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Gravity, Density, Acceleration, and the Constants of Nature

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Abstract

The component of light in the 3rd dimension decreases as light enters the 4th dimension created by a Black Hole. Hence particles moving in 3-D space will emit radiation due to the Cherenkov Effect. Gravity and acceleration are the same according to Einstein's Equivalence Principle. Density also has the same effect as gravity because gravity attracts matter thereby increasing matter density. The laws of Physics and all the constants of nature such as the Speed of light, Planck's constant, the Gravitational constant, and so on are a function of the dimension of the space they are in since the vacuum energy density of each higher dimension is greater. We analyze the graph of the accelerated expansion of the Universe to calculate the acceleration for small Redshift z and predict what will happen for larger z values.

Keywords

Density, Speed of Light, Time, Dimensions, Multiverse, Accelerated Expansion of the Universe

1. Introduction

According to Albert Einstein's General Theory of Relativity gravity curves space-time which means time slows down and space curves in the direction of the fourth spatial dimension. Since light follows the curvature of space-time it enters the fourth dimension. Its value diminishes from $c = 3 \times 10^8$ m/s in the high-density region of the accretion disk around the Black Hole and the 4-D space created by the Black Hole to a diminished value c_D. This further diminishes the component of the speed of light in the third dimension to c_d. Gravity and acceleration have the same effect of curving space-time according to Einstein's second postulate of General Relativity also known as the Equivalence Principle. Objects moving faster in the third dimension than the third dimensional com-

ponent of light c_d would radiate energy due to the Cherenkov effect.

2. Gravity, Density, Acceleration, and the Constants of Nature

Newton's formula $g = GM/R^2$ can also be written as $g = 4\pi G\rho R/3$ where g is the gravity on the surface of a sphere of density ρ and radius R. Plugging in the value for G we get $g = 2.79 \times 10^{-10}\ \rho R$, noting that for constant R both g and ρ increase in value simultaneously implying that regions of higher gravity are also regions of larger density. Since gravity is an attractive force, it will attract matter together to increase density.

Comparing the results of Table 1 we note that as Density increases, Gravity increases, and both have the effect of decreasing the Speed of Light in our 3rd dimensional space.

Since gravity is the same as acceleration as per the Equivalence Principle, any object in an accelerated frame of reference close to the speed of light in vacuum, such as electrons or protons in a Synchrotron will behave the same as if inside a Black Hole and will also diminish the 3-D speed of light near them, thereby radiating energy due to the Cherenkov Effect. The greater the acceleration, the greater the diminished speed of light $c_d = c_D\cos\theta$ where θ is the angle between 4-D and 3-D space surrounding the charged particle because the charged particle has increased the curvature of space-time and hence the component of c_D in third dimensional space has become smaller. Since it is impossible for our 3-D minds to imagine the fourth dimension think of a velocity vector $\vec{v}$ pointed at an angle θ in 3-D space out of the plane of the paper. Then the component of the velocity in 2-D space which is the plane of the paper is $v\cos\theta$.

The radiative energy loss per revolution in a synchrotron is $\delta E = 4\pi e^2\beta^3\gamma^4/3\rho$ [1] and for $v = c$, $\gamma \to \infty$ and hence charged particles can never exceed the speed of light in vacuum, which is the maximum speed that a particle can attain as originally stated by Einstein. Cherenkov radiation by the accelerated particle occurs when its speed is greater than c_d. It has never been questioned in the Physics literature why accelerated charged particles in Synchrotrons radiate energy. Now we know, it is because Synchrotron radiation is the same as Cherenkov radiation. Einstein's first postulate of General Relativity stating that all the laws of nature have the same form in an accelerated frame of reference is limited to the accelerated particle not radiating energy because once it begins to

Table 1. Of density experimental results.

Substance	ρ in kg/m³	g in m/s²	Light Speed c in m/s
AIR	1225	$3.42 \times 10^{-10}\ R$	$3 \times 10^8 = c$
WATER	1000	$2.79 \times 10^{-7}\ R$	$2.25 \times 10^8 = 0.75c$
GLASS	2500	$6.98 \times 10^{-7}\ R$	$2 \times 10^8 = 0.67c$
DIAMOND	3500	$9.77 \times 10^{-7}\ R$	$1.25 \times 10^8 = 0.42c$

radiate energy the fourth spatial dimension has been opened and the speed of light has decreased in the 3rd dimension.

