The Simplest Possible Cosmological Model with Explanation to Dark Energy

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Abstract

In this paper , a new and very simple cosmological model is introduced . It is shown how the model can explain some observations including Habble's law and dark energy and affect our understanding of some concepts .

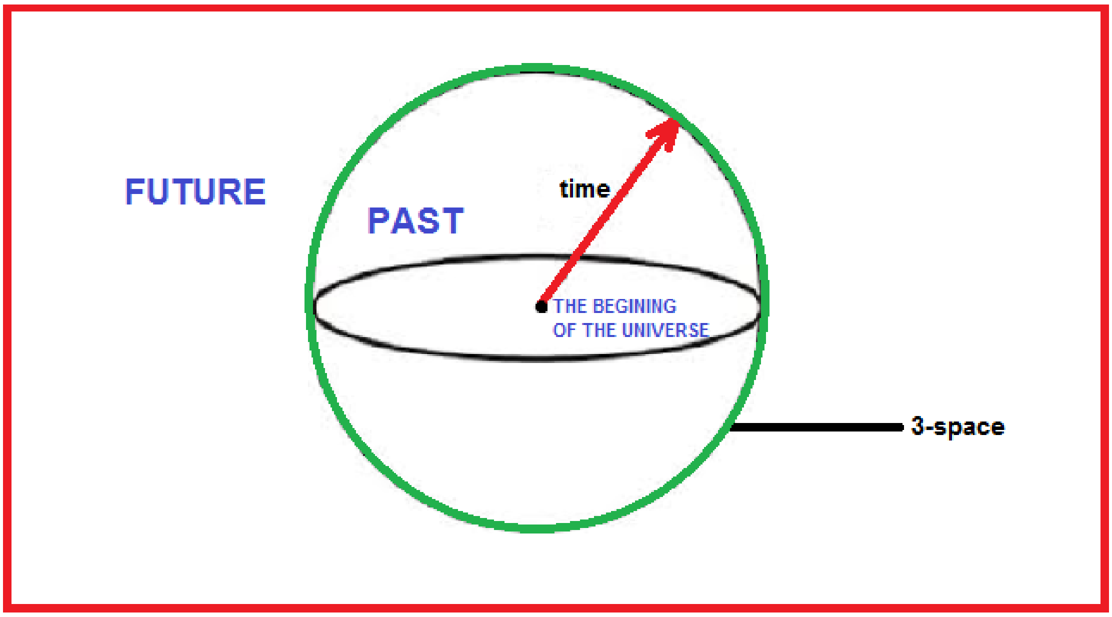
Introduction

The gradual accumulation of information about the large-scale universe produced an increasing desire for a simple and consistent description of the universe as a whole that led to the current standard model of cosmology and many competing models .

The following is a proposed alternative simpler model involving abandoning the global validity of some notions about space-time gained from our local experience.

The Model

According to this model the space-time is a 4-sphere in which the 3-dimensional surface represents the 3-space of the universe and the radius represents the time .

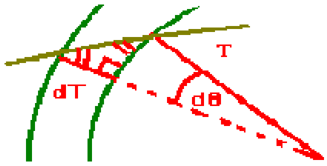


As a result of this relation between the *time* and the *3-space* we have to stop thinking about a single direction of time when we are exploring distances comparable to the radius (age) of the universe .*The idea that the time dimension in any point in the 3-space is the line from the center to that point represents the main feature of this model which distinguishes it from the existing ones*.

Now let us see how this model can be used to understand some facts and explain some observational data :

