# Limited Space Domain (L.S.D.)Theory

Steven Sesselmann

Dated August 2009

Abstract
A relativistic theory of cosmology proposing that the size of the Universe is limited by the observers rest mass, in such a way that the radius of the Universe stretches from the hypothetical Schwarzschild radius calculated from the observers mass, to the Mass Horizon Radius (MHR), a point on the horizon defining the absolute limit on the horizon beyond which the observer, can not observe, further, that the observers total potential energy domain is $2mc^2$ , spanning the range from $-mc^2$ to $+mc^2$ .

By a leap of faith, this theory draws the conclusion that the size of the Universe is a mass dependent variable. Calculations show that the current astronomical measurements of the Universe, agree closely with the MHR of a human weighing around 80 kg.

By knowing the radius of the Universe and the total energy in the Universe we can calculate the mass to space ratio, and define a value for the mass/energy of empty space.

Detailed Description

THE SCHWARZSCHILD RADIUS

In 1915 Karl Schwarzschild, a German physicist, demonstrated the first exact solution to Einstein's field equations of general relativity, and discovered a solution that showed how there was a minimum radius for any amount of mass, a radius where the escape velocity would be so high, that not even light could escape. This later became known as the Schwarzschild radius (SR radius), and is usually shown as the following equality.

$$r_s = \frac{2Gm}{c^2}$$

Where r(s) is the Schwarzschild radius and G the gravitational constant.

In fact, this solution could be derived by knowing Newtons law and the speed of light, and then finding the solution, where the escape velocity equals the speed of light, as follows.

$$V_e = \sqrt{\frac{2Gm}{r}}$$

Substitute V for c

$$c = \sqrt{\frac{2Gm}{r}}$$

Then solve for r find the radius where escape velocity equals the speed of light.

$$r_s = \frac{2Gm}{c^2}$$

It is generally understood that the SR radius is a point of no return, and that nothing whatsoever would be able to escape the gravitational attraction of an object with a mass to radius (density) of an SR object. Physicist John Wheeler later coined this a “black hole”.

In 1915 the Universe was believed to be static, but this was later shown not to be the case. Edwin Hubble’s careful measurements demonstrated that the Universe was in fact expanding.

## HUBBLE’S CONSTANT

In 1929, after carrying out distance measurements from Earth to a large number of Galaxies, by measuring the brightness of type 1a supernovae, and plotting the distance measurements on a chart, Edwin Hubble realized that there was a linear relationship between distance and recessional velocity, and from this, he formulated Hubble’s law. Hubble’s Law tells us that there is a linear relationship between the distance to a Galaxy, and the receding velocity of the Galaxy. In other words, the further away the Galaxy is, the faster it was moving away from us. Hubble calculated that this velocity was constant and somewhere in the order of 72 km/sec/mpc, or 2.5 x 10^-18 m/sec/m.

This can be interpreted as, every meter of space is becoming longer by around 2.5 x 10^-18 every second, and therefore one could calculate the speed of recession by the simple relationship

$$V = H_0 D$$

Where $H_0$ is Hubble’s constant and D is the distance, clearly showing a linear relationship between distance and velocity. In simple terms, this means that space is continuously stretching in all directions, so that the further apart two object are the faster they recede from each other.

The Hubble expansion can also be interpreted as a negative acceleration, between any two inertial objects traveling away from each other with some initial velocity.

When a once off force is applied between two bodies in space, causing a motion apart from each other at some initial velocity (ignoring friction and any gravitational forces between the objects), one would expect the relative velocity to remain constant, and continue forever, but due to the Hubble expansion, the relative velocity will appear to slow down.

## ESCAPE VELOCITY AND HUBBLE EXPANSION

Due to the Hubble expansion of space, we now realize that the initial velocity between any two objects in space, will as the radius between them increases, eventually come to a stand still. Likewise, an object escaping a gravitational field, and traveling in an outwards direction, through space, at the escape velocity, will gradually slow down. We can express this relationship with the following equation.

$$V_e = \sqrt{\frac{2Gm}{r}} - Hr$$

Where V(e) is the escape velocity and Hr is the Hubble expansion velocity. With this solution we can see that no matter how fast the initial velocity between two objects are, they will eventually be brought to a complete stand still, even if the velocity starts out at the speed of light c. As c is the maximum speed possible in our Universe, we must realize that for any given mass m, there must be a maximum radius beyond which nothing can reach, we shall name this radius the Mass Horizon Radius or MHR.

