Basic Concepts of the Dynamic Universe Theory

by Bob Day

Whenever a difficulty has been encountered with our theory of cosmology, it has always been resolved either by simply accepting it as an unexpected implication of the theory or by modifying the theory to accommodate the difficulty. For example, in the past decade or so evidence has accumulated that the universe seemingly is expanding at an accelerating rate. This discovery was unexpected and surprising. But it was accepted by the mainstream of cosmological physicists without a whole lot of debate. It was little questioned that there might be a problem with our model of the shape of the universe, which requires the actual data we obtained, the actual measurements we made, to be interpreted as an acceleration. Then, to explain the acceleration, Einstein's Theory of General Relativity was patched by re-introducing the "cosmological constant". The cosmological constant was an idea of Einstein's that he ultimately rejected as, he said, "the greatest blunder of my career".

Today, as we have done in the past, we are continuing along the road of adapting and patching our theories to accommodate new facts and results. In the past, this road has always come to an end. We have always come to a point where a theory has become so overburdened and unwieldy that it is obvious it is no longer tenable. It is not at all clear that we are approaching that point with our current cosmological theories. Perhaps the theories we have are, finally, "the perfect theories", which, at most, will just need a little bit of tweaking and adjusting of constants. But, just in case, it's always good to be thinking about fundamentally new ideas…

A new theory, called the Dynamic Universe theory (DU), has none of the difficulties that relativity has encountered. For example, in the DU there is no tradeoff between space and time; force is simply a force, not a "curvature in space"; and the expansion of the universe is decelerating, not accelerating. The DU was conceived by Dr. Tuomo Suntola (http://www.sci.fi/~suntola). In this essay, I will I try to explain the basics of Dr. Suntola's theory in a simple, easy to understand way, so that it will be accessible to those who have an interest in theories of the universe but don't have much background in physics or mathematics. The ideas presented in this essay are totally those of Dr. Suntola. I have added nothing. In the process of explaining his ideas, I hope I haven't done any serious damage to them. Any errors of course are mine.

Dr. Suntola shows that the Dynamic Universe theory unifies physics: The DU gives all of the results of general relativity, cosmology and electromagnetic theory, and is consistent with quantum electrodynamics. Here are some specific examples of phenomena that the DU models at least as well as general relativity:

- The tradeoff between mass and energy
- The rotation of the perihelion of mercury
- The bending of light around stars
- The slowing of clocks in a gravitational field
- The brightness vs. redshift of type Ia supernovae (In the DU, no assumption of an accelerating expansion of the universe is needed to model this.)

The goal of this essay is not to derive how the DU models all of these phenomena. It only goes as far as to show that the DU gives, as accurately as it's possible to measure, the same relationship of mass to energy as relativity does, and in doing that, to introduce the concepts upon which the DU is based. As good a theory as relativity is, it will be seen that it does not have exclusive dominion: the DU demonstrates that it is possible that other theories based on entirely different root concepts can explain the phenomena in our universe at least as well as relativity, and perhaps even better.

1. <u>Assumptions and Definitions</u>

a) The root idea that lies at the bottom of everything else in the Dynamic Universe theory is that our universe is the three dimensional surface of an expanding four dimensional sphere.

b) This essay begins with a time when the universe had a small radius in four dimensional space ("4-space") and when matter (mass) was spread evenly over the surface of the 4-sphere (that is, in "3-space") in a very fine mist or dust. (Dr. Suntola goes back a little farther and explains more about the beginnings.) In this essay, 3-space, the space that we live in and perceive, will be referred to more simply as just "space". A direction perpendicular to space (in the direction of the radial expansion of the 4-sphere) will be referred to as an "imaginary" direction. Directions in space are along the surface of the 4-sphere and are called "real" directions. Thus, our space can also be referred to as "real space".

c) The surface of the 4-sphere is such that it constrains all matter that is on it from leaving it, and gravity acts strictly along the surface of the 4-sphere, never through it. This assumption makes sense because, as we actually observe, gravity decreases with the square of the distance as the distance from an object increases; if gravity acted in four dimensions, it would fall off as the cube of the distance. All matter is moving "outward", along the 4-radius, at exactly the speed of the expansion of space in the fourth dimension, (because it is confined to the surface of the 4-sphere).

d) The speed of expansion in the fourth dimension decreases over time, because gravitation between matter in space is constantly slowing the outward expansion of the 4-sphere.

e) A mass is "at rest" when it is not moving along the surface of the 4-sphere, only moving outward with the expansion of the 4-sphere. Because space is expanding, we perceive objects at rest to be separating at velocities approximately proportional to their distances from each other (Hubble's law).

