Expansion Theory of Light, Matter Particles and Dark Energy in the Universe

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ABSTRACT

Investigate possibility formulation of Expansion theory of Light with the help of Universe expanding concept which was practically well proven. It is often assumed that in the course of the evolution of the universe, the dark energy either vanishes or becomes a positive constant. However, recently it was shown that in many models based on super gravity, the dark energy eventually becomes negative and the universe collapses within the time comparable to the present age of the universe which never is the case in reality. Here describe how Hubble constant was changing over the time and what was the impact of dark energy, also show that how mass particles and Plank constant affected by the dark energy. Any theories of this type have certain distinguishing features that can be tested by cosmological observations.

1 Introduction

The new framework mainly depends on the concept of “Universe expanding” which was practically well proven. Let us assume two objects located 3x10^8 meters apart (it is approximately equal to the speed of the light per sec), say the objects as A and B. Take a light signal C, having a frequency f=3x10^8 Hz , velocity of the signal V= 3x10^8 meters/sec. The light signal takes one sec to travel 3x10^8 meters. Using our basic principle c = nλ, where C= speed of light, n= frequency of the signal, λ= wave length of the signal, the wavelength of the signal is 1 meter.

Distance = Velocity x Time

Here Distance = 3 x 10^8 meters, V= 3 x 10^8 meters/sec

Time = \frac{Distance}{Velocity}

Time = \frac{3x10^8 meters}{3x10^8 meters/sec}

Time = 1sec

So the light signal C takes exactly 1sec to travel from A to B.

Figure: 1
Frequency of the signal $F = 3 \times 10^8 \text{ Hz}$  

$T_0$ $T_1$

Speed of the light $= 3 \times 10^8 \text{ meters/sec} ; \ T_0 - T_1 = 1 \text{sec}$

We know, our universe is expanding at certain rate so, the distance between the two points A and B will be increase by D meters after certain amount of time period, say $T = X$ million years, here D is distance increased due to Universe expansion between the objects.

Total distance between two objects, A and B will become $3 \times 10^8 + D$ meters.

**Figure: 2**

Let's project the same light signal which we discussed before, is having signal frequency $f = 3 \times 10^8 \text{Hz}$ and wavelength $\lambda = 1$ meter. Now find out the time taken to travel from A to B using our basic principle i.e. $\text{Distance} = \text{Velocity} \times \text{Time}$, the light signal C should take more than 1 sec to travel from A to B since the distance was increased by D meters, assume that the speed of the light is constant with the help of Special theory of relativity. But in our experiment, the light signal does not take more than 1 sec even though the distance between the two objects was increased by Dmeters; light signal takes the same amount of time to reach the object B, i.e. 1 sec. From this we can say that the light speed was not constant, it might be changing with respect to time to satisfy the universe expansion principle.

**Figure: 3**

Note: In an ideal case the time taken to travel the signal from A to B should not be equal to 1 sec because the distance between the two objects increased by D meters but speed limit of light does not change. Now from this we can say that, light speed is not just a constant and also it may vary (increase or decrease) over the time.

2 Light Speed Increasing or Decreasing

From the above example we can conclude that the speed of the light is not a constant in the real world. It should be either increasing or decreasing with time.

So the possible cases here are:

Case#1: Light speed is decreasing with respect to time
Case#2: Light speed is increasing with respect to time

**Let's try to elaborate more on case#1:** The Light speed is decreasing with respect to time, it means light speed is inversely proportional to time.

\[ C \propto \frac{1}{t} \]  

Where \( C \) = Speed of light, \( t \) = time in sec

\[ C = \frac{S}{t} \]  

Where \( S \) is proportionality constant

Here the parameter \( t \) has different meaning; it’s the total amount of time from the day one of light speed started decreasing. In our previous example the light signal \( C \) took (fig#3) 1sec to travel from object A to B even though the distance between the objects were increased by \( D \) meter, that means the light signal speed should be increased to satisfy the condition, i.e. The speed of light should increase to travel \( 3 \times 10^8 + D \) meters in 1sec. From this it’s clear that speed is not decreasing, it’s actually increasing with time. Hence the Case#1 is invalid.