FINDING THE MASS HORIZON RADIUS

Now that we have the adjusted equation for the escape velocity with the Hubble velocity, we can work out the MHR maximum radius and the SR minimum radius for any given mass by substituting either zero or c in place of the velocity, and solving for r.

The point on the radius where the escape velocity equals zero, is by definition the event horizon for an observer of mass m, it is the point on the radius where an object traveling away at escape velocity will eventually come to a halt.

We calculate as follows..

$$0 = \sqrt{\frac{2Gm}{r}} - Hr$$

..moving Hr to the left side

$$Hr = \sqrt{\frac{2Gm}{r}}$$

...and solving for r

$$r = \left(\frac{2Gm}{H^2}\right)^{\frac{1}{3}}$$

This gives us the expression for the mass horizon radius (MHR), for any given mass m, including an observer of mass m. It is important to emphasize the shift in thinking here, namely that the maximum radius and therefore the size of the observers Universe is dependent on the observers rest mass, providing the observer is not accelerating in a gravitational field.

Solving for the inner (minimum) radius involves the same equation, but rather than solving for zero, we solve for the speed of light c.

$$c = \sqrt{\frac{2Gm}{r}} - Hr$$

..once again, move Hr to the left side..

$$Hr + c = \sqrt{\frac{2Gm}{r}}$$

....and we could go ahead and solve this third degree polynomial, but because c is very large and H is very small, we can safely ignore Hr for any mass that will result in a small radius. Therefore we can in most cases use the simpler Schwarzschild solution.

$$r_s = \frac{2Gm}{c^2}$$

Now we have two solutions, one for the minimum and one for the maximum radius of a Universe, from the point of view of an observer of mass m, or any object of mass m for that sake.

***"The size of the observers Universe is dependent on it's mass, in such a way, that the observers space domain is limited at it's center of gravity, by the Schwarzschild radius and at the outer limits of space by the Mass Horizon Radius."***

Once again, what we have just demonstrated above, shows us that an object traveling at escape velocity in an outwards direction, with respect to the observer, will eventually come to a standstill at the MHR, this includes an object starting it's journey at the SR radius with the speed of light, c.

The constant deceleration due to the Hubble expansion can as we already mentioned above, be considered as an acceleration toward the observer. We may ask what the value of this acceleration is, and by imagining an object starting it's journey at the SR radius with a velocity equal to c, and traveling outwards until it comes to a stand still, we realize that the Hubble velocity factored by the speed of light must give us an accurate value for this constant acceleration.

$$a = - cH$$

Where a is the acceleration towards the observer, and H is given in m/s/m. We assign a negative value to the acceleration, as it is observer directed. Using the most up to date measurement for the hubble constant of 74.2 km/s/mpc we calculate the constant observer directed acceleration to be 7.21 x 10^-10 m/s/s, a value which incidentally corresponds very closely to the observed anomaly in the trajectory of the Pioneer 10 and 11 spacecraft.

## THE PIONEER ANOMALY

The Pioneer spacecrafts were launched over 30 years ago, on a mission to explore the solar system and space beyond, both spacecraft have now left the inner solar system, and are traveling in an outwards direction away from our Sun. The spacecraft were fitted with sophisticated radar equipment to allow scientists to carry out distance measurements. Accurate measurements taken over a period of 30 years have identified an anomalous constant slowing down of the velocity of both Pioneer 10 and 11, of (8.74 +- 1.33) x 10^-10 m/s/s. There have been numerous studies into the effect, and to date there have been no satisfactory explanation of the phenomenon.

Some scientists have noted that the anomalous sunward acceleration is of the same value as -cH, but no satisfactory explanation has as far as I am aware, been suggested, as to why this might be the case.

Careful analyses of the Pioneer data may reveal that the constant acceleration is directed toward the observer and not towards the sun, as first assumed.

A seasonal difference in the anomaly might also be observed, which could be due to an angular difference between the Earth based observer and the sun.

The implications of this theory are interesting, as it implies that the observers Universe is very likely to be fully contained within much larger Universe, and smaller Universes are fully contained within the observers universe. The radii of a Universe for various objects have been calculated from the above formula and listed below.

| | **mass in kg** | **inner (SR) radius** | **outer (MHR) radius** |
|---|---|---|---|
| An electron | 9.100E-31 | 1.351298E-57 | 6.852515E-06 |
| A proton | 1.670E-27 | 2.479854E-54 | 1.257549E-02 |
| An Iron atom | 9.270E-26 | 1.376542E-52 | 6.980529E-01 |
| A bacterium | 9.500E-13 | 1.410696E-39 | 7.153724E+12 |
| A house fly | 1.000E-05 | 1.484943E-32 | 7.530236E+19 |
| A 1 kg mass | 1.000E+00 | 1.484943E-27 | 7.530236E+24 |
| A human | 8.000E+01 | 1.187954E-25 | 6.024189E+26 |
| The moon | 7.360E+22 | 1.092918E-04 | 5.542254E+47 |
| The earth | 5.970E+24 | 8.865108E-03 | 4.495551E+49 |
| The sun | 1.988E+30 | 2.952066E+03 | 1.497011E+55 |

As we can see, the outer radii of atoms lie fully within our domain as human observers, indicating that they exist in our universe but we do not exist in theirs.

