The Hubble Constant is a Measure of the Fractional Increase in the Energy of the Universe

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ABSTRACT

The universe is postulated as the three dimensional surface volume of a hollow, spinning, four dimensional hypersphere, called the hyperverse. This simple notion seems not to have been re-examined in the light of the current state of precision cosmology. Using current measurements, we find the hyperverse radius is 27.7 billion light years, giving a radial expansion rate of twice the speed of light; all points in space are moving at 2c into the fourth dimension. The 2c radial expansion gives us a basis of time, and suggests the rate of radial expansion determines the speed of light. The circumferential expansion rate of the hyperverse matches the Hubble constant. Additionally, the Hubble constant is shown to be a measure of the increase in the energy of the universe, implying that the surface of the hyperverse, our universe, is composed of energy. The hypersphere model provides a positively curved and closed universe, and its 2c radial expansion rate, and circumferential expansion rate matching the Hubble constant, provide striking support that the universe is the 3D surface volume of an expanding hypersphere.

Subject headings: 2c radial expansion rate; cosmology; Hubble constant; hyperverse theory

Introduction

This paper introduces "hyperverse theory", and is focused on the predicted consequences if our universe was actually the three dimensional surface volume of a spinning, hollow, four dimensional sphere, termed the hyperverse. Some arguments to support this view of the universe are presented in this paper, and a few basic, but powerful, calculations are given.

Further papers in the series will show that the model produces insights on time, matter, gravity and more.

We will show in this paper that the radius of a hyperverse, whose surface volume matches the volume of the observable universe, gives a radial expansion rate of twice the speed of light. The rate of circumferential expansion of the hyperverse gives us exactly what it should: the Hubble constant.

The mass of the universe is derived and when we divide the rate of change of the mass of the universe by the mass of the universe, we get the Hubble constant. With mass-energy equivalence, we can deduce that the Hubble constant is a measure of the increase in the energy of the universe, implying that space exists, not as a vacuum, but as energy.

1. The Universe as the Surface Volume of a Four Dimensional Sphere

We will start with the concept that space actually exists, consisting of discrete units, vortex-like atoms of space. It is assumed these vortices take up space. We can then ask the question: "if space takes up space, where is there room for the additional atoms of space created by expansion?"

Packing additional atoms of space into an already full universe is not reasonable. The universe is huge, the atoms of space small, and the addition of space is occurring throughout the universe, meaning the pressure from the added atoms of space would be identical throughout. The only direction available for addition is outwards, or "fourthwards", into the fourth dimension.

A hollow, four dimensional hypersphere, or hyperverse, as we will call it, would easily allow, and even require, the addition of new atoms of space as its surface expanded radially outwards, or fourthwards. Consider a three dimensional sphere such as a rubber ball, the two dimensional surface area being a 'flatland universe' for the ball. Radial expansion of the ball (making the ball bigger) increases its surface area, requiring the addition of more surface area. Additionally, every point on the ball's surface is in total contact with the next higher dimension. A 4D hypersphere has a 3D surface volume. Just as every point on the 2D surface of a 3D sphere touches the next higher, third dimension, every point on the 3D surface volume touches the next higher, fourth dimension.

2. The Edge of Space is Everywhere

With the universe as the surface volume of a hollow, spinning, four dimensional hypersphere, every point in the universe is on the surface of the hyperverse, and we can state that every point in space touches nothingness. The edge of space exists at every point in space; every point in the universe is on the edge of space. The center of the hyperverse, however, does not exist on the surface; it resides at the center of the hypervolume of the hyperverse. Every point in the universe lies at the same distance from the center of the hyperverse.

3. The Radius of the Observable Hyperverse

The current radius of the observable universe is around 46 to 46.5 billion light years and the age of the universe was recently revised from about 13.7 billion years to 13.8 billion years. [1]. We can calculate the radius of the observable hyperverse by setting the surface volume of the 4D hypersphere equal to the 3D volume of our universe:

$$2\pi^2 R_H^3 = \frac{4}{3}\pi r_o^3 \tag{1}$$

where R_H is the radius of the observable hyperverse and r_o is the radius of the observable universe.