**Let us try case#2:** The Light speed is increasing with respect to time. Here the Light speed is proportional to time.

\[ C \propto t \]  

\[ C = St \]  

Where \( C \) = Speed of light, \( t \) = time in sec and \( S \) = Proportionality constant.

We can conclude that the light speed is increasing with respect to time to satisfy the basic principle of Universe expansion concept. I would like to represent the proportionality constant ‘\( S \)’ as universal constant from now onwards.

### 3 Calculate the value of \( S \), Universal Constant

\[ C = St \]  

We know speed of light \( C = 299792458 \frac{m}{s} \)

Universe age \( t = 13.7 \) billion years. Convert the universe age into seconds

\( t = 13.7 \) billion years

\( t = 13.7 \times 10^9 \times 365 \times 24 \times 60 \times 60 \)

\( t = 432043200 \times 10^9 \) sec

Substitute \( C \) and \( t \) values in equation #5

\[ 299792458 = S \times 432043200 \times 10^9 \] sec

Proportionality constant \( S = 0.693894 \times 10^{-9} \frac{m}{s^2} \)  

\[ S \]
So the Universal space constant \( S = 0.693894 \times 10^{-9} \frac{m}{s^2} \)

Here \( S \) is a constant and it has units \( \frac{m}{s^2} \) that means the speed of the light is not just increasing it’s also accelerating with respect to time to satisfy the universe expansion acceleration. In the first example the distance between the two objects is increased by \( D \) meters after \( X \) million years and the light speed is increased by \( L \) m/s and in the same way, the distance between two objects will increase by \( 2D \) meters after \( 2X \) million years since universe expansion is accelerating. So, to satisfy this light velocity is accelerated by \( 2L \) m/s then only the light signal can reach the second object in the same amount of time.

So the constant \( S \) is an accelerating constant.

4 Is the light speed is changing over the time?

From the above calculation, i.e equation#6, came to know that the Universal Space Constant \( S = 0.693894 \times 10^{-9} \text{ meter/ sec}^2 \). It shows that for every 1 sec there will be \( 0.69 \times 10^{-9} \) meters in light speed. Let’s calculate how much time it will take to increase the light speed by 1 m/s.

\[
0.693894 \times 10^{-9} \frac{m}{s^2} \text{ ----- 1 sec}
\]

\[
1 \frac{m}{s^2} \text{ ----- x (it’s the required value)}
\]

\[
X = (1 \text{ sec} \times 1 \frac{m}{s^2}) / 0.693894 \times 10^{-9} \frac{m}{s^2}
\]

\[
X = 1.411423 \times 10^9 \text{ sec}
\]

Converting the \( 1.411423 \times 10^9 \) sec into years…

\[
X = 0.45 \times 10^2 \text{ years}
\]

\[
X = 45 \text{ years} \quad (7)
\]

For every 45 years the speed of the light is increasing by 1 m/s.

The increase in the light speed was very minimal hence we are not able to detect the changes in real time experiments.

5 How the \( C = N \lambda \) affected by the universal constant ‘\( S \)?

From our previous calculations it’s clear that the light speed is increasing; now try to figure out wavelength and frequency of the signal with increase in speed. Basic principle involved here is

\[
C = N \lambda \quad \text{Where}
\]

\( N = \) frequency of the light signal and

\( \lambda = \) Wavelength of the signal.

Here we have 3 different possible scenarios, let’s understand each one of them clearly.

1. \( N \) increased with increase in light speed, keeping \( \lambda \) constant
2. \( \lambda \) is increased with increase in light speed, keeping \( N \) constant
3. Both \( N \) and \( \lambda \) are changing proportional to increase in \( C \).

**Case#1:** Assume frequency (\( N \)) increased with increase in the light speed and wavelength (\( \lambda \)) is constant

Let’s take an equipment which act as a light source having frequency \( N = 3 \times 10^8 \) Hz, the light signal traveling between two points having distance of \( D = 1 \) meters. The light signal is having wavelength of 1 meter.