## MASS ENERGY EQUALITY

We are all familiar with Einstein's mass energy equation mc^2, which tells us that all matter possesses an amount of energy equal to the speed of light squared. Einstein set out the proof in his 1905 Special Relativity paper, and showed us that any mass, even when at rest, possesses a large amount of energy.

In this theory, we shall see how that mass energy is stored as potential energy within the mass itself. If we consider, that every mass no matter how small or large, has within itself, a center of gravity, and a hypothetical minimum radius (SR radius), and were it not for the electromagnetic forces holding the atoms apart, the atoms that constitute the mass would all fall under the force of gravity, towards the center and towards it's SR radius, in the process releasing a considerable amount of potential energy.

If we consider such a situation where all the atoms in a given mass were allowed to suddenly collapse inwards to a point where the mass of the object reaches the SR radius, we must assume that the energy released will equal $mc^2$. I draw this conclusion because the laws of physics prevent anything escaping the SR radius, so preventing further energy to be gained by the observer.

And therefore we agree with Einstein that the stored energy in any rest mass m, is equal to $mc^2$, and that this energy is stored potential energy of the mass above it's own SR radius.

So we have now established a lower limit for both radius and energy, the SR radius is in this theory the lower limit for both energy and space, and from the observers point of view, this is a singularity within itself, a singularity because it by definition has no mass and no potential energy, with respect to the observer.

POTENTIAL ENERGY

The question then arises, how do we arrive at the potential energy for any given mass?

Newton's law gives us the following general equation for calculating the potential energy between two masses, by integrating the force required, to separate two masses, from r to r=∞, (f•d•r) the general form of the equation looks like this.

$$U_p = - \frac{GMm}{r}$$

Where Up is the potential energy and G is the Gravitational constant, M and m the masses and r is the radius.

The above equation has served us well, but it is not strictly accurate, as the energy required to separate any two masses, must also possess some mass at the rate of $E/c^2$. We can correct for this, by using Einstein's special relativity mass gain factor, or gamma, showing the factor for how mass increases with relative velocity.

$$m_1 = m_0 \cdot \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$$

We can properly draw the conclusion that an object falling from infinity, under the force of gravity, will at every point of the way, reach a velocity equal to escape velocity. Therefore and according to special relativity the falling mass must also experience a relativistic mass gain.

We can therefore transform gamma (Einstein's Special Relativity mass gain factor) for use in gravitational equations, by exchanging the velocity term, with the term for escape velocity, as follows..

$$\frac{1}{\sqrt{1 - \frac{2Gm}{rc^2}}}$$

The new term becomes a pure numerical factor, as all the units cancel out.

And now, in a leap of faith, we do the unthinkable, and modify Newton's force law..

$$F = \frac{GMm}{r\sqrt{1 - \frac{2GM}{rc^2}}}$$

It is important to note that this modification to Newtons force law results in a slightly different value of G, and would therefore give the same results as Newton to any problem involving a constant radius, such as circular orbits, but would give different results wherever there is a varying radius.

One of the problems involving a varying radius is finding the potential energy of two masses separated from a distance r to r = ∞ , ie. finding the integral Fdr.

$$U_p = Fdr = \int_r^\infty \frac{GMm}{r\sqrt{1 - \frac{2GM}{rc^2}}} \cdot dr$$

Thanks to my friend Chris Bradley, whose mathematical skills are much better than mine, we solved this problem and found the potential energy solution remarkably looks as follows..

$$U_p = mc^2 \sqrt{1 - \frac{2GM}{rc^2}}$$

What this equation tells us is that the potential energy of a mass m goes towards zero at the SR radius, and not at the origin as in Newtons theory, and that as the radius approaches infinity, the energy approaches $mc^2$.

From the observers own point of view, the net potential energy of it's own mass, appear to be zero, which is probably why it took so long for someone like Einstein to show that energy is stored within mass itself.

