmic energy densities and compared directly with cosmic measurement of COBE and WMAP [21-34]. Thus although our equation arising from the preceding reasoning, namely [21-23]

$$\begin{aligned} \sum_1^4 \bar{\alpha}_u &= 26 + 74 \\ &= 4 + 22 + 74 \\ &= \gamma(O) + \gamma(DM) + \gamma(PD) \end{aligned} \tag{7}$$

for ordinary, dark matter and pure dark energy density is quite accurate, it is easily made exact by drawing on the transfinite version of the original gross et al Heterotic string theory dimensional hierarchy obtained by scaling $(\bar{\alpha}_o/2)$ using the golden mean exponent of E-infinity self similarity, i.e. [21-39]

$$\begin{aligned} (\bar{\alpha}_o/2) (\phi)^n &\xrightarrow{n=1} 42 + 2k \\ &\xrightarrow{2} 26 + k \end{aligned}$$

$$\overset{3}{\rightarrow} 16 + k \tag{8}$$

$$\overset{4}{\rightarrow} 10$$

$$\overset{5}{\rightarrow} 6 + k$$

$$\overset{6}{\rightarrow} 4 - k$$

where $k = \phi^3(1 - \phi^3) = 0.18033989$ is ‘tHooft’s renormalon “quasi” particle of the ‘tHooft-Weltman-Wilson dimensional regularization method [32-34]. We thus see that the 26, 16, 10, 6 and 4 should be more harmoniously $26 + k$, $16 + k$, 10 , $6 + k$ and $4 - k$. Taking that into account one finds the exact cosmic energy density spectrum, namely [21-39]:

$$\begin{aligned} \sum_{i=1}^4 \alpha_i &= (4 - k) + (94 + k) \\ &= \left(\frac{100}{22+k}\right) + (22 + k) + \left(100 - \left[\frac{100}{22+k} + (22 + k)\right]\right) \end{aligned} \tag{9}$$

$$= 4.508497187 + 22.18033989 + 73.3116292 = 100$$

where we made use of the Otto Hermann’s reciprocity theorem [39]. These are of course the exact density values computed in earlier publications using a host of different exact theories all based on the golden mean number system [21-34]. Now we stress the following: Just take the ideal values of α_i out and replace them with the accurate experimental value and our entire E-infinity computation scheme [21-34] is destroyed because we are not using the golden mean number system but in a manner of speech we are returning to the Roman quasi pre-historic number system or almost so. The simplest way to show that clearly is by observing that the key equality [21-39]

$$\frac{100}{137+k_o} = \frac{16+k}{22+k} \tag{10}$$

could never hold by setting $k_o = 0$ or $k = 0$ or $k = k_o = 0$ or changing any of the integers involved particularly in the 100 dimensions of E-infinity core. The meaning of this deep equation was discussed in previous publications that we recommend to the reader to consult however fleetingly [40]. Never the less it could not harm and could only be of help to discuss this point in a condensed way.

The beginning of our little demonstration, it must be said, is D. Gross et al ingenious Heterotic string theory. In this case the total energy may be dissected in more or less the dimensional hierarchy, namely starting from Einstein’s maximum density $E = mc^2$ and finding that [30-31].

$$\begin{aligned} E &= \left(\frac{26-4}{26-4}\right) mc^2 \\ &= \left(\frac{22}{22}\right) mc^2 \end{aligned} \tag{11}$$

and therefore for the Heterotic string theory we have [30-31]

$$E = \left(\frac{1+5+16}{22}\right) mc^2 \tag{12}$$

That means the corresponding densities are

$$\gamma(O) = 1/22, \tag{13}$$

$$\gamma(DM) = 5/22,$$

and

$$\gamma(PD) = 16/22 \tag{14}$$

This is of course the crude simplest approximation that can be made exact by including $\bar{\alpha}$ and the coupling Δ . Ignoring the coupling between the two parts of the dark section, one finds that the most important part for us here is the pure dark energy

$$\begin{aligned} \gamma(PD) &= \frac{16+k}{22+k} \\ &= 0.7294901688 \tag{15} \\ &= 72.94901689\% \end{aligned}$$

Now we move to another Cantorian spacetime resolution where Einstein's gravity with its Riemannian tensor quasi-degrees of freedom [21-34] $R^{(4)} = 20$ and the similarly attractive electromagnetic representation $\bar{\alpha}_o = 137 + k_o$ coalesce. That gives us [21-34]

$$\begin{aligned} R^{(4)} + \bar{\alpha}_o &= 20 + 137 + k_o \tag{16} \\ &= 157 + k_o \end{aligned}$$

However this $157 + k_o$ may be interpreted in a different manner as the joining of the intrinsic dimension of the core of the E8 bulk with the $\sum_1^4 \alpha_i = 100$ core of E-infinity so that we have [31-34]

$$\begin{aligned} \sum_1^4 \alpha_i + \dim(\text{intrinsic } E8) &= 57 \tag{17} \\ &= 157 \end{aligned}$$