**Figure: 4**

![Diagram](image)

Frequency of the signal \( N = 3 \times 10^8 \) Hz

Wavelength of the signal \( \lambda = 1 \) meter

Now perform the same experiment after 3 million years, assuming no difference in signal frequency so the equipment generates light signal with the same frequency \( N = 3 \times 10^8 \) Hz. Now the distance between two points changed to \( D = 2 \) meters due to universe expansion, so there will be change in wavelength. Now perform the same experiment after \( X \) million years, the equipment we used in this experiment is designed in such a way that there will not be any change in generated light signal frequency, i.e. \( N = 3 \times 10^8 \) Hz. Assume the distance between two points shown in above fig:4 increased from 1 meter to 2 meters due to universe expansion, here increased distance by 2 meter was an assumption, may not be accurate, it’s just taken for explanation of the theory.

**Figure: 5**

![Diagram](image)

Frequency of the signal \( N = 3 \times 10^8 \) Hz

Wavelength of the signal \( \lambda = 2 \) meter

With this explanation, it is clearly shown that the equipment was capable to generate same frequency which was generated \( X \)-million years before so we can say that frequency is constant all the time hence frequency is not changed but some other parameter might be changing. Let’s focus on that.

**Case#2:** Assume wavelength (\( \lambda \)) increased with increase in light speed and frequency (\( N \)) constant.
From the previous scenario, case#1, the frequency was not changed but the distance between two objects was increased from 1 meter to 2 meter after X million years due to universe expansion. So the light signal wavelength has to stretch by 1-meter to maintaining frequency as constant.

Figure: 6

From this it’s clear that the wavelength of the light signal is changing with respect to the change in time and the change in light speed. Here the wavelength \( \lambda \) is increased because it’s completely depends on the space structure, I mean the wavelength increased but not the frequency to hence the same wave try to stretch and fit between the points.

**Case#3:** Both frequency \( (N) \) and wavelength \( (\lambda) \) are changing proportional to increase in light speed \( C \).

Logically it’s incorrect since proved that the signal frequency is constant in Case#1.

**Why the light speed should be function of light? What happens if not?**

It’s because of the Hubble Constant, we know the basic principle in the universe expansion is, Hubble law

\[
V = HD
\]  
\[H = \frac{1}{t}\]  
\[
C = St
\]

from equation #4

Substitute equation 9 and 4 in equation 8

\[
H = \frac{S}{C}
\]  

From the above equation #10, we can understand that the Hubble constant decreases if the light speed increases, in other words, the universe acceleration rate is constantly decreasing. The reason behind this is to maintain the universe expansion rate because we don’t have infinite length universe, the universe dimensions are finite but the dimensions are in big nu-
If the universe acceleration rate is constant then there is a chance at a particular point the acceleration rate reaches where there is no universe at all. One more important point is the acceleration constant never equal to zero because the light speed is not an infinite. In this way, all the time our universe expansion happens and it never exceeds a limit.

As per Special theory of Relativity the speed of light is a constant, $c$, in the universe, the principle is valid at any instant of time but not for ever. Here our new theory is not violating the Special theory of Relativity. The main reason for the speed limit constant was due to the space structure. The universe space structure allows everything to travel at a particular speed, i.e. called the speed limit which is equal to $c$.

In my opinion the mass of the light particles such as photons never be equal to zero. As the time passes, the space structure changes hence the speed limit changes. So anything can achieve the speed of light in case the object mass is equal to light quanta. The gravitational waves also travel at same speed of the light, $c$.

**Summary 1:**

The light speed is not increasing in general, it’s actually accelerating, the acceleration constant was very less, it is around $S\approx 0.69384 \times 10^{-9} \text{ meter/sec}^2$ hence the practical experiment was not able to detect the minor values. The light speed will increase by 1-meter in every 45 years. That means, the current speed of the light is 299,792,458 m/s, it will increase to 299,792,459 m/s after 45 years. The famous $c = \lambda$ equation is affected with the change and it’s clear that frequency is not changing but the wavelength was affected with light speed change.

Now move on to next topic, that is universe expansion. As we proved the light speed changing over the time so what happens to universe with the behaviors. Let’s analyze all the possibilities of universe changes.