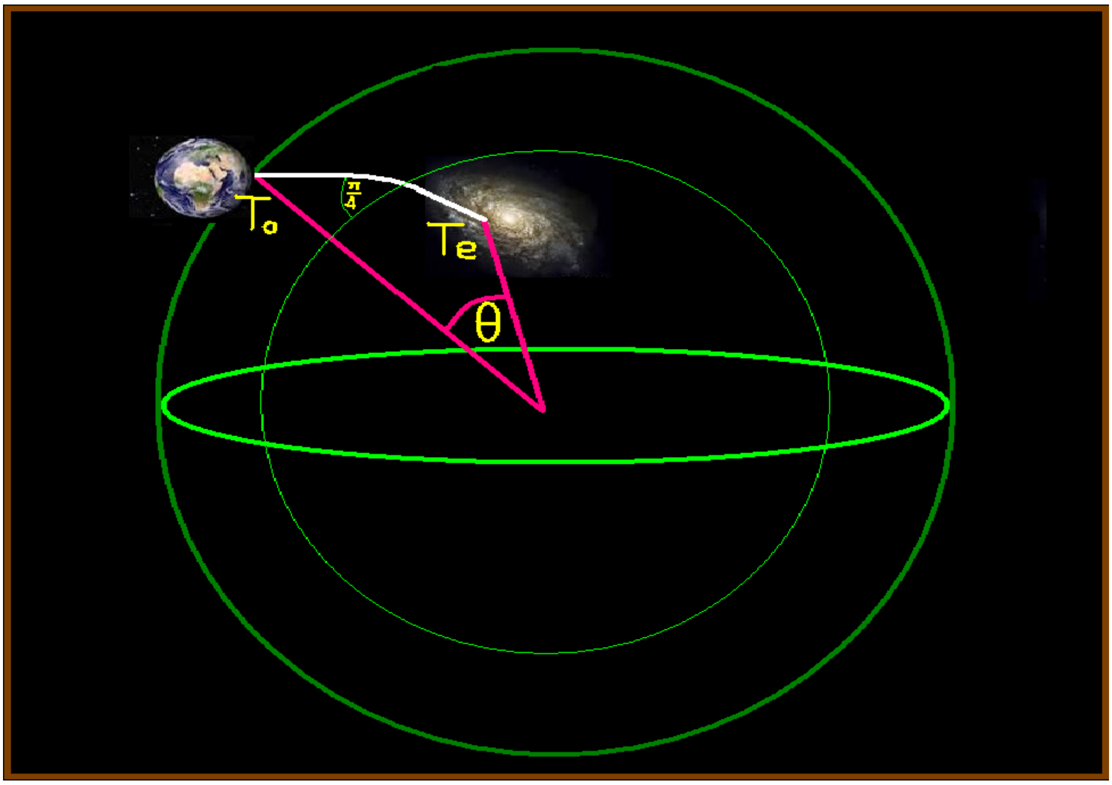
Hubble's Law and red shift **:** The world line of light (**c = 1**) as it travel through the 4-dimensional space-time between the source of light and the observer is a logarithmic spiral (tends to straight line in large values of the age of the universe) this is because it keeps making an angle (**Π / 4**) with the 3-dimensional surface in every time because the speed is equal to the tangent of this angle.

Thus the relation between the time of emission (**T***e*) and the time of observation (**T***o*) and the angle between the world lines of the observer and the source (**θ**) can be obtained as follows :



We have : ($dT = T\ d\theta$) then by integration (from $T = T_e$ to $T = T_o$) we arrive at the important result:

$$T_o = T_e\,(e^{\theta})$$



The red-shift (**z**) resulted from this relation between the time of emission and the time of observation is :

$$\boxed{z = (e^{\theta}) - 1}$$

Now let us show how Hubble's law can be derived from this relation and the reason why it is valid only in small distances.

Firstly: from the properties of the exponential function for small values of **(θ)** the relation between **(z)** and **(θ)** is :

$z \approx \theta$ for small value of (**θ**)

We have $\theta = D / T$ where (**D**) is the proper distance between the observer and the source.

Secondly : We have $z \approx v$ for small (**v**) where (**v**) is the velocity of the source moving away from the observer .

Thirdly: It can be deduced directly from this model that any increase in time is associated with an increase in the distance between any two objects proportional to this distance and the inverse of the age of the universe so the velocity of the increase of the proper distance is obtained from the relation : $v = D / T$.

Taking these three points into account we arrive at the following explanation of Hubble's law and its validity :

When applying the global law of red-shift { $z = (e^{\theta}) - 1$} locally , the result is the same as that obtained when the red-shift is wrongly attributed to the velocity of the increase of the proper distance between the source and the observer .

The result can be drawn from this is that: ($T = 1/ H$) and ($v= D/T$) but this velocity cannot be used to calculate the red-shift although it gives nearly correct results in small distances .

It should also be noted that the relation { $z = (e^{\theta}) - 1$} can be used to explain red-shift data claimed to be results of accelerated expansion (which is impossible according to this model) such as supernova observations .

The Large-scale Universe is Homogeneous and Isotropic : This can be thought of as a natural result of the shape of the *3-space* in this model , because there is no preferred region or direction in a spherical surface.

Dark Energy and the Cosmological Constant : As seen in the model and regardless of the material content at any moment in any place there exist a non-zero value for the curvature of spherical surface that decreases with the age of the universe this can be thought of as the so-called cosmological constant (which is no longer constant according to this model) which is used to explain dark energy . In addition to the

Hubble's Law (as understood in this model) this curvature represents another way to determine the age of the universe.