Adjusting 57 transfinitely harmonic we have $57 + k_o$ and thus we have [21-34]

$$\sum_1^4 \alpha_i + (57 + k_o) = 157 + k_o \tag{18}$$

as it should be. A simple comparison between

$$\frac{(26+k)-10}{(26+k)-4} = \frac{16+k}{22+k} \tag{19}$$

of Gross et al Heterotic string theory with the above reveals that we have a similar Heterotic situation given by

$$\frac{(157+k_o)-(57+k_o)}{(157+k_o)-(20)} = \frac{100}{137+k_o} \tag{20}$$

which confirms expected and unexpected equally as eluded to earlier on by equation (10). Needless to say, this equation together with its supporting transfinite platonic set theory and the experimental results of COBE and WMAP [21-34], is a beautiful proof of the correctness of not only E-infinity theory but also of Gross Heterotic string theory, 'tHooft's dimensional regularization, loop quantum gravity as well as the dark energy and dark matter theories presented here and in many previous publications [21-34]. Finally we first recommend a careful

study of Ref. [41] which addresses many points discussed in the present paper regarding the dynamics of numeric and second we may add to the four trivial question we mention at the very beginning of this paper the following not entirely trivial fifth question, namely:

- e. Are we not justified in calling our golden mean number system and the transfinite harmonization procedure used, natural fine-tuning mathematics? [40-43].

IV. DISCUSSION

Taking a bird's eye view of theoretical quantum physics and cosmology we discover the obvious, or what should be more than obvious from the long history of science, namely that computation and the number theory used in this computation is part and parcel of the very foundation of the theory itself and in fact of the final comparison between theory and experiment. Looking from the same perspective and seeing the many paradoxes and difficulties plaguing our science, we must conclude that something is 'foul' in the state of 'our science' [11]. Many great candid and honest scientists attempted to explain the situation and "the trouble with physics" and we add to this "the trouble with cosmology and dark energy". It is quite possible that we do have trouble with ourselves in the first place [18]. Putting it bluntly there may be trouble with our egos, our feelings and our own inclination to stubbornness coupled paradoxically with our being unprepared to travel uncharted ways and sing out of the 'mainstream' core [14], [20].

In the present work we have singled out our number system as the biggest hurdle in the way of getting it right and present our case to the best of our knowledge that the golden mean number system is the best tool we could ever have to solve our problems. The golden mean number system is the only transfinite Turing machine that allows us to compute with all numbers, including non-numbers like zero and infinity and still distinguish between being and nothingness and obtain the right answer such as the miraculous Spinoza's God scheme for existence, namely very rational and super simple. Another possible alternative name to Spinoza's God may be the natural fine-tuning of the golden mean number system. The reader can thus imagine the considerable epistemological and philosophical implications of the present interpretation of cosmic fine-tuning.

One particular merit of this present paper is that quantum wave collapse was given a pure mathematical as well as real physical interpretation and related both the mathematical and the physical to each other [43]. The mathematical is in accordance with Connes' theory and holds that the quantum particle is a zero set $(0, \phi)$ and the quantum wave is an empty set $(-1, \phi^2)$. Measurement by its very nature will convert an empty set quantum wave to a non-empty zero set quantum particle. The physical interpretation on the other hand sees the quantum wave as a boundary layer and spacetime as a fluid. Consequently as disturbance destroys the Prandtl layer and converts it to elementary von Karman spirals, we have an analogous situation where measurement destroys the quantum wave "boundary layer" so that the vital ϕ^2 intersection becomes two ϕ and ϕ union, i.e. a quantum wave becomes two quantum particles, i.e. an empty set is now rendered two zero sets. This is the first time in the long history of quantum wave collapse that such a physical mathematical model has been advanced [43].

V. CONCLUSION

In short we achieved in the present paper several important results pertinent to the real meaning of major problems in physics and cosmology and effectively removed various paradoxes. In a nutshell these results and conclusions are:

1. The golden mean number system is the deep rational explanation for the fine tuning of our universe and naturally the standard model of high energy elementary particles.
2. The quantum wave can be described as an empty set in set theoretical pure mathematical terms. However it can also be described physically as a version of the Prandtl boundary layer phenomenon. Amazingly both pictures compliment each other and give a deep satisfying feeling of complete understanding. From this picture the real mathematical and physical meaning of quantum wave collapse follows logically and becomes far from being mysterious.

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AUTHOR'S PROFILE



Professor M.S. El Naschie was born in Cairo, Egypt on 10th October 1943. He received his elementary education in Egypt. He then moved to Germany where he received his college education and then his undergraduate education at the Technical University of Hannover where he earned his (Dipl-Ing) diploma, equivalent to a Master's degree in Engineering plus being a professional chartered engineer. After that he moved to the UK where he enlisted as a post graduate student in the stability research group of the late Lord Henry Chilver and obtained his Ph.D. degree in structural mechanics under the supervision of Professor J.M.T. Thompson, FRS. After his promotions up to the rank of full professor, he held various positions in the UK, Saudi Arabia and USA and was a visiting professor, senior scholar or adjunct professor in Surrey University, UK, Cornell, USA, Cambridge University, UK and Cairo University, Egypt. In 2012 he ran for the presidency of Egypt but withdrew at the final stage and returned to academia and his beloved scientific research. He is presently a distinguished professor at the Dept. of Physics, Faculty of Science of the University of Alexandria, Egypt. Professor El Naschie is well known for his research in structural stability in engineering as well as for his work on high energy physics and more recently for his work in cosmology and elucidation of the secret of dark energy and dark matter as well as for proposing a dark energy Casimir nano reactor. He is the creator of E-infinity theory, which is a physical theory based on random Cantor sets and can be applied to micro, macro and mesoscopic systems. Professor El Naschie is the single or joint author of about one thousand publications in engineering, physics, mathematics, cosmology and political science. His current h-index is 81 and his i-10 index is 793 and total citations are 36363 according to Google Scholar Citation.