**Expansion Theory of Universe**

The Expansion Theory of Universe explains how the matter was created in the universe. Let’s try to understand why the dark energy exists in our universe and its importance. What happens if a beam of light, i.e. photon falls on the dark energy and what kind of reactions it can make? Does the Photon convert the dark energy into matter? It looks to be, when a Photon interacts with dark energy, Dark energy will be converted into matter particles and these tiny matter particles will be grouped together and form the actual mater objects which we are seeing today in the universe.

**Figure: 7**
I believe universe expansion is nothing but the rate at which the dark energy is converted into matter. The Dark energy might be having capability to bend into any shape. The reason for the expansion is, In the initial days of universe, there was a single light source which was happened due to high density and pressure of the universe, as the time passes the amount of light source increased hence more amount of the dark energy was converted into matter. Dark Energy particles are tightly coupled with each other. The dark energy has a chemical bond in it. Because of the tightly coupling between the dark energy particles, the universe takes any shape but it does not lose the bond between the particles.

7. How the Hubble Constant Changing

Let’s take the Hubble’s equation for our further derivations.

\[ V = HD \] \hspace{1cm} (8)

Where \( V = \text{Recession velocity}, H = \text{Hubble Constant} \) and \( D = \text{Distance} \)

Re-write the Hubble constant as

\[ H = \frac{1}{t} \] \hspace{1cm} (9)

Universal constant, from equation #4, \( C = St \)

From equation #4, #9 and #8

\[ H = \frac{S}{C} \] \hspace{1cm} (10)

From the equation#10, it’s clear that the Hubble acceleration constant is decreasing with increase in the light speed. It does not mean that the universe is negatively decreasing. It is the rate at which the Hubble constant is decreasing, it’s de-accelerating. Though the Hubble constant is decreasing, actually the amount of new space created was constant.

\[ i.e. \quad HC = S \] \hspace{1cm} (11)

It’s clear that, the new space created was constant all the time. It is also one of the main reasons for acceleration constant decreasing. The Hubble constant never become zero here since the light speed never touches infinite. The Hubble constant \( H \) and Light Speed \( C \) are interdependent.

Conclusion from the above derivation:

- The universe expansion accelerating rate is nothing but more amount of the Photons falling on dark energy hence more amount mass particles generated from time to time.
- Using the Expansion Theory of Light, \( C = ST \), mass of an object decreases with respect to time keeping the relative speed of a frame constant hence the energy generated from a particle remains constant.

8. How mass of the generated particles affected

As per the new theory, i.e. Expansion theory of light, \( C = ST \), the mass of an object/particles decreases with respect to time keeping the relative speed of the frame constant so the energy generated from a particle will be same forever even though the speed of the light increases.

Derivation for the above statement:

From Relativity theory

\[ m = \frac{m_0}{\sqrt{1 - \left(\frac{v}{c}\right)^2}} \] \hspace{1cm} (15)
Where  \( m \) = mass of an object in a frame  
\( m_0 \) = initial mass in a reference frame  
\( \nu \) = velocity of given frame  
\( c \) = speed of light

Now assume at certain time in future i.e. \( t = t_1 \) the velocity becomes \( \nu = \frac{c}{2} \)

Substitute, \( \nu = \frac{c}{2} \) in Equation 15

\[
mt_1 = \frac{m_0}{\sqrt{1 - \left(\frac{\nu}{c}\right)^2}}
\]

(16)

\[
mt_1 = \frac{m_0}{\sqrt{\frac{3}{4}}}
\]

(17)

\[
mt_1 = \frac{2m_0}{\sqrt{3}}
\]

(18)

Where \( mt_1 \) = object mass at time \( t_1 \)

Let’s assume at some time the speed of the light increased from \( C \) to \( 2C \) but the velocity of the frame is same.