f) There is a "zero energy balance" between the gravitational energy and the energy of mass at rest in space. That is, the sum of the (negative) gravitational energy and the energy of mass at rest is zero at all times. This sounds a little strange, but remember, mass at rest in space is moving with space outward at the speed of expansion in the fourth dimension. The energy of motion of a mass at rest will be referred to from now on as its "rest energy", and its momentum at rest as its "rest momentum". The zero energy balance applies not just to the total of all mass; it applies also to any individual mass object. Thus, for any given mass object, its rest energy is a conserved quantity.

g) An immediate consequence of the zero energy balance is that the speed expansion in the fourth dimension defines the speed of light. In other words, the speed of light, c, is the speed of increase of the radius of the 4-sphere. (Dr. Suntola derives this result.)

h) In sharp distinction to relativity, the space and time dimensions are separate and independent of each other. Time is absolute and the same time scale applies throughout the universe. Time and space do not interact and there is no tradeoff between them. (Don't even think of applying the Lorentz transformation!)

i) We define the energy of en object to be the speed the expansion of space in the fourth dimension (i.e., the speed of light) times its momentum, in accord with the energy of electromagnetic radiation.

j) In the text that follows, R" denotes the current radius of the 4-sphere, and M" denotes the equivalent mass of the universe, the mass at the center of the 4-sphere that would be needed in order to have the same gravitational effect as the mass uniformly distributed over the surface of the 4-sphere. (For reasons beyond the scope of this essay, but which Dr. Suntola explains, M" is somewhat less than the sum of all mass in space.) The symbol "double prime" ("), denotes an imaginary quantity, a single prime (') denotes a real quantity, and an asterisk (*) denotes a complex number.

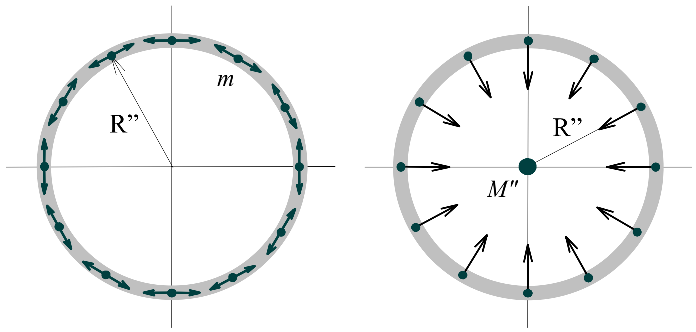

Figure 1. The tangential shrinking force due to the gravitation of uniformly distributed mass in space is equivalent to the gravitational effect of mass equivalence M” at the center of 4-space.

2. The Hierarchy and Tilting of Local Spaces

This section describes how the entirety of space (“whole space”) comprises a hierarchy of "local spaces", for which we use the term “frames”. Each frame is nested within the frame at next higher level (“parent frame”). It is shown that, except for the outermost frame, each frame is tilted with respect to its parent frame. These concepts are necessary for the development of the relationship between mass and energy in the DU.

Consider the following two situations:

A: Imagine the universe in its initial uniform state, with its mass spread evenly in space as a very fine dust, and picture a mass, m, a speck of this dust. Mass m simply moves outward, radially from the center of the 4-sphere, along with all the rest of the uniformly distributed dust.

B: Now modify this initial state by gathering up all of the mass in a thin spherical shell of radius r, centered on mass m. Form the gathered mass (call it mass M) into a clump, and place mass M at the same distance, r, from mass m. (We assume here that m << M << M” and r << R”.)

In these two situations, the total gravitational energy of mass m is the same, and total energy is conserved. This is true because the gravitational energy of mass m is the sum of the energies of the gravitational bonds between mass m and each of the other mass particles in the universe, and in rearranging the mass particles to create mass M in situation B we haven’t changed the distance from mass m to any other mass particle.

In situation A all of the gravitational energy of mass m results entirely from the attraction of M" at the center of the 4-sphere, whereas in B the gravitational energy comes from two sources: the (slightly reduced) attraction, E_r”, from M", and an orthogonal attraction from mass M, in space along the surface of the 4-sphere.

