

Golden Anyons for Cosmic Dark Energy Density

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Abstract

The note gives a watertight confirmation of the E-infinity Cantorian theory results for ordinary and dark cosmic energy density of the universe $\gamma(O)=1/22$ and $\gamma(D)=21/22$ respectively. The computation is fundamentally based on a golden mean fusion function that goes back to the highly original anyon proposal of F. Wilczek.

Keywords

Anyons, Wilczek Unification, Golden Mean Fusion, Dark Energy

1. Introduction

The exceedingly important role of anyons in physics started in earnest when F. Wilczek was able to show that the theoretical possibility of two dimensional exotic particles, [1] [2] [3] which are neither fermions nor bosons, is realized in nature via the experimental discovery of the fractional hall effect by H. Stormer and D. Tsui [4]. The present work starts with these real quasi particles which were given the name anyons by Wilczek [2] and go on to show how it can be reformulated via four dimensional fusion algebra and non-commutative dimensional function of von Neumann-Connes and E-infinity theory [5] [6] [7] [8] [9] to confirm the correctness of the results pertaining to the cosmic ordinary and dark energy densities $\gamma(O)=1/22$ and $\gamma(D)=21/22$ respectively as will be detailed in the coming sections [6] [7] [8] [9].

2. Analysis

2.1. Previous Fundamental Results

Let us start by recalling the results of the ordinary and dark cosmic energy densities obtained previously using numerous methods [6] [7] [8] [9]. These results were based mainly on the fundamental identification of the pre-quantum parti-

cle and the pre-quantum wave with the zero set and the empty set respectively [4] [8]. In turn the zero set and the empty set are fully fixed by the corresponding value of a dimensional function developed by A. Connes based on the work of von Neumann related to his continuous geometry [5]. It was then a relatively simple matter to show that the corresponding bi-dimensions are given by zero and ϕ for the pre-quantum particle and minus one and ϕ^2 for the pre-quantum wave where ϕ is the inverse golden mean $1/\phi = (1 + \sqrt{5})/2$ [6] [7] [8] [9]. Since at this resolution scale densities is a topological volume it was possible to calculate the volume corresponding to the pre-quantum particle density by intersection in five dimensional Kaluza-Klein spacetime and similarly but via union operation for the pre-quantum wave [6] [7] [8] [9]. Proceeding in this way one finds that the energy density of the pre-quantum particle which is correlated and thus measurable [6] [7] [8] [9] is given by

$$\gamma(O) = (\phi)^5 \quad (1)$$

while for the uncorrelated and thus not directly measurable cosmic dark energy density one finds

$$\gamma(D) = 5\phi^2 \quad (2)$$

The total density is therefore given by [4]

$$\begin{aligned} \gamma &= \gamma(O) + \gamma(D) \\ &= \phi^5 + 5\phi^2 \\ &= 2 \end{aligned} \quad (3)$$

Since it was established that Einstein's $E = mc^2$ represents the maximal energy density possible, *i.e.* $\gamma = 100\%$ corresponding to $\gamma = 1$, then to bring the above result in line with $E = mc^2$ where m is the mass and c is the speed of light, then we simply interpret $E = mc^2$ as being $E = (2/2)mc^2$ [6] [7] [8] [9]. In other words, we have

$$\begin{aligned} E &= \left(\frac{\phi^5 + 5\phi^2}{2} \right) mc^2 \\ &= (\phi^5/2)(mc^2) + (5\phi^2/2)mc^2 \\ &= E(O) + E(D) \\ &= mc^2 \end{aligned} \quad (4)$$

where $E(O)$ is the quantum particle ordinary energy and $E(D)$ is that of the quantum wave dark energy [6] [7] [8] [9]. Taking rational-integer approximation of the above identities we find

$$\begin{aligned} E &\cong (mc^2)/22 + (21/22)mc^2 \\ &= E(\text{Einstein}) \end{aligned} \quad (5)$$

This result is in astounding agreement with accurate cosmic measurements and observations which assert that $E(O)$ is about 4.5% and $E(D)$ is the rest 95.5% of the total expected energy [6] [7] [8] [9]. We may summarize the

above as

$$\begin{aligned}\gamma(O) &= \phi^5/2 \\ &= 0.04508497197 \\ &\cong 1/22 \\ &\cong 4.5\%\end{aligned}\tag{6}$$

for ordinary cosmic energy density and

$$\begin{aligned}\gamma(D) &= 5\phi^2/2 \\ &= 0.9549150289 \\ &\cong 21/22 \\ &\cong 95.5\%\end{aligned}\tag{7}$$

for the dark energy section which as we know cannot be measured in a direct way without quantum wave non-demolition measuring devices that are technologically not yet available at the time of writing [7] [9].