Now assume at certain time in future i.e. \( t = t_2 \) the velocity becomes \( \nu = \frac{c}{2} \) and \( c = 2c \)

Substitute \( \nu = \frac{c}{2} \) and \( c = 2c \) in Equation 15

Object mass at time \( t_2 \),

\[
mt_2 = \frac{m_0}{\sqrt{1 - \left(\frac{\nu}{2c}\right)^2}}
\]

(19)

\[
mt_2 = \frac{4m_0}{\sqrt{15}}
\]

(20)

If we compare equation 18 and 20, it’s clear that \( mt_2 \) is less than \( mt_1 \), \( mt_2 < mt_1 \)

\( 21 \)

9. How Plank Constant affected

We know Plank’s energy equation \( E = hf \)

\( E \) = Energy of light signal

\( h \) = Plank’s constant

\( f \) = frequency of light signal

We know Eienstien mass Energy equation, \( E = mc^2 \)
Energy of a given particle

\[ E = mc^2 \]

mass of the particle

\[ m = \text{mass of the particle} \]

c = speed of light

Substitute equation 22 in 23

\[ hf = mc^2 \] (24)

We know

\[ c = f \lambda \] (25)

Substitute equation #25 in #24

\[ \frac{hc}{\lambda} = mc^2 \] (26)

\[ h = mc\lambda \] (27)

From the Expansion Theory of Light, the speed of light \( C \) increases with respect to time and Wavelength of the light signal increases

\[ C \rightarrow \text{Increasing with respect to time} \]
\[ \lambda \rightarrow \text{Increasing with respect to time} \]

And from section 9 of the paper, we concluded that the mass of the generated particles decreases over the time

\[ m \rightarrow \text{decreasing with respect to time} \]

So the Plank Constant \( h \) remains constant forever, irrespective of change in \( m, c, \lambda \).

10. Total available free space in the universe

As per Big Bang theory, the experiments proved that our universe is having age of around 13.7 billion years. By taking the universe age as one of the parameter let’s try to calculate total available free space in the universe. The following calculations use the Expansion Theory of Light, \( C = St \), here \( t = \) universe age in seconds

\[
\text{Universe length } L = \sum_{t=1}^{13.7 \text{ billion years}} 0.6938 \times 10^{-9} \\
= 1 (0.6938 \times 10^{-9}) + 2(0.6938 \times 10^{-9}) + \ldots + 13.7 \text{ billion years}(0.6938 \times 10^{-9}) \\
= 0.6938 \times 10^{-9} (1 + 2 + \ldots + 13.7 \text{ billion years})
\]

Convert 13.7 billion years into seconds …

\[ = 0.6938 \times 10^{-9} (1 + 2 + \ldots + 432043200 \times 10^9) \]

\[ = 0.64 \times 10^{26} \text{ meters} \]

Length of our universe \( L = 6.4 \times 10^{25} \text{ meters} \) (29)

This not exactly the total universe dimensions but its total free space available in our universe.
Summary 2:

It is clear from the above theoretical explanation, our universe is completely filled with dark energy, the mass particles will be generated when the dark energy interacts with light photons. The universe acceleration is not just a constant, it is actually decreasing but it’s not negatively decreasing. The generated mass particles do not have a constant mass forever, the mass of particles decreases with respect to time but interesting thing is, the Plank constant is going to be constant forever, it’s the one of universal constant.

Expansion Theory of Matter

As I described how matter was generating in previous topics, called Expansion Theory of Universe. Let’s take the Photo Electric Effect equation for deriving the mathematical equation.

\[ hf = KE + W0 \]  \hspace{1cm} (30)

\[ h = \text{Plank’s constant} \]

\[ f = \text{frequency of light signal} \]

\[ KE = \text{Kinetic Energy of photon} = \frac{mv^2}{2}, \text{velocity at generated photon moves} \]

\[ W0 = \text{Work function is the minimum energy required to emit a photon} \]

\[ hf = \text{Energy of photon} \]

As per Expansion Theory of Universe, when a light photon interacts with dark energy, the dark energy will be converted to matter particles. Let’s replace the work function \( W0 \) with mass energy equivalence theory, \( E = mc^2 \) which is equal to energy of the generated matter particle. It’s also nothing but energy stored in that particular matter particles.

