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Direct Observational Test of a Proposed Cosmological Model

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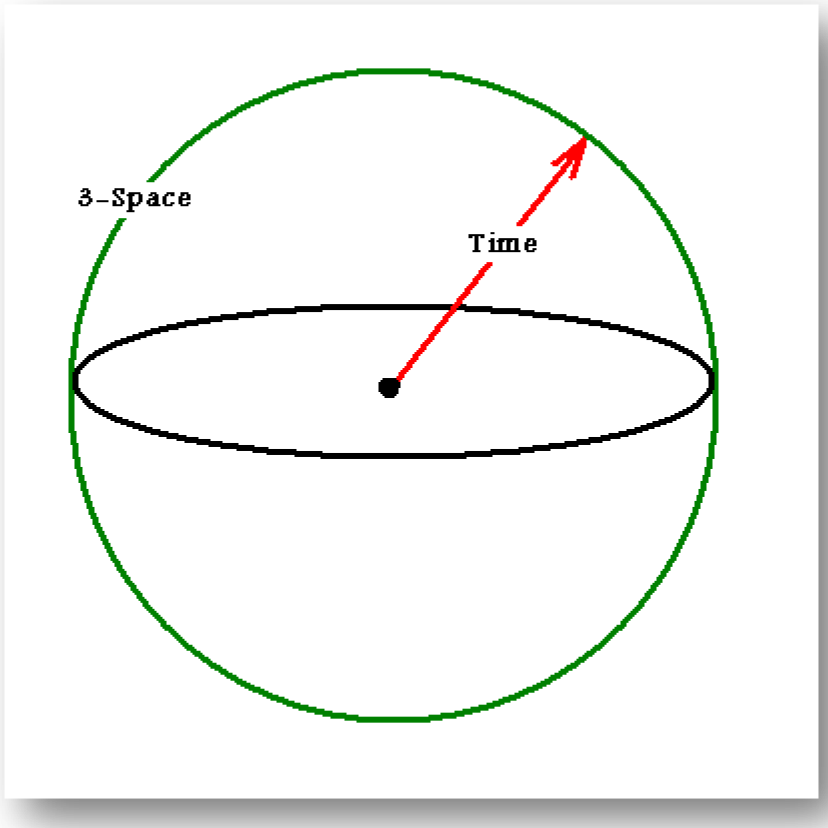
Abstract

A simple observational test of a proposed cosmological model with radial time and spherical space is introduced. It is shown briefly how the proposed model which can solve many problems of cosmology is wrongly excluded.

The Proposed Model

Perhaps, the simplest shape of space-time one can think of is the 4-ball in which the radius represents the cosmological time and the hypersurface (3-sphere) represents our 3-space (x, y, z)



This attractive shape is not far from the imagination of physicists but it is excluded for two reasons:

1) It seems to contradict the results of the global application of *Einstein's field equation* because according to this model the global geometry of the universe depends only on the age of the universe and has nothing to do with the average density of the universe as (supposed to be) implied by the field equation.
2) It contradicts the acceleration of the expansion of the universe which is (supposed to be) supported by the observational data about red-shifts because a model of a spherical space with radial time implies a steady expansion of the universe.

Instead of hurriedly excluding this shape of space-time our proposed cosmological model tries to overcome these difficulties.

We can overcome the first difficulty easily by adopting a good definition for the cosmological constant which eliminates the dependence of the global geometry of the universe on its average density and relates it directly to the age of the universe. The cosmological constant which satisfies these requirements is the quantity that composed of two parts: the geometrical part which is the curvature of the universe determined by the age of the universe and the material part which is the average density of the universe .This proposed definition of the cosmological constant will not only enable us to use the simple model of radial time and spherical space but will also solve all the problems of modern cosmology which are generated from the dependence of the global geometry of the universe on its density like the *Cosmological Constant Problem* without hypothetical concepts (dark energy, inflation, multi-verse, extra dimensions … etc.).