Generally, as observers, we are fortunately not not standing on the SR radius looking up, we are at rest in a very weak gravitational field. For the purpose of this theory we shall for the moment ignore the gravitational field of Earth and imagine ourselves free falling in space far from any gravitating body.

Thanks to the electromagnetic forces that prevent us from collapsing towards our own SR radius, we feel no potential, and this is the case for a mass of any size. The energy potential from the observers point of view is therefore always zero.

So how can the potential of a body with a known energy potential of $mc^2$ be zero?

There must therefore be a negative potential of $-mc^2$ present, to balance the forces, and we shall see how that negative potential may turn out to be space itself.

The kinetic energy of a mass is as we know..

$$E_k = \frac{1}{2}mv^2$$

..and a hypothetical mass collapsing inwards on it's own SR radius, must reach the speed of light, in order for the potential energy to reach $mc^2$, therefore substituting v for c, we discover that $mc^2$ is only half the story.

$$E_k = \frac{1}{2}mc^2$$

So in order to satisfy Einstein's energy equivalence we discover that a mass collapsing on its own SR radius only releases half the energy, so what is going on?

What this tells us is that the observer at rest, must be at half it's potential, and that the real potential is $2mc^2$.

So then, was Einstein Wrong?

No, Einstein calculated correctly, that the observers potential energy above the absolute zero point, is $mc^2$, but failed to realize that the space domain of the observer also has a mass equal to m and accounts for $-mc^2$.

Based on this assumption, we can now go on and calculate the mass/energy of one cubic meter of space, by first calculating the volume of all space. We now know the radius, so calculating the volume is simple.

$$V = \frac{2Gm}{H^2} \cdot \frac{4\pi}{3}$$

The simplified expression for the volume of space for any mass m becomes..

$$V = \frac{8Gm\pi}{3H^2}$$

By substituting 1 in place of the mass, we get the space volume for 1 kg mass.

$$V = \frac{8G\pi}{3H^2}$$

The volume of space works out to approximately 8.94 x $10^{25}$ $m^3$, so by dividing 1 by the volume, we calculate that ...

1 $m^3$ of space has a mass of 1.118 x $10^{-26}$ kg

Likewise we can also say that space has energy, by multiplying the above mass by $c^2$, this calculates out to..

1 $m^3$ of space has an energy of 10.0 x $10^{-9}$ Joules

## THE ENERGY OF SPACE

In general terms, one could say that, from the observers point of view, the mass of all space equals the mass of all matter, so it is equally correct to state that space has mass, as it is to say that space has energy.

The observer at rest will always find itself at the midpoint between matter and space, and will, when at rest occupy what appears to be a zero potential, which in fact is the midpoint on a potential energy scale going from zero to $2mc^2$.

We must assume, that the only reason an observer can find itself at rest in the middle of a potential energy field spanning $2mc^2$, must be due to the electromagnetic forces holding the matter up at this potential. Were it not for this electromagnetic force, all matter ought to collapse from it's own gravitational force.

It appears that all matter is suspended at exactly half it's potential, which this gives us a clue as to the strength of the electromagnetic force.