Using the mid-value of 46.25 billion light years for the radius of the observable universe, we find the hyperverse radius is 27.5866 billion light years:

$$R_H = (46.25)\sqrt[3]{\frac{2}{3\pi}} \approx 27.5866 \text{ billion light years} \tag{2}$$

4. We are Moving into the Fourth Dimension at Twice the Speed of Light

Since the universe is about 13.8 billion years old, the speed of radial expansion comes to twice the speed of light:

$$\frac{27.5866 \text{ billion light years}}{13.8 \text{ billion years}} = 1.999 \text{ light years per year } \Rightarrow 2c \tag{3}$$

The hyperverse radius is growing at $2c$, meaning the hyperverse surface is moving at two times the speed of light into the fourth dimension. Since every point in the universe is on the front of that expansion, we are moving at two times the speed of light into the fourth dimension.

It is a striking concept, even staggering. In one second of our time, we have moved two light seconds of distance, or about 600,000 kilometers, in a direction to which we cannot point. The moon is 384,000 kilometers away, so the distance we move radially, in one second, is about one and a half times the distance to the moon. We are at any location for a truly tiny, fleeting moment. Do we experience or feel this somehow? We will conjecture that this is the basis of time.

Events in the past are indeed far behind us, not just in memory, but in distance, and they occurred in a location which no longer exists because the 'front', the hyperverse surface, has moved radially. This is not a violation of relativity; we are talking about movement of the entire universe, not something within it. We will see in another paper of the series that the radial expansion creates relativity within the universe and explains why the speed of light is the maximum translational velocity within the universe. A 2c radial expansion is the perfect number to explain time, energy, matter, gravity, and much more.

5. The Hubble Expansion is the Circumferential Expansion of the Hyperverse

Any two points on the surface of a 4D hypersphere, in any direction, lie upon its circumference. The rate of separation between two points on the circumference of a circle is the rate of circumferential expansion. The rate of change of the circumference of a circle, relative to the radius, is 2π:

$$\frac{\Delta C_H}{\Delta R_H} = \frac{d\,(2\pi R_H)}{d\,(R_H)} = 2\pi \tag{4}$$

The rate of change of the hyperverse radius, delta R_H, is $2c$. Substituting $2c$ for ΔR_H gives:

$$\Delta C_H = 2\pi \Delta R_H = 2\pi\,(2c) \tag{5}$$

Dividing the rate of change of the circumference of the hyperverse, $2\pi\,(2c)$, by the circumference of the hyperverse, gives the fractional change of the circumference, and that value is the Hubble constant:

$$\frac{\Delta C_H}{C_H} = \frac{2\pi\,(2c)}{2\pi R_H} = \frac{2c}{R_H} = H \tag{6}$$

where H is the Hubble constant, C_H is the hyperverse circumference, ΔC_H is the rate of change of the hyperverse circumference, and c is the speed of light.

Calculating the value of the Hubble constant, based on equation (6), gives us:

$$H = \frac{2c}{R_H} = \frac{2\,(2.99792458 \times 10^8\,\mathrm{m\,s^{-1}})}{27.586\,6 \ \text{ million light years}} \approx 21.73 \text{ kilometers per second per million light years} \tag{7}$$

The Hubble constant is the measure of the rate of separation of galaxies in the universe, or simply, the rate space expands. Estimates of the Hubble constant range from around 20.78 to 22.69 kilometers per second per million light years [2], and our calculated value falls squarely in this range; the rate of the circumferential expansion of the hyperverse fits the Hubble constant. The Hubble expansion is the circumferential expansion of the hyperverse.

6. The Mass of the Observable Universe

Fred Hoyle [3] calculated the mass of the universe to be $\frac{c^3}{2GH}$. By substituting $\frac{2c}{R_H}$ for the Hubble constant, H, we get, in hyperverse terms, a mass of $\frac{R_H c^2}{4G}$. Joel C. Carvalho [4] calculated a mass value of $\frac{c^3}{GH}$, or $\frac{R_H c^2}{2G}$, twice that of Hoyle's.

