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From Witten's 462 Supercharges of 5-D Branes in Eleven Dimensions to the 95.5 Percent Cosmic Dark Energy Density behind the Accelerated Expansion of the Universe

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Abstract

The measured 95.5% dark energy density of the cosmos presumed to be behind the observed accelerated cosmic expansion is determined theoretically based upon Witten's five branes in eleven dimensions theory. We show that the said dark energy density is easily found from the ratio of the 462 states of the five dimensional Branes to the total number of states, namely 528 minus the 44 degrees of freedom of the vacuum, *i.e.* $\gamma(D)=(462)/(528-44)=462/484=21/22\simeq 95\%$, almost exactly as found in WMAP and Type 1a supernova measurements.

Keywords

Number Theory, Witten Branes, Dark Energy, Superstrings Cosmic Expansion, Type 1a Supernova, E-Infinity, Exceptional Lie Symmetry Groups

1. Introduction

The relation between extra space dimensions on one side and compactification and dark energy on the other side is in the meantime quite reasonably understood [1]-[15]. In the present paper we argue that from the 528 quantum states of Witten's 5-D brane in eleven dimensional [1]-[11] there are 462 five dimensional branes compactified out of "vision" and are therefore basically the source of the mysterious phenomenon of dark energy which the mainstream consider to be the driving force behind the surprising effect of accelerated cosmic expansion [12]-[14]. In other words, it must be possible to derive from Witten's theory the 95.5% of the inferred dark

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energy density as confirmed with the accurate COBE, WMAP and Type 1a supernova measurements and observations. These painstakingly accurate measurements were incidentally rewarded with the 2011 Nobel Prize for Physics or Cosmology [12]-[14] [16]. This is the subject and aim of the present paper which links in a fundamental way high energy physics [1]-[11] and dark energy cosmology [12]-[18] with number theory [19]-[26].

2. Dark Energy from Witten's Brane Theory

Let us start from the fact that we can look at a super symmetric compactified bosonic sector of a bosonic E-infinity Cantorian spacetime [8] [9] [12] [17] [18] as being $(26+k)-4$ that means a Venezian space minus a four dimensional Einstein space $D = 4$ and another $(26+k)-5$ for a Kaluza-Klein space. To combine both space, *i.e.* the one without electromagnetism ($D = 4$) and the one with electromagnetism ($D = 5$), although we could call them the other way around, we have fused all three dimensions combining $D = 4$ with $D = 5$ as well as $D = 26 + k$ [17] [18] to Forman equivalent transfinite supercharge [2] [3] [9]

$$\left(\Gamma^{MNPQR}C\right)_{\alpha\beta} Z_{MNPQR} = \left[(26+k)-4\right]\left[(26+k)-5\right] = 469.7871377 \tag{1}$$

Now if we look at the familiar integer form with [2]-[5]

$$\left(\Gamma^{MNPQR}C\right)_{\alpha\beta} Z_{MNPQR} = (26-4)(25-5) = (22)(21) = 462 \tag{2}$$

then we notice that [2] [3] [9] [10] [13]

$$462 = \binom{11}{5} \tag{3}$$

is the fundamental crucial part in Witten's 5-brane in eleven dimensions model [2]-[5]

$$\binom{11}{1} + \binom{11}{2} + \binom{11}{5} = 528 \tag{4}$$

Said differently we find that

$$\binom{11}{5} = 528 - \left[\binom{11}{1} + \binom{11}{2}\right] = 528 - 66 = 462 = (22)(21) \tag{5}$$

On the other hand we see clearly that to obtain |E8E8| dimensionality which is equal to 496 or the accurate transfinitely corrected value $496 - k^2$ we need in the cases of (22) (21) to add 34 to obtain [1]-[3] [10] [13]

$$(22)(21) + 34 = 496 = |E8E8| \tag{6}$$

while in the exact transfinite case we have the neat, simple result of the transfinite supercharge added to our transfinite bosonic space [2]-[5]

$$(22+k)(21+k) + [26+k] = 496 - k^2 = |E8E8| = \underline{\underline{495.9674775}} \tag{7}$$

In other words our |E8E8| is made of two parts. The obvious part is the bosonic space $26 + k$ and the second part is $(22 + k)(21 + k)$ which is actually a transfinite five brane part corresponding to the integer part [1]-[3] [10] [13]

$$\binom{11}{5} = 462 \tag{8}$$

of Witten's model [2] [3] [9]. This leads us to suspect that we could obtain the dark energy Lorentzian-like factor $\gamma(O)$ *i.e.* the dark energy density in the following way

$$\begin{aligned} \gamma(O) &= \frac{(22+k)(21+k)}{|E8E8|_c - (D=4)} = \frac{(22+k)(21+k)}{492 = k^2} = \frac{(22+k)(21+k)}{\left(\sqrt{492-k^2}\right)^2} \\ &= \frac{21+k}{22+k} = 95.49150281\% \end{aligned} \tag{9}$$

This is the exact result as confirmed not only using many other analysis but also with accurate measurements [16]. We conclude that Witten's model is a reality and leads to the conclusion that dark energy density is a five brane energy and our universe is really a 5 dimensional universe with $N_K^{(32)} \simeq 528$ and E8E8 symmetry with 496 dimensions. These are all consistent facts and results. In other words our work is a sweeping confirmation of Witten's theory as well as E8E8 theory of Green, Gross, Schwarz and the string revolutionary team. The confirmation of superstrings and brane theory comes this time in an experimental laboratory called the entire universe and all of that is tied with $E = mc^2 = mc^2/22 + mc^2(21/22)$. It is simply magnificent.

