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Selfvariations Vs Standard Cosmological Model using as Criterion the Cosmological Data

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Abstract- We compare the Standard Cosmological Model with the Model of the Selfvariations, based upon the cosmological data as we collect them since the time of Hubble. We selected to examine the 14 most fundamental pieces of data. The Standard Cosmological Model can justify four of these, it can justify two additional with some further assumptions, while it cannot justify the remaining eight. The Cosmological Model of the Selfvariations justifies eleven, while the completeness of justification of the remaining two is a matter of further investigation. We did not identify any piece of cosmological data that contradicts the predictions of the Model of the Selfvariations.

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Strictly as per the compliance and regulations of :

Selfvariations Vs Standard Cosmological Model using as Criterion the Cosmological Data

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I. Introduction

The Standard Cosmological Model prevailed over other models mostly because it justifies the redshift of distant astronomical objects, the Cosmic Microwave Background Radiation, and the nucleosynthesis of the elements. This success of the model, attenuated the strictness of the scientific community resulting in the introduction of many hypotheses into the model in an attempt to justify the ever increasing amount of cosmological data, ranging from the hypothesis of Cosmic Inflation in the 1980's, up to the most recent hypothesis of Dark Matter to justify the increased luminosity distances of type Ia supernovae. At the same time, many similar cosmological models were developed, which, at their core, justified the redshift by the expansion of the Universe. Finally we came to the anisotropies recorded by the Planck satellite, the temperature difference between the Northern and Southern hemisphere of the Universe, the recording of the variation of the fine structure constant, the Sloan Great Wall, and to the extremely large extent of the 73 quasars structure, the Huge-LQC group, which was recently observed. These recent data are in complete opposition to the Standard Cosmological Model. The same holds for the luminosity distances of type Ia supernova. The Dark Energy hypothesis momentarily justifies these distances by alluding to a Universe that expands at an accelerating rate. But in combination with the fact that we know, from successive measurements by the COBE, WMAP and Planck satellites, that the Universe is flat, there arises an insurmountable problem: the time required for the electromagnetic radiation we observe from astronomical objects with a redshift $z>1$ to reach the Earth, is greater than the age of the Universe predicted by the Standard Cosmological Model.

The correlation of redshift with the distance of far distant astronomical objects, as conducted by Edwin Hubble at the begin of the past century, leads to a certain conclusion: one, or more physical quantities from these considered as constant, vary within the universe. To SCM justifies the redshift with macroscopic causes via the expansion of the universe. However the redshift can be perfectly justified with microscopic causes. From a slight continuous increase of the rest mass and a slight continuous increase/ decrease of the electric charge of material particles. This increase/ decrease is expressed by the law of selfvariations.

Actually Hubble himself had serious doubts about the interpretation of reshifts as 'recession' velocities. As expressed by Hubble and Humason in the most influential paper [1,2]:

"The interpretation of redshifts as actual velocities, however, does not command the same confidence, and the term 'velocity' will be used for the present in the sense of 'apparent' velocity, without prejudice as to its ultimate significance… The writers are constrained to describe the 'apparent velocities – displacements' without venturing on the interpretation and its cosmological significance."

According to Allan Sandage [3]:

"Hubble believed that his count data gave a more reasonable result concerning spatial curvature if the redshift correction was made assuming *no recession.* To the very end of his writings he maintained this position, favouring (or at the very least keeping open) the model where no true expansion exists, and therefore that the redshift *"represents a hitherto unrecognized principle of nature"."*

The model of selfvariations predicts and justifies all of the cosmological data. Some of the predictions of the model demand further investigation as to their completeness, which is natural for a new model. There is no cosmological observation that contradicts the predictions of the model. Essentially, the totality of cosmological data is contained as information in a single equation for the rest mass of material particles and an analogous equation for the electric charge that express the law of selfvariations in the macrocosm. The consequences of the selfvariations at the scale of the

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Universe, are recorded in the most direct way in the cosmological data.

The redshift and the increased distance brightnesses of distant astronomical objects, the microwave background radiation and the flatness of the universe are mainly due to the selfvariation of the rest mass and less to that of the of the electric charge. The fluctuations of the CMBR temperature and the fine structure parameter, the temperature difference of the northern and southern hemispheres of the universe and the absence of antimatter in the universe are solely due to the selfvariation of the electric charge. The Dark Matter relates both to the selfvariation of the electrical charge and the original form of the universe.

In the distant past, the equations predict that the original form of the universe differs only minimally from the vacuum. The ionization energy of atoms and the synthesizing energy of nucleons tend to zero as we go backwards in time. The universe went through a phase of ionized atoms when the nucleosynthesis of the elements could be made at temperatures near 0 K.