We have studied how Dark Energy is responsible for building the dimensions of space [2]. The speed of light decreases in higher dimensions and increases in lower dimensions than that in 3-D space [3] because higher dimensions have more vacuum mass energy density in them while lower dimensions have less. This implies that the permittivity ϵ_0 and permeability μ_0 of free space must be lower in lower dimensions and higher in higher dimensions than its value in 3-D vacuum space. $E = hf$ is the connection between Energy and frequency according to Quantum Mechanics, and since Energy increases in each higher dimension while time slows down, implying frequency $f = 1/t$ decreases, therefore $E/f = h$, the Planck's constant cannot maintain its constant value, increasing in value in higher dimensions of space. The vacuum mass energy density of higher dimensions is greater and since $E/c^2 = m$, the mass of objects in higher dimensions would increase. Every time you add an extra dimension the mass of the object must increase. As an example, a thin 2-D disk of radius r will be lighter than a solid 3-D sphere of the same radius r. The Gravitational Constant can also be written as c^4r/E and hence it decreases with dimension since c decreases and E increases while r, the radial distance has no effect. The Universal Gas constant and Boltzmann's constant (k) have the same units as Entropy that decreases with dimension [2] and therefore both will also decrease with dimension. The Stefan-Boltzmann constant (σ) is proportional to $k^4f/(E^3r^2)$ and since the numerator decreases while the denominator increases σ will decrease. Since the Rydberg constant is inversely proportional to the wavelength and the wavelength λ decreases with density implying that the Rydberg constant will increase with dimension. Energy E is proportional to $q^2/(\epsilon_0 r)$ where r is the radial distance from the charge q of the electron [4]. $E\epsilon_0 r$ is proportional to q^2, therefore its charge q and all the charges related to the electron charge by the quark model for protons and neutrons would also be increased due to the Energy and permittivity being greater in higher dimensions of space. Hence the masses of electrons, protons, neutrons, and the atom would increase while the charges of the electron and the proton would also increase. The Bohr radius $a_0 = h^2\epsilon_0/(\pi m q^2)$ where m and q are the mass and charge of the electron. This formula can be simplified to show that a_0 is proportional to λ^2/r and since λ becomes smaller in denser mediums or in higher dimensions where the vacuum mass energy density increases, the Bohr radius will also decrease. Since the charges of the electron and the proton have become larger the attractive force between them will increase and therefore the Bohr radius will decrease as shown in **Table 2**.

Each dimension has its own unique constants of nature. Some constants will increase while others will decrease with increasing dimension, and then there are the physical constants like Pi, Avogadro's Number, the Fine Structure Constant, and all ratios such as the proton mass to the electron mass ratio that have no units and therefore are dimensionless numbers, independent of the dimension of space-time in which they are measured.

The following statement has been stated verbatim on Page 302 of Chapter 5 of the Book "Dark energy, observational evidence and theoretical models, volume 1" [5]. "*Consequently, the discovery of accelerated expansion of Universe, development of the dark energy concept and radical change of the energy conditions paradigm require detailed analysis of influence of this change on all PET aspects, including different methods of its proving.*"

Hence Dark Energy is not a natural consequence of String Theory and the experiments of the accelerated expansion of the Universe cannot be explained by String Theory Cosmology as shown in **Figure 1**.

Table 2. Of constants of nature and other related quantities that increase or decrease with higher dimension.