We could argue the present case in a different way which makes the concept and analysis much easier as we show next:

Since $\binom{11}{5} = 462$ is our higher dimensional object [2] [3] [9] [10], they are truly compactified and a candidate for the dark energy sector in the universe. The total number of "objects", *i.e.* quantum states on the other hand is 528 in the same Witten's model so that the ratio of $\binom{11}{5}$ to 528 minus the vacuum in the case of $d = 11$ which is 44 would give us the density of the dark energy, *i.e.* $\gamma(D)$. That way we have [12]-[14]

$$\gamma(D) = \frac{\binom{11}{5}}{528-44} = \frac{462}{484} = \frac{(21)(22)}{(22)^2} = \frac{21}{22} \tag{10}$$

as should be. For the ordinary energy part the analysis is then trivial and leads to the obvious result that $\gamma(O)$ of ordinary energy must be [12]-[14]

$$\gamma(O) = 1 - \gamma(D) = 1 - \frac{(21)(22)}{(22)^2} = \frac{22-21}{22} = \frac{1}{22} \tag{11}$$

To obtain $\gamma(O)$ directly we have to use again the non-used part in deriving $E = mc^2$, namely $26 - 4 = 22$ and consequently [12]-[14]

$$\gamma(O) = \frac{26-4}{528-44} = \frac{22}{(22)^2} = \frac{1}{22} \tag{12}$$

Note that using the dissection of Witten's super translation algebra we find [2] [3] [9] [10]

$$D = K_{11}^{(32)} = \binom{11}{1} + \binom{11}{2} + \binom{11}{5} = 11 + 55 + 462 = 528 \tag{13}$$

It is not easily done to move to $\gamma(O)$ in an obvious way because we have a Witten-Duff equivalent supercharge decomposition of E8E8 as [2]-[5]

$$|E8E8| = \binom{11}{0} + \binom{11}{3} + \binom{11}{4} = 1 + 165 + 330 = 496 \tag{14}$$

missing which added to 528 gives a global supercharge-like value amounting to

$$528 + 496 = 1024 = (2)^{11-1} = (2)^{10} = 1024 \tag{15}$$

The best dissection in this case is to resort to the E-line of exceptional Lie symmetry groups where we have [19] [20]

$$E8 + E7 + E6 + |E5 = SO(10)| = 248 + 133 + 78 + 45 = 459 + 45 = 504 \tag{16}$$

and

$$504 + |SU(5)| = 504 + 24 = 528 \tag{17}$$

Here SU(5) of grand unification is nothing but E4. We see here that the smallest *Ei* is $|E4 = SU(5)| = 24$

and that is what we used to find $\gamma(O)$

$$\gamma(O)=\frac{\min|E|=24\approx(\text{unification group})}{528}=\frac{24}{(24)(22)}=\frac{1}{22} \tag{18}$$

Note also that $24=26-\text{Einstein vacuum}=26-2=24$.

Thus $\gamma(O)$ is not a brane value but rather a symmetry value connected to

Symmetry $\rightarrow$ symmetry breaking $\rightarrow$ pre quantum particle.

The manifold $26-2=24$ is extremely important for real energy and it turns out that dark energy is simply [12]-[14]

$$\frac{528-24}{528}=\frac{504}{528}=\frac{(21)(24)}{(22)(24)}=\frac{21}{22} \tag{19}$$

which is the exact value.

3. The Vital Role of Number Theory in Physics

Now is this a trial and error solution? The answer is no. Then the next logical question is how could one recognize the meaning of all of these numbers? The answer is because we know the answer from so many other different exact solutions. One could then retort sharply by saying that this is then more or less numerology, is it not? The answer to this crucial question is a definite no because if 90 percent of all the exact answers in high energy physics are found using numerology, then either this word numerology should be a misnomer and the correct name is number theory [21]-[26] or all theoretical physicists should forget the rest and engage themselves exclusively with numerology and elevate the word from a devaluation scorning word to a respectable and in this case highly effective method to come to exact results in agreement with experiments and cosmic observations. Numbers are not just arbitrary things to do calculation with, they are probably the most basic things of nature and interact together following laws and theorems, some well known and some not yet discovered in the exact science of number theory applied to real world physics [21]-[26].

4. Discussion and Conclusion

Dark energy, unlike ordinary energy, can be interpreted as caused by the five branes in eleven dimensions of Witten's well known model with a total number of quantum states equal to the number of killing vector fields with $n=32$ which is given by [3]-[11]

$$N_{11}^{(32)}=(32)(32+1)/2=\binom{11}{1}+\binom{11}{2}+\binom{11}{5}=11+55+462=528 \tag{20}$$

Similarly this could be found from the E-line of exceptional Lie symmetry groups [19] [20].

$$\begin{aligned}&|E8|+|E7|+|E6|+|E5=SO(10)|=248+133+78+45=504,\\&504+|E4=SU(4)|=504+24=528\end{aligned} \tag{21}$$

These results are subsequently used to express the density of dark energy and ordinary energy of the cosmos in an unheard of simple way. The analysis is easily confirmed via a simple vacuum degrees of freedom analysis as follows:

Since $E=mc^2$ is based on $D=4$ Einstein's space we have only two degrees of freedom vacuum or pure energy given by

$$D(\text{vacuum})=n(n-3)/2=4/2=2 \tag{22}$$

On the other hand Witten's M-theory with $D=11$ has a far more comprehensive fully fledged vacuum with $D=11(11-3)/2=44$ degrees of freedom. Consequently our $\gamma(O)$ density or Lorentz parameter is given by the ratio of the Einstein vacuum to Witten's vacuum [13] [14]

$$\gamma(O)=\frac{2}{44}=\frac{1}{22} \tag{23}$$

validating $E(O) = mc^2/22$ and therefore it follows that $E(D) = 1 - E(O) = (1 - 1/22)mc^2 = mc^2(21/22)$ exactly as found here.

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