The law of selfvariations incorporates the arrow of time in the macrocosm and predicts that there is no arrow of time in the microcosm. Starting from a situation that differed only minimally from the vacuum the universe has evolved over the years because of the selfvariations, to the form we observe today. Nevetheless the universe remains consistent with its origin since at every stage of its evolution, at any time, the total energy content is zero. The law of the selfvariations expresses the unique relationship between matter and vacuum .

The equations of the model of the selfvariations allow us to go back in time as far as we want. The period considered as the age of the universe by the SCM is only the recent time period where matter has taken the form we observe today. According to the law of the selfvariations, beyond the limits of the universe we observe today there is no Big Bang, but an immense period of time evolution of the universe. This evolution is determined by the selfvariations.

II. The Fundamental Cosmological Data and the Predictions of the Two Models

We list the main cosmological data and the corresponding prediction of each model.

a) The redshift of distant astronomical objects

The Standard Cosmological Model justifies the redshift macroscopically, as a result of the expansion [4] of the Universe. On the contrary, in the model of selfvariations the redshift results from microscopic causes, as a consequence of the decrease of the rest masses of material particles [5, 6] at distant astronomical objects.

b) The Cosmic Microwave Background Radiation

The Standard Cosmological Model predicts the Cosmic Microwave Background Radiation as a remnant of the Big Bang [7]. The Model of the selfvariations predicts the Cosmic Microwave Background Radiation as the consequence of the enormous, theoretically infinite, values of the Thomson and Klein-Nishina scattering coefficients in the very early Universe. The enormous values of the scattering coefficients render the very early Universe opaque at a temperature close to OK [5, 6].

c) The increased luminosity distances of type Ia supernovae

In order to justify the increased luminosity distances of type Ia supernovae, the Standard Cosmological Model has to introduce further hypotheses, such as the one of dark energy [8, 9]. Knowing from observational data that the Universe is flat, the great distances measured for these supernovae constitute an insurmountable problem for the Standard Cosmological Model, as we shall see in the following subparagraph d.

In the model of the selfvariations the luminosity distances are predicted to be greater than the real distances for all distant astronomical objects. Because of the selfvariations, the energy generated by fusion, and by any conversion of rest mass into energy, is less at distant astronomical objects compared to the corresponding laboratory amount. The mass of distant supernovae is smaller than the mass of the prototype "standard candle" supernova. After performing the relevant calculations we obtain the correct relation between the luminosity distance and the redshift of astronomical objects [5, 6].

The model of the selfvariations predicts that at distant astronomical objects, the degree of opacity of the stellar surfaces increases, but at the same time the degree of atomic ionization also increases. These two factors affect the luminosity of distant astronomical objects for large values of the redshift z. It is important that for small values of the redshift, where we only measure the consequences of the selfvariation of the rest masses, the prediction of the law of the selfvariations is exactly confirmed.

d) The Flatness of the Universe

The COBE, WMAP and Planck satellites have successively confirmed that the Universe is flat. Since the Universe is flat for the time interval $T(z)$ required for the electromagnetic radiation to reach Earth from a distant astronomical object with redshift z, it holds that [5].

$$T(z) > \frac{z}{H}\ .$$

For $z > 1$ we get $T(z) > \frac{1}{H}$, that is, the time interval $T(z)$ is greater than the age of the Universe predicted by the Standard Cosmological Model. The problem created by the combination of the flatness of the Universe and the increased luminosity distances of the supernovae, for the time interval $T(z)$, has been completely silenced. Since the Universe is flat, the hypothesis of Dark Energy is not enough to render the supernovae luminosity distances compatible with the Standard Cosmological Model. We remind that the initial measurements [8, 9] were conducted in order to confirm that the luminosity distances are smaller than those given by Hubble's law, since that was predicted by the Standard Cosmological Model. To this insurmountable problem for the Standard Model we have to add the case of star HD140283, which seems to have an age greater than the age of the Universe [10]. We come to the conclusion, mainly because of the first reason, that the Standard Cosmological Model is not in accordance with the observed flatness of the Universe.

The model of the selfvariations predicts that the total energy content of the Universe is zero and, therefore, the Universe is flat.

e) The Nucleosynthesis of the Chemical Elements

The Standard Cosmological Model predicts the nucleosynthesis of the chemical elements [11]. The very high temperatures in the very early Universe result in the decomposition of particles into their partial, constituent particles. As the Universe expands and cools, the phases of nucleosynthesis are predicted in detail.