The Schwarzschild radius can be defined as the distance from a point to another point at which the accumulated expansion of space produces a separation speed equaling the speed of light. If we divide the speed of light by the Hubble constant, we get the Schwarzschild radius:

$$R_{schw} = \frac{c}{H} \tag{8}$$

With the hyperverse surface radially expanding at twice the speed of light, at one-half the radius, the universe is radially expanding at the speed of light:

$$R_{schw} = \frac{c}{\left(\frac{2c}{R_H}\right)} = \frac{R_H}{2} \tag{9}$$

The equation of the Schwarzschild radius, where G is the gravitational constant and M is mass, is:

$$R_{schw} = \frac{2GM}{c^2} \tag{10}$$

Inserting Hoyle's mass value of $\frac{R_H c^2}{4G}$ into the Schwarzschild radius equation, (10), gives $R_{schw} = \frac{R_H}{2}$, whereas the Carvalho mass estimate gives a Schwarzschild radius equal to the hyperverse radius: $R_{schw} = R_H$. We will use Fred Hoyle's mass as the mass of the universe as it is consistent with equation (9). Thus the mass of the universe, M_o, will be defined as:

$$M_o = \frac{R_H c^2}{4G} \tag{11}$$

The mass works out to about $8.835\,8 \times 10^{52}$ kg.

7. The Hubble Constant Measures the Change of the Mass and Energy in the Universe

If we take the rate of change, the derivative, of the mass of the observable universe in respect to the radius, we get:

$$\frac{dM_o}{dR_H} = \frac{d\frac{R_H c^2}{4G}}{dR_H} = \frac{c^2}{4G} \tag{12}$$

Rearranging, the rate of change of mass, ΔM_o, is

$$\Delta M_o = \frac{c^2}{4G}\Delta R_H \tag{13}$$

Since $\Delta R_H = 2c$, we see that $\Delta M_o = \frac{c^3}{2G}$:

$$\Delta M_o = \frac{c^3}{2G} \tag{14}$$

This value can also be obtained by dividing the mass of the observable universe by the age of the universe, which is the inverse of the Hubble constant:

$$\Delta M_o = \frac{\frac{R_H c^2}{4G}}{\frac{R_H}{2c}} = \frac{c^3}{2G} \tag{15}$$

If we divide the change in mass by the total mass of the observable universe, M_o, we get the average change in mass, which matches the Hubble constant:

$$\frac{\Delta M_o}{M_o} = \frac{\frac{c^3}{2G}}{\frac{R_H c^2}{4G}} = \frac{2c}{R_H} = H \tag{16}$$

From mass-energy equivalence, the Hubble constant is the change in energy of the observable universe:

$$H = \frac{\Delta E_o}{E_o} = 2.285\,027\,734\,440\,597\,113\,7 \times 10^{-18}\ \mathrm{J/\,s/\,J} \tag{17}$$

where E_o is the energy of the observable universe, and ΔE_o is the rate of change of energy in the observable universe. If the calculations are done on the Carvalho mass estimate, we get the identical result, $\frac{2c}{R_H}$, the Hubble constant.

Thus we can argue that the Hubble constant is not just a measure of the rate of separation of galaxies, or of the circumferential expansion of the hyperverse, but is, at a deeper level, a measure of the increase of mass and energy in the observable universe.

The Hubble constant, defined here as 21.73 kilometers per second per million light years, or more commonly in astronomy in terms of kilometers per second per megaparsec, is a value expressed as distance per time per distance. The distance values cancel out, allowing the Hubble constant to be stated as a dimensionless number per second, such as $\frac{2.285 \times 10^{-18}}{\mathrm{s}}$. Therefore, there is no inherent conflict in stating the Hubble constant as 2.285×10^{-18} J/ s/ J.

This calculation implies that the universe is composed of energy. The difference between space, and the nothingness into which it expands, is the presence of energy, and it is energy that forms the advancing front of the hyperverse.

The Universe is the Surface Volume of the Hyperverse

A radial expansion rate of twice the speed of light, and a circumferential expansion rate matching the Hubble constant are striking observations that are highly unlikely to be coincidental. Additionally, a universe as the surface volume of a hollow, spinning, 4-sphere gives us a positively curved, closed universe, as favored in modern cosmology. The Hubble constant as a measure of the fractional rate of increase of energy implies that the hyperverse has a surface composed of energy, and this energy is being added continually as space expands. These features help make an expanding hyperverse an appealing model for the structure of the universe.

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