## SUMMARY

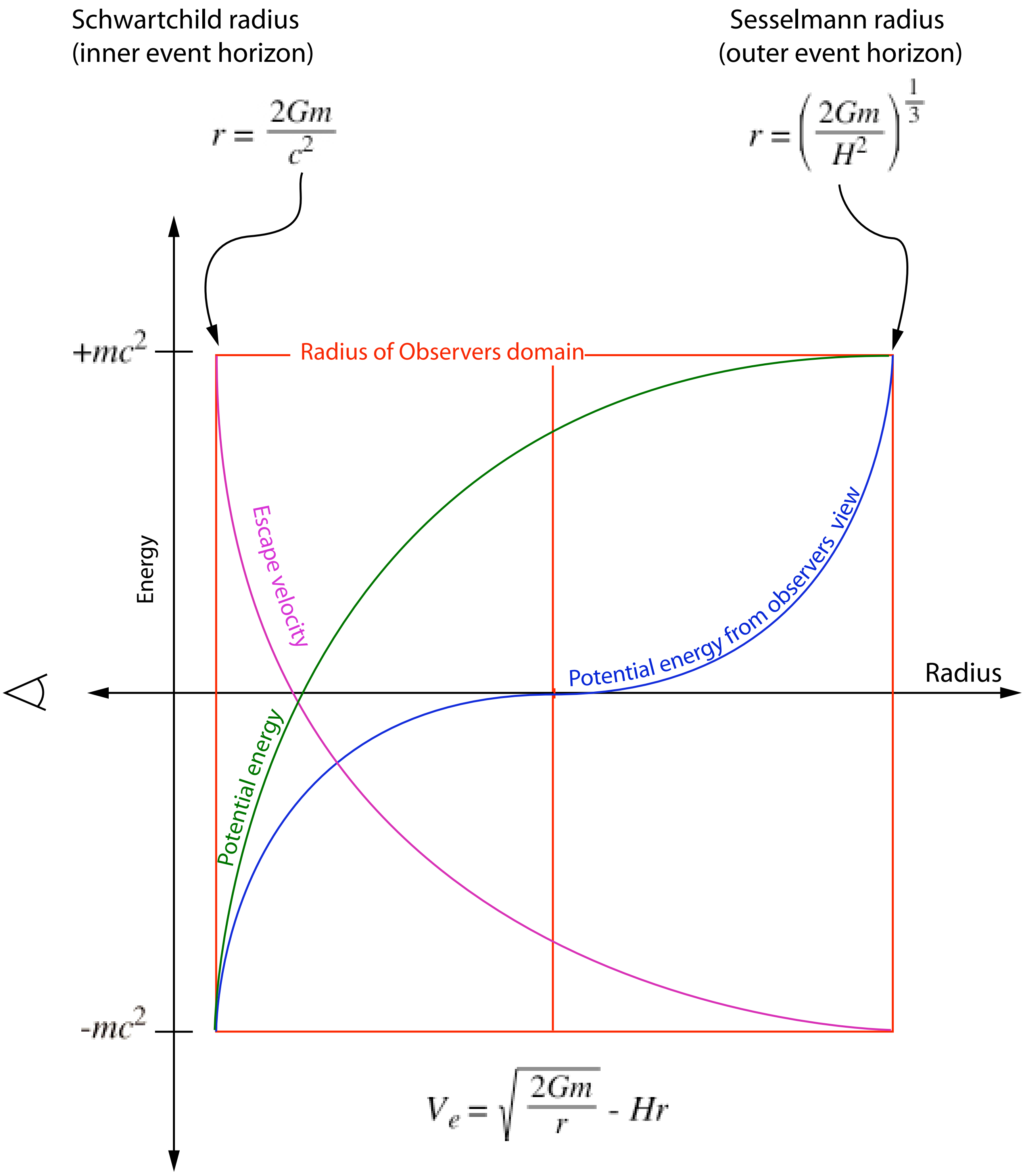
A theory proposing that the domain of an observers Universe stretches from the observers hypothetical Schwarzschild radius near its centre of gravity, to a point on the distant horizon, where the theoretical escape velocity less the Hubble expansion velocity equals zero, further it proposes that the observers total energy domain is $2mc^2$, ranging from $+mc^2$ to $-Mc^2$.

From this theory it becomes clear that both space and matter has mass, and that the mass of all space equals the mass of all matter.

Further work needs to be done to establish if the mass energy predicted by this theory, will explain the current cosmological problems, such as the anomaly in the rotation rate of galaxies.

Another interesting consequence of this theory is in the application of quantum theory and the possibility of uniting the strong force and gravity as one, and explaining why the strong force only appears at close range. •

DOMAIN THEORY DIAGRAM




Steven Sesselmann
Bee Research Pty Ltd
Suite 315 (Level 3)
247 Coward Street
Mascot NSW 2020
Australia

Author:

Steven Sesselmann
Bee Research Pty Ltd
Suite 315 (level 3)
247 Coward Street
Mascot NSW 2020
Australia

Keywords
cosmology, dark matter, dark energy, potential energy, hubble constant, gravity

First Published
23 August 2009
on http://www.fusor.net

[edited 24 August 2009 - minor corrections]
[edited 25 August 2009 - some rewrite and changes]
[edited 26 August 2009 - math error on page 8]
[edited 27 August 2009 - spelling errors]
[edited 06 September 2009 - Correction to space energy equations]
[edited 13 September 2009 - minor corrections]
[edited 24 September 2009 - additions and deletions]
[edited 05 January 2010 - various rewording]

Printed References

J. D. Anderson et al. - Study of the anomalous acceleration of Pioneer 10 and 11
S. G Turyshev et al. - The Study of the Pioneer Anomaly

Web References

http://en.wikipedia.org/wiki/Schwarzschild_radius
http://en.wikipedia.org/wiki/Hubble’s_law
http://en.wikipedia.org/wiki/Newtons_law
http://en.wikipedia.org/wiki/E=mc2
http://hyperphysics.phy-astr.gsu.edu/hbase/HFrame.html
http://en.wikipedia.org/wiki/Chandrasekhar_limit