The model of the selfvariations predicts [5, 6] that the binding energies of elementary particles for the formation of complex particles decrease at distant astronomical objects down to the value $\Delta m_0 c^2 (1-A)$. Regarding parameter we know that $A \to 1^-$, while $\Delta m_0 c^2$ is the laboratory value of the binding energy. Therefore, nucleosynthesis can take place at very low temperatures, close to $0K$, which are predicted by the model in the very early Universe.

Nucleosynthesis can take place in two distinctly different phases during the evolution of the Universe, as predicted by the model of the selfvariations: in the very early Universe, at a temperature close to 0K, but also during the accumulation of matter for the formation of the large scale structures in the Universe. The decreased binding energies of the material particles during the phase of accumulation of matter allow for the nucleosynthesis of heavy elements at temperatures at which, until today, nucleosynthesis was considered impossible. Thus, we can justify the existence of heavy elements in the Sun and other stars.

The model predicts that with the passage of time the selfvariations strengthen the binding energies of the particles, resulting in the enormous cohesion energies we measure in the laboratory today. The model is self-consistent, but a complete study is demanded as far as the completeness of the prediction is concerned.

f) The ionization of atoms in the very early Universe

The Standard Cosmological Model predicts that the Universe underwent a phase of atomic ionization [4], because of the high temperatures after the Big Bang.

The model of the selfvariations predicts [5, 6] a decrease in the values of atomic ionization energies at distant astronomical objects, down to value $X_n(1-A)$, where X_n is the laboratory value of the ionization energy of an atom. Taking into consideration that $A \to 1^-$, the ionization of atoms in the very early Universe follows.

g) The Sloan Great Wall

During the recent measurements for the large - scale structures of matter in the Universe, the Sloan Digital Sky Survey [12] recorded huge structures of matter followed by enormous voids. The largest recorded structure, the Sloan Great Wall, spans a length of $1.38 \times 10^9\ ly$, while it is estimated that its formation requires about $80 \times 10^9\ yr$. The size of the Sloan Great Wall introduces an issue of anisotropy of the Universe for the Standard Cosmological Model. Furthermore, the time needed for its formation exceeds the age of the Universe predicted by the model.

The equations of the model of the selfvariations are compatible with the condition $r \to \infty$ [5, 6], which means that we can go back in time as much as we want. Therefore, the size, and the time interval needed for the formation of the Sloan Great Wall, are compatible with the model of the selfvariations.

h) The Variation of the Fine Structure Constant

In the Standard Cosmological Model the fine structure constant has to actually be constant. As we have already mentioned, the Standard Cosmological Model explains the main cosmological data based on macroscopic and not microscopic causes.

The cosmological model of the selfvariations predicts a slight variation of the electric charge [5, 6]. Indeed, this variation can take place in two directions, either towards the increase, or towards the decrease of the absolute value of the electric charge. This potential for the evolution of the selfvariation of the electric charge in two directions is due to the fact that the electric charge exists in the Universe in the form of pairs of opposite quantities. Such a potential does not exist for the rest mass, which evolves only the direction of increase. The fine structure constant depends on the electric charge and is, therefore, affected by the selfvariations.

Recent measurements [13-27] have recorded a slight variation of the fine structure constant. Indeed, the measurements have shown that in the Northern hemisphere of the sky the fine structure constant had in the past a smaller than laboratory value, and in the Southern hemisphere a greater one. The Standard Cosmological Model cannot explain such results, while they don't pose a problem for the model of the selfvariations.

i) The Temperature Difference between the North and the South Hemisphere of the Universe

Recently, the Planck satellite confirmed the initial measurements of WMAP, according to which the temperature of the Northern hemisphere of the Universe is slightly lower than the temperature of the Southern hemisphere. According to the Standard Cosmological Model this temperature difference should not exist.

The difference in the value of the fine structure constant between the two hemispheres, as we already mentioned in the previous subparagraph, is due to the difference in the value of the electric charge [5, 6]. This difference in the electric charge is responsible also for the difference in temperature between the two hemispheres of the Universe. In the regions of the Universe where we measure a smaller fine structure constant, therefore a smaller value of the electric charge, it is predicted that the Universe will have a lower temperature [28]. We propose the measurement of the value of the fine structure constant in the direction of the cold spot identified by the Planck satellite in the Northern hemisphere. We predict that the value of the fine structure constant measured along this direction will be smaller than its laboratory value.

j) The Anisotropies in the Distribution of Quasars

The model of the selfvariations predicts an important factor as the main cause of the anisotropies that are already recorded in the observable Universe. According to the model, we only observe a small part [5, 6] of the Universe. The more our observational instruments improve, the more detailed our observations become, the larger the observed anisotropies due to this factor are going to be.