Now we can rewrite the field equation of general relativity:

$$G_{\mu\nu} - \left(G_{\mu\nu}^{global} - k\,T_{\mu\nu}^{average(global)} \right) = k\,T_{\mu\nu}$$

Which can be written in a more beautiful form as a difference between local and global quantities in both sides of the equation?

$$G_{\mu\nu} - G_{\mu\nu}^{global} = k\,T_{\mu\nu} - k\,T_{\mu\nu}^{global}$$

This will not affect the successful local application of the field equation because of the small value of the average density compared to the density of the source of the gravitation field (the zero-point vacuum energy density is canceled out because it is a part of both the cosmological constant and the stress-energy tensor)

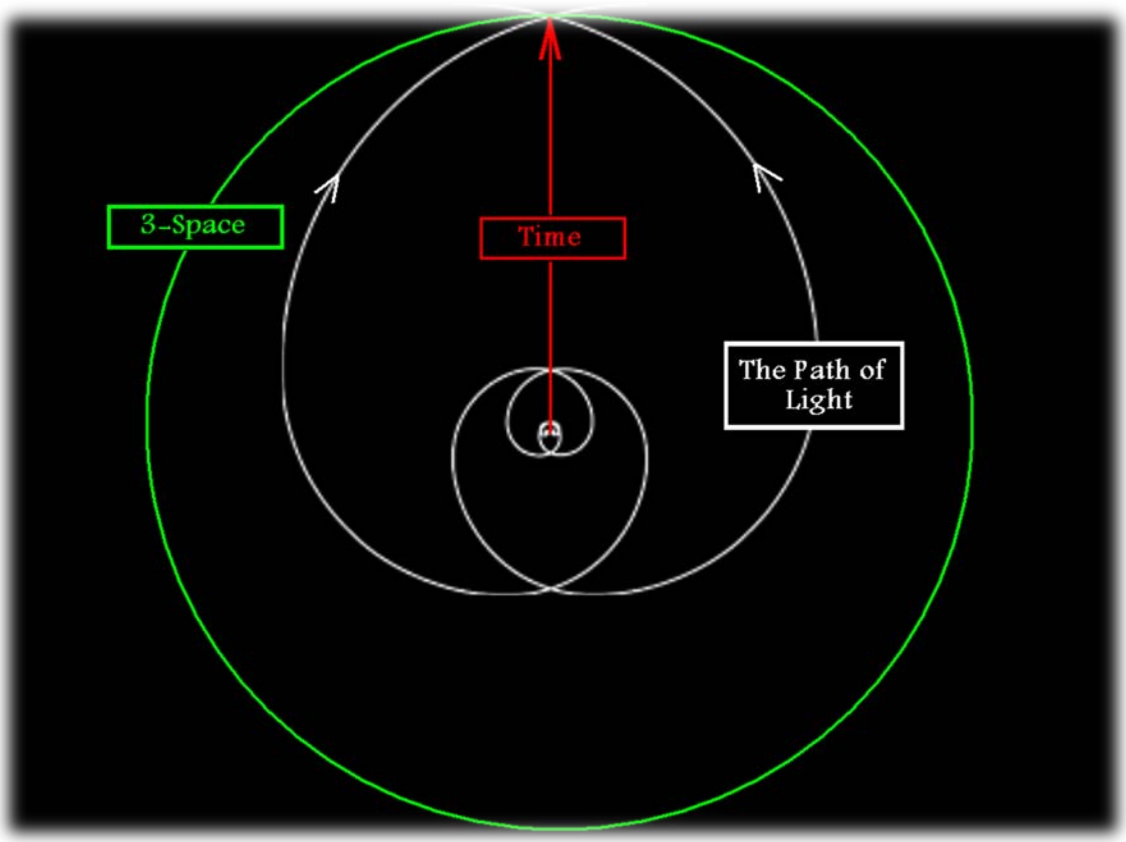
Now, let us turn to the second difficulty with our proposed model of the accelerating expansion of the universe or more precisely the cosmological red-shift which is assumed to be a result of the acceleration of the expansion. Surprisingly, our simple spherical model which denies this acceleration offers another interpretation of this cosmological red-shift. It can be proved mathematically by analyzing the world-line of light as it travels through this shape of space-time between the source and the observer that it is a logarithmic spiral which leads to a red-shift given by:

$$z = e^{\theta} - 1$$

Where θ is the angle between the world-line of the source and the observer. This agrees with the observational data and reproduces Hubble's Law in small values of θ .The spiral path of light resolves the Horizon Problem (The problem with the standard cosmological model that different regions of the universe have not contacted to each other but have the same physical properties) because all the radiations emitted from a source will converge to reach again the same source from all direction which may suggests that the radiations with the same properties which we receive from different directions could be emitted

from our own galaxy and led by the spiral path to meet our world line again . This may also offers an answer to the problematic phenomena which was discovered recently that some features of the cosmic radiation is aligned with the orientation of our solar system which can be thought of as the part of radiation which is emitted from the sun the converged to reach it again from all direction and thus appears as aligned with the ecliptic plane for any observer near the sun.