The examination of the equality of the radius of the universe obtained from Hubble's constant and the radius obtained from this curvature serves as a good test for this model :

Let (**Λ**) be the cosmological constant which is interpreted as dark energy and (**R = cT**) is the radius of the universe :

The curvature of the 4-sphere **= 12/ R^2**

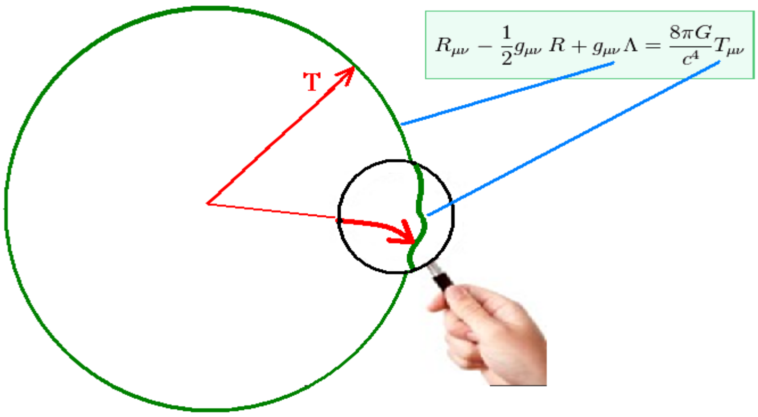
The global curvature (cosmological constant) **~ 10^-52 m^-2**

Thus **R = (12 / Λ)^(1/2) ~ 3.464 * 10^26 m**

We have **(c / H) = 1.306 * 10^26 m**

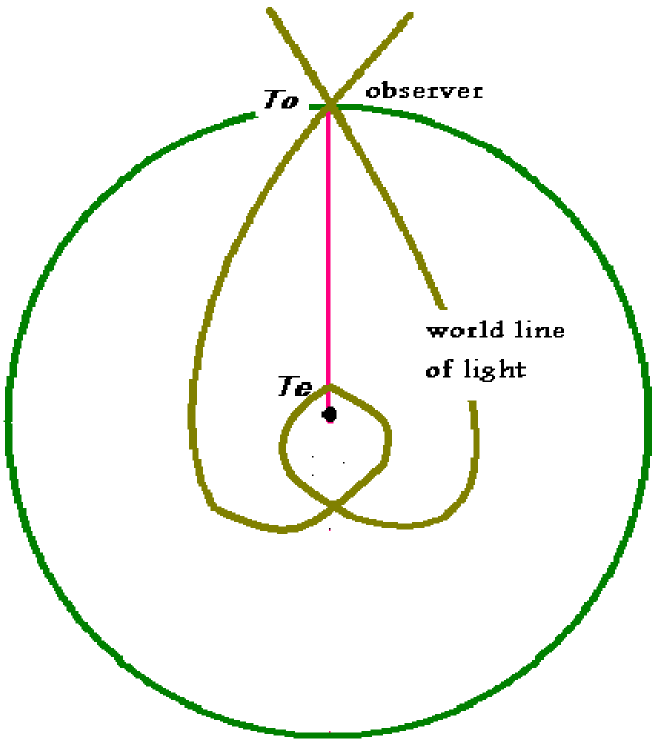
They are nearly the same , the difference ranges within the uncertainty in the value of (**Λ**) **.**

Einstein's Field Equations : According to this model the geometry of large-scale universe is simply spherical geometry with the time dimension in the direction of the radius , this global geometry has nothing to do with the material content of the universe but depends only on the age of the universe while the local topological structure of the space-time is affected by the stress-energy tensor and the global geometry which is represented in the cosmological constant as obtained from *Einstein's Field Equation.*



Horizon Problem : The problem with the standard cosmological model that different regions of the universe have not contacted each other (according to the standard model) but have the same physical properties is known as the horizon problem . The cosmic background radiation which fills the space between galaxies is precisely the same everywhere.

This model provides a simple explanation to this homogeneity. According to the equation of the world line of light from this model { $T_o = T_e (e ^{\theta})$ } all the radiation emitted from a source at the time { $T_e = T_o (e ^{- 2\Pi}) = 0.00186744\ T_o$ } reaches the same source at time (T_o) from all direction. This supports a simple assumption that cosmic background radiation is the radiation emitted from our own galaxy at early time ($T_e = T_o (e ^{- n 2\Pi})$ where **n** is any integer) then converged to reach us again at the time (T_o).



Conclusion

The space-time continuum can be divided into four dimensions the way we wish , but if we want to choose one of them to be measured by a clock , there must be some restrictions obtained from this model .