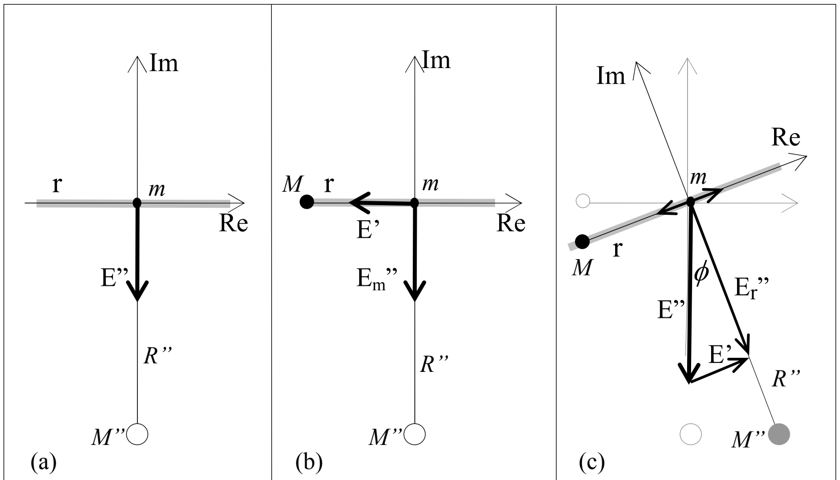

Figure 2. How local spaces are tilted by gravitation. (a) The initial condition for interactions in space is a state of rest in which mass is uniformly distributed throughout space, and the imaginary axis is in the direction of the 4-radius of space and the energies of motion and gravitation of an object are only in the imaginary direction. (b) The initial state modified by removing a thin spherical shell of mass at a distance r from mass m, forming it into a clump, “mass M”, and placing it a distance r from m. (c) The division of the initial gravitation, E”, into the orthogonal components, E_r” and E’ causes the modified system (b) to be tilted an angle ϕ with respect to the initial system (a), where ϕ = arccos (E_r” / E”).

The effect of the division of the gravitational energy of mass m into two components in situation B is to tilt the real and imaginary axes in the space in which mass m resides with respect to the axes in situation A (see Figure 2). The angle by which the space surrounding mass m is tilted is ϕ = arccos (E_r” / E”).

The total gravitational energy of mass m is E” = GM"m/R", and the reduced imaginary energy in situation B is E_r” = GM"m/R" - GMm/r, the total energy minus the lateral energy in space that we created by creating mass M. Consequently, ϕ = arccos ((GM"m/R" - GMm/r) / (GM"m/R"))

There are several things to note about the tilting of space:

a) It's not mass m that tilts; it's the space in which mass m resides that is tilted. Such a space is called a "local space".

b) Local spaces may be "nested". For example, a galaxy contains a solar system, which contains a planet, around which is a moon that contains an atom. These are all "local spaces". Local spaces are also called "frames", and, for example, the frame of a galaxy is said to be the "parent frame" of a solar system it contains.

c) Since a local frame is tilted with respect to its parent frame, the speed of light in a local frame is reduced with respect that in its parent frame. If c_p is the speed of light in a parent frame, the speed of light, c, in the local space it contains is $c = c_p \cos \phi$. The speed of light in the outermost frame is denoted by c_0.

d) The tilting of space is totally due to gravity; it has nothing to do with the speed at which an object is traveling.

e) The angle, ϕ, of the tilt is greatest near a mass center and decreases as the distance from the mass center increases.

3. The Relationship between Mass and Energy

Now we're ready to derive the relationship between mass and energy. We'll show that the equation we can derive from the assumptions of the Dynamic Universe theory is essentially the same as Einstein's equation. Relativity gives very good predictions of what we can actually observe, so if the DU theory holds any water, its predictions must be at least as accurate.

3.1 The Relationship among Velocity, Momentum and Energy in Space

Things get a little tricky here. We begin with velocity in space and then consider how velocity relates to momentum and energy in space.

When an object, m, is at rest in space, it is moving at the speed of light, c, in the imaginary direction. An object gets a velocity in space in one of the usual ways: something bumps into it, or it's pulled by gravity or a magnet, or it's accelerated somehow. It doesn't matter how it gets its velocity, but note that whatever causes an object to move, it all occurs in space; there is no action in an imaginary direction (in the fourth dimension). As an object moves in space two constraints are, and must always be, satisfied:

a) Because it must keep up with the velocity of space, c, in the imaginary direction, an object's velocity in the imaginary direction must also be c.

b) Because of the zero energy balance between the energies of motion and gravitation, an object's rest energy, and, consequently, the scalar value of its rest momentum, mc, must be a conserved quantity.