There is indeed so much in these topics which such an approach cannot but miss, but the intention in this stage of our argument is mainly to show that it is a mistake to suppose that the acceleration of the expansion is the only possible explanation of the observed cosmological red-shift or even the best of all possibilities.

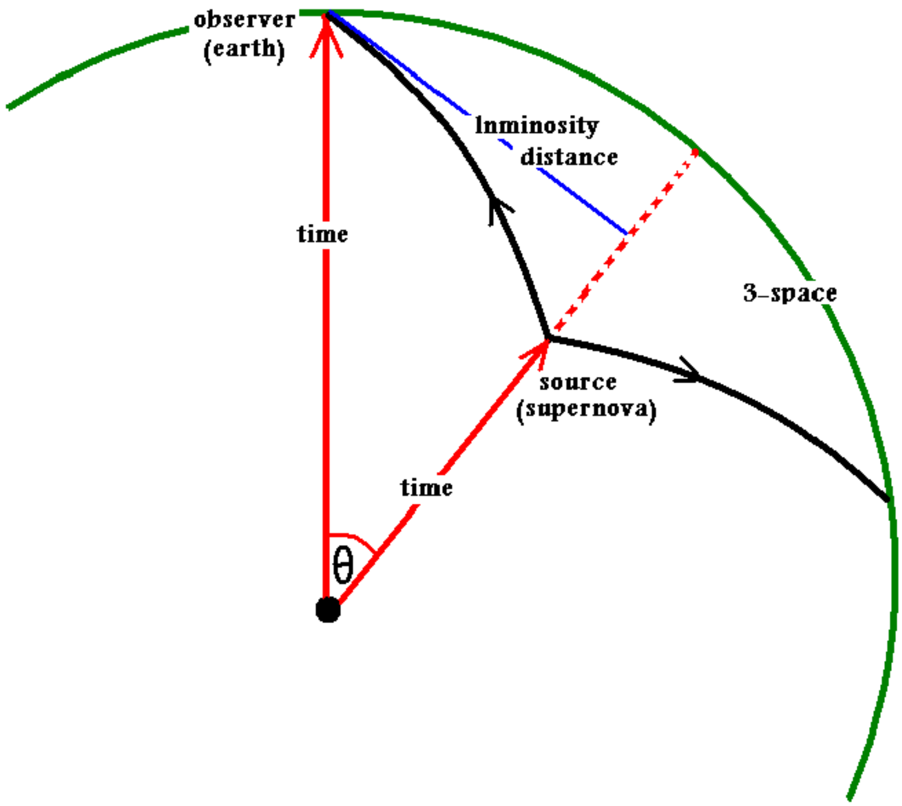


The Observational Test of the Proposed Model

The plan of this test is to identify some of the relations between physical properties obtained from this cosmological model which distinguish it from the *Standard Cosmological Model* and other existing models and compare these relations with the model-independent observational data.

One of the best of these relations is the Redshift-Flux relation because both redshift and flux are model-independent physical quantities and fortunately some natural phenomena such as *type Ia supernova* provides us with the tools needed to construct the relation between these two quantities in different cosmological models because this type of supernova give a certain known amount of light and thus represents a standard candle that can be used to calculate luminosity distance which can be used to link the flux to the red-shift according to the adopted cosmological model.

Now, let us see the mathematical form of this relation in our proposed cosmological model.



The time of observation is T which is equal to $\frac{1}{H}$ according to our model, where H is Hubble 's constant in a system of units where the speed of light is equal to unity.

In our model we also have:

$z = e^{\theta} - 1$ Which leads to: $\theta = \ln(z+1)$

Luminosity Distance D_L in this model is: $T \sin\theta = \frac{\sin\theta}{H}$

Let the luminosity of the source be L then the flux F is given by:

$$F = \frac{L}{4\pi {D_L}^2} = \frac{H^2 L}{4\pi(\sin(\ln(z+1)))^2}$$