On correlations between fundamental constants and cosmological parameters

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Abstract:

Fundamental constants such as Fine structure constant, Gravitational constant, Elementary charge and Speed of light seems to bear odd correlations to present cosmological parameters such as the age of the universe, the temperature of the Cosmic Microwave Background radiation and Angular velocity of earth. Which is currently not explainable and could lead to greater insights about the nature of the constants themselves and to the cosmological theories which they are derived from.

1. Introduction:

Anyone interested in the nature of things around us would be obsessed with the meaning of the constants of nature, in particular the Fine-structure constant (α). Since certain constants, such α, mass or charge of the elementary particles are currently not directly deducible from first principles, seeking clues for their values could enhance our theoretical understanding significantly. With the advancement in technology, which hard working cosmologists have put to great use and has provided us with more data and accurate measurements of parameters related to Cosmic Microwave Background radiation and age of the Universe. Armed with all the facts of older and recent discoveries we will explore certain simple yet remarkable numerical correlations which are quite difficult to explain why they seems to be related at all. For the nature of the enquires that follows tolerances of values are not necessarily crucial, once could understand it from a rudimentary point of view.

2. Constants and Correlations:

1. The fine structure constant α is $7.2973525664\ 10^{-3}$, is a dimensionless number. Its inverse α^{-1} is approximately 137.036. Current age of the universe T_U is approximately $13.7\ 10^9$ years. One can notice a correlation between these two quantities which is quite striking in multitude of ways. One could say that this is a mere coincidence, after all the age of the universe is not a constant and conclude that they are not at all connected, but then one is forced to agree that it is quite peculiar that we happen to exist and measure the age of the universe right around the time it happened to have the value which closely resembles the α^{-1}. Or one could say that they could be connected in that case one should produce a reasonable argument as to what the connection could be.
2. The rotational angular velocity of earth is $7.29212351\ 10^{-5}$ rad/s. Its inverse is about $137.1342655\ 10^2$ s/rad. One could immediately notice similarity of the value to the previous values of α and T_U despite the differences over three significant digits. One can only wonder how it could possibly be connected to the two quantities, ideally there is no reason to expect any correlation whatsoever, but still numerically they seem to agree quite well up to three significant digits, which is extremely bizarre if we think about the nature of the quantities. Is it not odd that we happen to live on a planet which happens to have a particular rotation rate which has some strange correlation to a universal constant and present age of the universe ?. Also since the true nature of the α is still not completely

understood, it could be possible that it is related to the angular velocity of the earth somehow.

3. If we consider the ratio of square root of the gravitational constant to the speed of light $\sqrt{G}/c$ it happens to be $2.7250533\ 10^{-14}\ m^{1/2}\ kg^{-1/2}$. Interestingly enough the measured temperature of the cosmic microwave background radiation happens to be 2.72548 ± 0.00057 K. There is absolutely no reason to expect that these disparate physical quantities are numerically correlated. It must be mentioned that such direct correlation could also happen at multiples of ten of the CMB temperature, it would be difficult to make sense of why that would happen, regardless of that it could be worthwhile exploring why we live in a really special time when we happen to see this intriguing coincidence.
4. Another odd thing about the CMB is that, Spectral radiance of the CMB radiation at the present temperature of 2.725 K expressed in terms of frequency of radiation $dE_\nu/d\nu$ peaks at 160.22 GHz. The charge of an electron is $1.6021766208\ 10^{-19}$ C. Once again there is a strange correlation between a particular value associated with the CMB and a fundamental constant of nature.
5. The mass of the Higgs Boson M_H is routinely measured to be in the range of 125-126 GeV/c^2. The numerical quantity 4π can be approximated as 12.566371. Maybe this also is an extreme coincidence, or it could mean something theoretically. If one thinks about it the only other constant that naturally comes close to this value is the magnetic permeability of free space μ_0.

3. Conclusion:

I believe all these coincidences are worth investigating from a theoretical point of view. One could argue that these are not necessarily perfect correlations to a significant degree, but that is beside the point because it might be possible to explain the deviations. I wish I could do it myself, but unfortunately, I am not a trained physicist and I do not know how long it would take me to understand the theories so that I could try to explore the reasons for these strange values. I do have some vague notions as to why these could possibly occur, but it would be just pointless speculation without formal mathematical analysis. So, the reason I am writing this paper is to bring these to the attention of as many physicists as possible who would be interested in investigating them.

Clues for improving our theoretical understanding can be gained from these and there are motivating factors as follows. For example, if at all α is connected to the rotation of the earth, we can ask questions like would we measure the same values of the constants if the earth were spinning at much larger angular velocity ?, Would life arise on earth in that case ?, How would the universe look like when observed from such fast-spinning planet ?, How would matter interact with the vacuum or incoming photons ?, maybe it could provide insights about the *Anthropic principle* or about the '*Axis of Evil*' anomaly. More importantly since fine structure constant is defined by other constants, it could mean that some or all of them might not be constants at all and could vary from region to region. Theories like Inflationary cosmology predict that there should be multiple universes with different constants in each of them, if it is possible to show that constants do vary, then they may not be different universes, rather different patches of the same universe. Points 3,4 are particularly interesting because they could be related to the nature of the

extra dimension (fourth spatial dimension) in Kaluza-Klein theory. It could also help resolve the current differences in the measurement of the *Hubble Constant* H_0 using different methods.