In order to give an object a velocity, say, v, in space, we must do work on it -- we must add momentum to the object in the direction of the real axis. Referring to Figure 3 below, If mv is the object's momentum in space, such that the object travels at an angle θ with respect to the local imaginary axis, we can write the proportion $p'/mc = mv/(mc\cos\theta)$. Consequently, $p' = mv/\sqrt{1 - v^2/c^2}$, or, defining β as v/c, $p' = mv/\sqrt{1-\beta^2}$.

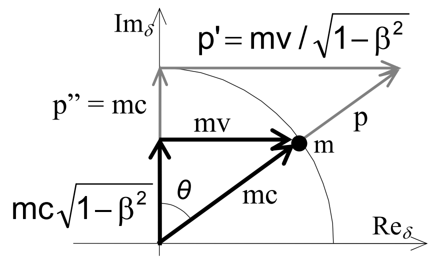

Figure 3. The momentum values of an object, m, moving at a velocity v in space. The object is traveling in a local space that is tilted at an angle ϕ with respect to its parent space. (The tilt and the angle ϕ are not shown.) v is such that the object travels at the angle θ with respect to the local imaginary axis, Im_δ. Due to the zero energy balance between the energies of motion and gravitation, the rest energy, and, consequently, the magnitude of its rest momentum, mc, is conserved

(Note: the labels on the extended vectors refer to the entire length from the origin, not just to the extended portion.)

When an object, m, is at rest in space, all of its momentum is directed in the imaginary direction. When it is moving at a velocity v in space, it obtained that velocity by diverting some of its rest momentum from the imaginary direction. That is to say, all of the object's velocity in space comes from its rest momentum. Its total energy is its rest energy plus the work done on it to turn its rest momentum vector to create a momentum component in space. Looking again at figure 3, we can write the equation for the total energy of a moving object as c_0 times the magnitude of the resultant of its momentum vectors in the imaginary and space directions, mc and $mv/\sqrt{1-\beta^2}$, respectively:

$$E_{tot} = c_0\sqrt{(mc)^2 + (mv/\sqrt{1-\beta^2})^2}$$

And voila!! We have essentially Einstein's equation! But we also have more. Because the velocity of an object in the fourth dimension is determined by the local imaginary velocity of space, c, we interpret the term $m\sqrt{1-\beta^2}$ as a reduced mass, and give it the name "internal mass", m_I. The internal mass of an object determines its internal energy, $c_0 m_I c$. Internal energy isn't just an abstract concept; it manifests itself in the real world. Internal energy is the rest energy available within a moving object. For a moving clock, the reduced internal energy results in a reduction of its ticking frequency by the factor $\sqrt{1-\beta^2}$. Time does not flow slower for objects in motion but the rates of physical processes do.

Also, we can interpret $m/\sqrt{1-\beta^2}$ as an increased mass that is associated with an object's velocity in space. We name it the "effective mass", m_{eff}. m_{eff} is the counterpart to the internal mass, m_I, and is the mass the object exhibits in interactions with gravity and other masses in space. Note that $m_I\, m_{eff} = m^2$, which tells us that mass is conserved even though it has different manifestations in the real and imaginary directions. m_{eff} is the same as Einstein's relativistic mass, so the equation for E_{tot} can be written: $E_{tot} = c_0\sqrt{(mc)^2 + (m_{eff}v)^2}$, which looks more traditional.

Finally, it is now easy to show that the DU definition of energy as the speed of light times an object's momentum (which has been assumed in the derivations in this essay) is consistent with everyday physics. The speed of light, c, in our local space is very close to c_0, and the velocities we normally encounter are far less than the speed of light, so we can write $E_{tot} \approx c\sqrt{(mc)^2 + (mv)^2} = mc^2\sqrt{1+(v/c)^2} \approx mc^2(1+v^2/2c^2)$, and finally $E_{tot} \approx mc^2 + mv^2/2$. This last form is Einstein's energy of rest mass (inherent in all mass) plus $mv^2/2$, the familiar approximation for kinetic energy of a moving object.

Here are some Internet links to additional information about the Dynamic Universe theory:

Dr. Suntola's website: http://www.sci.fi/~suntola/

A short summary of the Dynamic Universe theory by Dr. Suntola:
http://www.sci.fi/~suntola/DU-library/2004%20PIRT-IX%20London,%20Dynamic%20space%20converts%20relativity%20into%20absolute%20time%20and%20distance.pdf

Dr. Suntola's book on the Dynamic Universe theory (available from Amazon):
http://www.amazon.com/gp/product/9525502104/sr=1-2/qid=1155659187/ref=sr_1_2/002-7813533-7298429?ie=UTF8&s=books

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