2.2. Enter 4-D Fusion Algebra and Wilczek's Anyons

It is well known from topological quantum field theory and its relation to sub-factors that there is a dimensional function for an explicit situation called 4-D fusion algebra given by [5] [6]

$$d(1) = d(\epsilon) = 1\tag{8}$$

and

$$d(x) = d(\beta) = 1/\phi\tag{9}$$

Now, not so incidentally this 4-D function may be taken over to the two dimensional anyon where, as reasoned in the anionic theory [1] [2] [3] the vacuum is given by one while the anyon itself is given by $1/\phi$. It is not difficult to see the relation between anyon theory vacuum and our empty set on the one side and the anyons and our zero set on the other [6] [7] [8] [9]. They differ in magnitude but not in principle while not forgetting for one minute that one is four dimensional and the other is two dimensional. Proceeding formally as in the previous section, we can calculate a volume analogous to that of Equation (3) which turned out to be $\phi^5 + 5\phi^2 = 2$ [6] [7] [8] [9]. This time the contribution of the anyon would be the dominant one, namely

$$\begin{aligned}V(a) &= (2)(1/\phi) \\ &= 2(1 + \phi) \\ &= 2 + 1 + \phi^3 \\ &= 3 + \phi^3\end{aligned}\tag{10}$$

On the other hand, the contribution of the anyon vacuum is given by the simple self explanatory equation

$$\begin{aligned}V(v) &= (2)(1) \\ &= 2\end{aligned}\tag{11}$$

The total is thus

$$\begin{aligned}
 V &= 3 + \phi^3 + 2 \\
 &= 5 + \phi^3
 \end{aligned}
 \tag{12}$$

The corresponding Einstein maximal energy is therefore [6] [7] [8] [9]

$$\begin{aligned}
 E &= \left(\frac{5 + \phi^3}{5 + \phi^3} \right) mc^2 \\
 &= mc^2
 \end{aligned}
 \tag{13}$$

Dissecting $5 + \phi^3$ into the smooth (integer) part, *i.e.* 5 and the irrational transfinite fractal portion ϕ^3 which together form a self affine or a self similar fractal Kaluza-Klein spacetime dimension we may write [6] [7] [8] [9]

$$E = \left(\frac{\phi^3}{5 + \phi^3} + \frac{5}{5 + \phi^3} \right) mc^2
 \tag{14}$$

The reader may attest for himself that $(\phi^3)/(5 + \phi^3)$ and $5/(5 + \phi^3)$ are nothing but exactly the same ordinary and dark cosmic energy densities which we found earlier on in numerous previous publications [6] [7] [8] [9]. They were given by [6] [7] [8] [9]

$$\begin{aligned}
 \gamma(O) &= \frac{\phi^3}{5 + \phi^3} \\
 &= \phi^5/2
 \end{aligned}
 \tag{15}$$

and

$$\begin{aligned}
 \gamma(D) &= \frac{5}{5 + \phi^3} \\
 &= 5\phi^2/2
 \end{aligned}
 \tag{16}$$

exactly as should be [6] [7] [8] [9]. We note on passing the important fact that summing all the four dimensions of the 4-D fusion algebra [7] [9] also leads to the same Kaluza-Klein dimension result, namely

$$\begin{aligned}
 d(1) + d(\epsilon) + d(x) + d(\beta) &= 1 + 1 + 1/\phi + 1/\phi \\
 &= 2 + 3 = \phi^3 \\
 &= 5 + \phi^3
 \end{aligned}
 \tag{17}$$

3. Conclusion

It is more than gratifying and less than exhilarating to find that the profound anyons theory [1] [2] [3] gives the same results that E-infinity theory gives for the central major problem of quantum cosmology, namely that of the supposedly missing dark energy. In short, this was labelled “missing” dark energy, because seemingly accurate measurements found only 4.5% of the energy which was expected to be found [6] [7] [8] [9]. In a nutshell, the present analysis on its own and more so as a confirmation of previous analysis should dispel for ever any lurking doubt about the correctness of our result for the various cosmological energy densities [6] [7] [8] [9]. Furthermore, because the present computation relies on and connects so many diverse fields of physics and cosmology,

such as a topological quantum field theory, M-theory, sub-factors, E-infinity theory, anyons and the golden mean number system, it is fair to say that the end result may be viewed at a minimum as a partial unification of physics and quantum cosmology. On the other hand, the golden mean as a number system features everywhere in our analysis at key strategic points that we are inclined to say that this system is more than just numbers and may well be the mathematical language chosen by nature. In this connection, we may recommend to the interested reader two popular science videos by F. Wilczek [10] and the present author [11] on this and related issues.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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