The recent observation [29] of a group of 73 quasars, the Huge-LQC group, which spans a distance of $4\times10^9\ yr$, is just such an anisotropy. The size of this group exceeds by far the limits set by the Standard Cosmological Model. This anisotropy is recorded in the cosmological data exactly because we only observe a small part of the Universe. According to the Model of the Selfvariations, the Universe is isotropic at larger distances, far larger than the part of the Universe we observe today.

k) Dark Matter

The existence of Dark Matter is known since the beginning of the last century from its contribution to the cohesion of galaxies. However, recent measurements [30] by modern, improved observational instruments have shown that Dark Matter does not behave as expected based on the Standard Cosmological Model. Of course we could, to some degree, assume that the observations are not problematic for the model, but expose our ignorance about the nature of Dark Matter.

The Model of the Selfvariations predicts that in the initial phase of the evolution of the Universe, part of the matter accumulates and creates the large-scale structures of the Universe at high temperatures. The rest of the matter remains permanently [5, 6] at a temperature close to $0K$. The different conditions in which the selfvariations evolve, could lead to the creation of particles with different properties. Additionally the equations of the model predict that the antimatter which existed in the early universe is converted to Dark Matter particles with the passage of time. Of course, further investigation is necessary, in order to evaluate the completeness of the prediction.

l) The temperature fluctuations of the CMBR

The SCM can only make some assumptions about the causes of fluctuations in the CMBR. It cannot provide a clear theoretical prediction.

The model of the selfvariations in detail provides for the temperature fluctuations in the CMBR with accurate theoretical predictions [6]. This is a consequence of the selfvariation of the electric charge.

m) The absence of antimatter in the universe.

The SCM can not justify the absence of antimatter in the universe. The quantity of matter and antimatter should be equal.

The model of the selfvariations predicts that over time antimatter is converted to neutral particles of Dark Matter. This is a consequence of the evolution of the selfvariation of the electric charge [6].

n) The Horizon problem

From the observational data we know that different regions of the universe located billions of light years from each other have interacted in the past. This fact is referred in Cosmology as the "Horizon problem".

In order to solve the Horizon problem, the hypothesis of cosmic inflation is introduced into Standard Cosmological Model (SCM), according to which the universe expands exponentially during a tiny fraction of a second just after the Bing Bang. With this hypothesis the SCM justifies further the flatness of the universe, while it bypasses the fact that immediately after the Bing Bang the universe shall collapse again to a point. During the 1970s we already knew the density of matter of the universe and that the equations of General Theory of Relativity lead to this catastrophic result for the

SCM. Without the cosmic inflationary hypothesis the SCM cannot survive the consequences of the Big Bang.

The equations of the Cosmological Model of the Selfvariations predict that the rest masses, as well as the velocity of material particles tend to vanish towards the very early universe. Therefore the uncertainty of the momentum ΔP of each material particle tends to zero, $\Delta P \to 0$. This in turn implies by the Uncertainty Principle of Heisenberg that the uncertainty of the position of each material particle towards the very early universe tends to infinity, $\Delta x \to \infty$. The early particles tend to occupy the whole extant spacetime which means that the universe literally 'emerges from everywhere'. The consequences from this phase of evolution of the universe are recorded in our times by the observational instruments. The Horizon problem does not arise as 'a problem', within the Cosmological Model of the Selfvariations. The article, with the analytical predictions and the mathematical calculations about this issue, has been accepted for publication in the Journal 'Physics International'. The article also contains additional information such as the dependence of the rest mass and the volume of the white dwarfs and the neutron stars on redshift. Also the redshift decelerates the rate of evolution of certain phenomena, such as the process of excitation and de-excitation of atoms.

III. Discussion

Based on the physical theories of the past century, the only reliable justification of the redshift of the far distant astronomical objects can be accomplished by the expansion of the universe. This had resulted in the SCM. As we go back in time we are leaded towards a singularity of infinite density and temperature. Thus, we are led to the Bing Bang hypothesis. Immediately after the Bing Bang the material particles are completely decomposed to constituent particles, due to the extremely high temperatures. As the universe expands and cools down, the synthesis of particles takes place while the CMBR remains as a remnant.

