The Cause of the Increased Luminosity Distances of Supernovae Recorded in the Cosmological Data

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The law of selfvariations quantitatively determines a slight increase of the masses and charges as the common cause of quantum and cosmological phenomena. It predicts and explains the totality of the cosmological data. In this article we present the prediction of the law concerning the increased luminosity distances of distant astronomical objects. The prediction we make is in agreement with the cosmological data for the luminosity distances of type Ia supernovae.

1 Introduction

The science of Physics possesses today a plethora of knowledge that allows us to seek the first principles governing physical reality. We can search for a small number of propositions-axioms that could reproduce the totality of our knowledge in Physics. The theory of selfvariations has emerged along this line of reasoning.

We make two hypotheses: The rest masses and electric charges of the material particles increase slightly with the passage of time (selfvariations), and the consequences of this increase propagate in four-dimensional spacetime with a vanishing arc length. Starting from these two hypotheses we conclude that the selfvariations occur in a strictly defined manner. We call the quantitative mathematical determination of the way in which the selfvariations occur, the law of selfvariations.

The law of selfvariations contains an exceptionally large amount of data and information. It is related to the quantum phenomena, the potential fields, and the cosmological data. With the evidence we have in our disposal, and the mathematical calculations we have performed, we can propose the law of selfvariations as the common cause of quantum phenomena and cosmological data. The consequences of the law of selfvariations extend from the microcosm up to the observations we conduct billions of light years away. Equation

$$\left(m_0 c^2 + ih \frac{\dot{m}_0}{m_0} \right)^{\cdot} = 0,$$

with unique unkown the rest mass m_0 of particles, both contains as physical information, and justifies, the whole corpus of the current cosmological observational data.

Specifically for the cosmological data, the law of selfvariations predicts and justifies: the redshift of distant astronomical objects and Hubble's law, the cosmic microwave background radiation, the large-scale structures of matter in the Universe, the fact that the Universe is flat, the fact that the total energy-content of the Universe is zero, the fact that the very early Universe went through a phase of ionization, the arrow of time in the macrocosm and its breakdown in the microcosm, the fact that the luminosity distances of distant astronomical objects will always be measured larger than the actual distances. It is this last prediction that we present in the current article.

Since the observations of distant astronomical objects correspond to past time, the rest masses of the material particles in these objects are smaller than the corresponding masses we measure in the laboratory, due to the selfvariations. Therefore, the energy resulting from fusion and fission in distant astronomical objects is less than expected. These distant astronomical objects are fuelled with a smaller than expected amount of energy in order to emit the electromagnetic radiation we observe today from Earth. This fact reduces the luminosity of distant astronomical objects.

In the last decade of the previous century two independent research groups under A.G. Riess and S. Perlmutter, measured the decrease of the luminosity for a large number of type Ia supernovae at great distances. In order to explain the observational data within the framework of the standard cosmological model, the hypothesis of dark energy was introduced.

We have today a large amount of observational data confirming the decrease of luminosity at large distances. All these measurements result in a specific diagram correlating the luminosity-distance with the redshift of distant astronomical objects. This diagram, as it results from the cosmological data, is exactly the same with the one predicted theoretically by the law of selfvariations. In the next paragraph we present the diagram that we theoretically predict.

2 The luminosity distances of distant astronomical objects will always be measured greater than their real distances

The law of selfvariations [1, 2] predicts the relation

$$r = \frac{c}{k} \ln \left(\frac{A}{1 - (1+z)(1-A)} \right),$$

between the distance r and the redshift z of distant astronomical objects. For the dimensionless parameter A, it holds that

$A \to 1^-$, since it obeys the inequality

$$\frac{z}{1+z} < A < 1,$$

for every value of the redshift z. The parameter k is constant, and is related to the Hubble parameter H through equation

$$\frac{kA}{1-A} = H.$$

The law of selfvariations predicts that the energy $E(z)$ resulting from fusion, and which powers the distant astronomical objects, is decreased compared with the corresponding energy E measured in the laboratory, according to relation

$$E(z) = \frac{E}{1+z}\,.$$

Because of this, the luminosity of distant astronomical objects is decreased, relative to the expected one. This has as a consequence that the luminosity distances R of distant astronomical objects are measured larger than the actual distances r, $R > r$. From the mathematical calculations [1, 2] we obtain

$$R = r\sqrt{1+z}\,,$$

between the distances R and r.

Combining the previous equations we get the luminosity distance R as a function of the redshift z of distant astronomical objects:

$$R = \frac{cA\sqrt{1+z}}{(1-A)H}\ln\left(\frac{A}{1-(1+z)(1-A)}\right).$$

In the diagram in figure 1 we present the diagram of $R = R(z)$ for $A = 0.975$, $A = 0.990$, $A = 0.995$, $A = 0.999$, $H = 60$ km/s Mpc, $c = 3 \times 10^5$ km/s up to $z = 1.5$. In order to explain the inconsistency of the Standard Cosmological Model with the diagram in figure 1, the existence of dark energy was invented and introduced.

Type Ia supernovae are astronomical objects for which we can measure their luminosity distance for great distances. The measurements already conducted [3, 4] agree with the diagram in figure 1.

In the measurements conducted for the determination of the Hubble parameter H, the consequences of equation $R = r\sqrt{1+z}$ have not been taken into account. For small values of the redshift z, the value $H = 60$ km/s Mpc results. The measurements made up to date, have included astronomical objects with a high redshift z, thus raising the value of parameter H to between 72 and 74 km/s Mpc. Today we perform measurements of very high accuracy. Taking into consideration the consequences of equation $R = r\sqrt{1+z}$, we predict that the value of parameter H will be measured independently of the redshift z of the astronomical object. We, of course, refer to measurements of the parameter H that are based on the luminosity distance of the astronomical objects.

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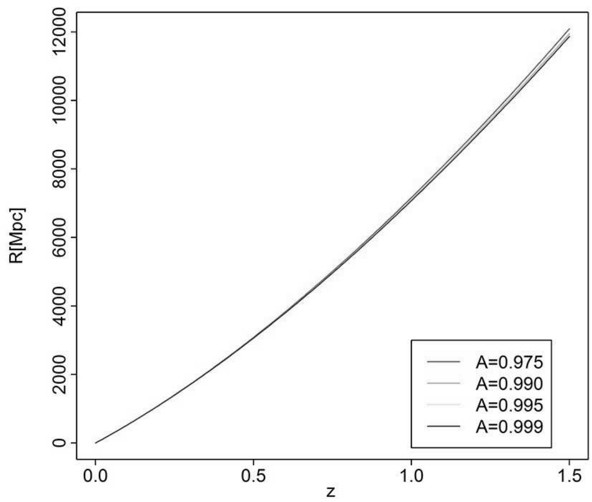

Fig. 1: The diagram of $R = R(z)$ for $A = 0.975$, $A = 0.990$, $A = 0.995$, $A = 0.999$, $H = 60$ km/s Mpc, $c = 3 \times 10^5$ km/s up to $z = 1.5$. The measurement of the luminosity distances of type Ia supernova confirms the theoretical prediction of the law of selfvariations.

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