Speed of light, Frequency, Wavelength	Decreases
Planck's Constant	Increases
Charge of electron and proton	Increases
Mass of the atom and its constituents	Increases
Bohr Radius	Decreases
Rydberg Constant	Increases
Gravitational Constant	Decreases
Universal Gas Constant	Decreases
Boltzmann's Constant	Decreases
Stefan-Boltzmann Constant	Decreases
Permittivity/Permeability of free space	Increases
Entropy	Decreases
Vacuum mass Energy Density	Increases

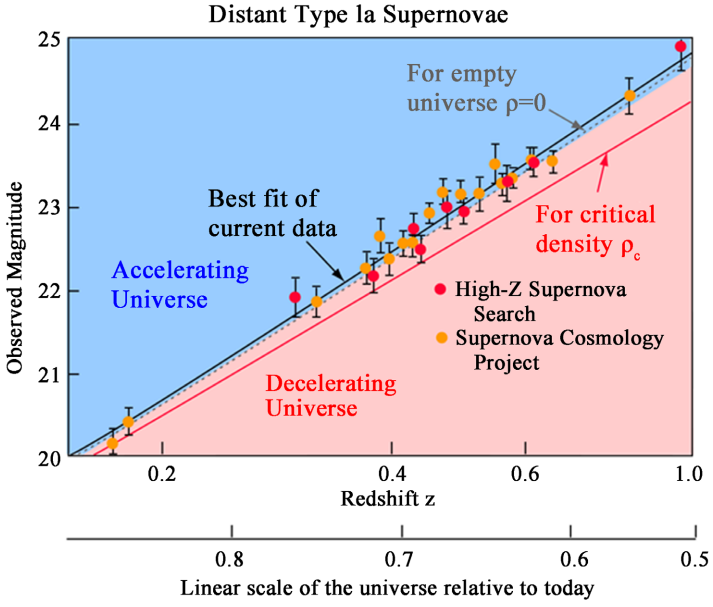

Figure 1. The accelerated expansion of the universe.

Let us analyze the above graph [6] to better understand the accelerated expansion of the Universe. The Supernovae are not accelerating of their own accord, but it is space between us and the distant Type 1a Supernovae that is expanding to push the Supernovae further away from us, and this is what leads to the accelerated expansion of the Universe. As we go further out in space (higher values of Redshift z) the best fit line of the graph goes further into the region of the Accelerating Universe. This is because there is more space that is expanding between our measuring instruments and the distant Type 1a Supernovae. According to Hoyle for distances close to us, the acceleration is zero. For distances between z = 0.6 and 1 we can calculate the acceleration by using the following formulas:

$$v(r)/c = \left\{(z+1)^2 - 1\right\} \Big/ \left\{(z+1)^2 + 1\right\}$$

where $v(r)$ is the recession velocity for Redshift z. For z = 1, $v(1)$ = 0.6 c and for z = 0.6, v (0.6) = 0.44 c and the average velocity between z = 0.6 and 1 is v ($av.$) = 0.52 c and Δv = 0.16 c.

Using the graph m-M = 1.6 between z = 0.6 and 1.

The distance between these two values of z is:

$d = 10^{(m-M+5)/5}$ pc $= 10^{1.32}$ pc = 20.9 pc $= 64.6 \times 10^{16}$ m . The acceleration $a = \Delta v/\Delta t = v(av.)\Delta v/d = 0.012$ m/s^2 . Hence the accelerated expansion of the Universe has increased from 0 to 0.012 m/s^2. The above formula $v(r)/c = \left\{(z+1)^2 - 1\right\} \Big/ \left\{(z+1)^2 + 1\right\}$ is only valid for speeds less than the speed of light. It is only after z = 6 for which $v(r)/c$ = 0.96 that relativity and the quantum nature of space shows up for speeds of expansion greater than the speed of light. The Universe is known to expand faster than the speed of light and hence the acceleration due to Dark Energy becomes much greater for larger distances between our measuring instruments and the source. By measuring Supernovae even further out in space this result can be better quantified as an expression between acceleration and the Redshift z.

3. Conclusion

The laws of Physics are the same in all inertial frames of reference and in all accelerated frames of reference provided the accelerated particle does not have an acceleration great enough to emit radiation as has been observed in Synchrotrons. Black Holes create the fourth dimension through which light and elementary particles can enter the White Hole located in the fourth dimension. However, the vacuum speed of light is lessened from its value of 3 × 10^8 m/s due to the greater mass energy density of 4-D vacuum space while some of the other constants of nature are also all changed. We evaluate the accelerated expansion of the Universe and note that experimental results will begin to show interesting results for z > 6, once we get into and out of the relativistic regime and the quantum nature of space-time begins to exert itself as the speed of light becomes greater than c.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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