The improvement of the observational instruments and the accretion of cosmological data for almost a century, led to the introduction of several fundamental hypotheses into the SCM, in order for this model to remain in accordance with the cosmological data. The main hypotheses refer to the introduction of cosmic inflation and Dark Energy. However current cosmological data is not anymore in accordance with the predictions of the SCM. The fine structure parameter variation, the temperature difference between the Northern and the Southern hemispheres of the universe, the estimated immense age of the Sloan Great Wall, the enormous structure of 73 quasars discovered in 2013 and the existence of galaxies in proximity to the Bing Bang, are some examples. There is currently no single hypothesis which can justify these data within the framework of the SCM. If we attempt for example to justify theoretically the fine structure parameter variation, we are led to a theory analogous to the Theory of Selfvariations and finally to the justification of redshift within a static and not within an expanding universe.

During the 1990s the luminosity distances of the Ia supernovae have been measured with the target to verify that these luminosity distances were smaller than those provided by the Hubble law, in accordance to the prediction of the SCM. Today we know that the luminosity distances of the type Ia supernovae are not only larger than those predicted by Hubble's law, but they seemed unrealistic for the framework of the SCM. The difficulty of the introduction of the Dark Energy hypothesis, in order for the SCM to remain in accordance with the available data, can not go unnoticed. This remark does not refer to the researchers who introduced this hypothesis and who have contributed largely and obtained excellent work as pioneers for the exploration of the universe. The origin of the Dark Energy hypothesis lies in the physical theories of the past century and is based on the wrong assumption that these theories have the necessary completeness in order to justify the cosmological data.

There are many reasons which lead to the assumption that the fundamental physical theories of the past century are not complete. We shall refer only to one, the ignorance about the cause of the quantum phenomena. Einstein insisted on this subject up to the end of his life. The Theory of Selfvariations sets the foundations of a common cause for the quantum and the cosmological phenomena. Especially the cosmological data are included as information and are justified by the Law of the Selfvariations on cosmological scales.

The Law of Selfvariations predicts that the state of the very early universe only slightly differs from the state of vacuum at a temperature close to OK. The evolution of the selfvariations with the passage of time leads the universe from its initial state to the state we observe it today. During each phase of evolution, the universe remains consistent with its origin, since its total energy content remains zero. The Law of Selfvariations does not answer to the question posed by Leibniz "why does something exist rather than nothing?". Nevertheless it provides us with the unique relation between matter and the vacuum.

As we go backwards in time, the binding energies of the nucleons, the ionization energies and the excitation energies of the atoms, as well as the gravitational energy are reduced, until they vanish. The material particles are totally decomposed into constituent particles. With the passage of time and the evolution of the selfvariations, the synthesis of particles takes place. The CMBR is predicted to originate from the whole space of the universe i.e. it originates 'from everywhere'.

The Law of Selfvariations justifies the totality of the current cosmological data. As we observe the universe as it was in the past, the consequences of the selfvariations are recorded within the cosmological data. The parameters appearing in Astrophysics, in Thermodynamics and in Quantum Mechanics, as well as the conclusions derived by their propositions, are affected by the selfvariations. It is these consequences that are recorded by the observational instruments in the cosmological data.

IV. Results

The evidence presented in the previous paragraph results in the following table. The table shows a clear superiority of the Cosmological Model of the Selfvariations over the Standard Cosmological Model.

Cosmological Data	Standard Cosmological Model	Cosmological Model of The Selfvariations
Redshift	direct consequence of the expansion of the Universe	direct consequence of the selfvariations
Cosmic Microwave Background Radiation	remnant of the Big Bang	consequence of the enormous values of the Thomson and Klein-Nishina scattering coefficients in the early Universe
increased luminosity distances of type Ia supernova	not in agreement	direct consequence of the selfvariations
flatness of the Universe	not in agreement	the total energy content of the Universe is predicted to be zero, therefore the Universe is flat
nucleosynthesis of the chemical elements	predicted	predicted, further investigation of completeness of the prediction is required
ionization of atoms in the early Universe	predicted as a consequence of the high temperatures after the Big Bang	direct consequence of the selfvariations
size and age of the Sloan Great Wall	not predicted	predicted
variation of the fine structure constant	not predicted	direct consequence of the selfvariation of the electric charge
temperature difference between the Northern and Southern hemisphere of the Universe	not predicted	direct consequence of the selfvariation of the electric charge
anisotropies in the distribution of quasars	not predicted	predicted
Dark Matter	further investigation required, mainly due to recent observations	predicted, further investigation of completeness of the prediction is required
temperature fluctuations of the CMBR	not predicted	direct consequence of the selfvariation of the electric charge
absence of antimatter in the universe	not predicted	direct consequence of the selfvariation of the electric charge
the Horizon problem	the introduction of the inflationary hypothesis is demanded	it is included as information within the equations of the model

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