\[ W0 = mc^2 \]

\[ hf = KE + mc^2 \]  \hspace{1cm} (31)

\[ hf = \frac{mv^2}{2} + mc^2 \]  \hspace{1cm} (32)

Here the dark energy has particular frequency at which the matter particles could generate. The frequency required to convert the dark energy into matter particles is called Threshold frequency.

\[ \text{Threshold frequency} = f0 \]  \hspace{1cm} (33)

At exact the threshold frequency the generated particles will not have any kinetic energy.

\[ KE=0 \text{ at } f0=0 \]  \hspace{1cm} (34)

\[ hf = 0 + mc^2 \]

\[ hf = mc^2 \]  \hspace{1cm} (35)

\( M0 = \text{mass of the generated particles. The } m0 \text{ remains constant for different frequencies.} \)
11. Light frequency is unequal to Threshold frequency

Let’s find out if the photon frequency is not equal to threshold frequency, either the light frequency is less than or more than threshold frequency.

We have three different conditions here:

Case#1: light frequency = Threshold frequency (F=f0)

Case#2: light frequency > Threshold frequency (F>f0)

Case#3: light frequency < Threshold frequency (F<f0)

Let’s explain each case in detailed.

Case#1: Here the light photon frequency is equal to Threshold frequency (F=f0)

At threshold frequency the Kinetic energy of generated particle is equal to zero

\[ KE = 0 \]

Substitute KE=0 in equation 31

\[ hf = 0 + mc^2 \]

\[ hf = mc^2 \quad (36) \]

The generated particles at the threshold frequency will not have any kinetic energy hence the particles will not move by its own. That means external energy is required to move the particles. This kind of particles is called Regular matter particles which we see in our real world. For example Earth made up of these regular particles. Any particles we see in real universe are made up of these regular matter particles.

Case#2: Here the light photon frequency is greater than Threshold frequency (F>f0)

From equation 3, we know \( hf_0 = m_0c^2 \), \( hf_0 \) is the minimum energy required to generate a particles from the dark energy. In this scenario, the frequency is above the threshold frequency hence the energy of photon is more than required so additional energy will act as kinetic energy of generated particles.

\[ hf = KE + m_0c^2 \]

\[ KE = hf - m_0c^2 \quad (37) \]

\[ KE = +ve energy \quad Because \ hf > m_0c^2 \quad (38) \]

In this scenario the particles move with positive kinetic energy. For different frequency, there will be different kinetic energy levels. That means different particles move at different velocities. This kind of particles is called Dark matter particles.

Case#2: Here the light photon frequency is less than Threshold frequency (F<f0)

\[ hf = KE + m_0c^2 \]

\[ KE = hf - m_0c^2 \quad (37) \]

\[ KE = -ve energy \quad Because \ hf < m_0c^2 \quad (38) \]
Particles having negative kinetic energy are called Antimatter particles.

- The Antimatter particles collide with dark matter particle which are having same amount of positive kinetic energy and generates energy, this process is called Annihilation process.
- The main reason for having the dark matter particles more gravitational force compare to regular matter was due to the velocity of the particles and kinetic energy in it.
- From our previous scenario we can say that the frequency available below the threshold frequency is less than the frequency above the threshold frequency hence there is more chance of having dark matter particles compare to Antimatter particles. Also the antimatter particles collide with equal positive energy dark matter particles so there should not be any antimatter particles available in our universe. But I believe there could be minimal amount of antimatter particles available in our universe those may not be having equal positive energy dark matter particles. This is the main reason why not able to see antimatter particles in our universe.

Summary 3:

1. Matter Particles having zero kinetic energy act as Regular matter
   Kinetic Energy =0
2. Matter Particles having positive kinetic energy act as Dark matter
   Kinetic Energy = positive energy = (+Ve) energy
3. Matter Particles having negative kinetic energy act as Antimatter
   Kinetic Energy = negative energy = (−Ve) energy
4. Antimatter particles collide with dark matter particles if the energy levels of the particles are equal but having opposite polarity. The collision release maximum amount of energy due to Annihilation Process.

12 Conclusion:

The light speed is not increasing, it’s actually accelerating, the acceleration constant was very less, it would be around \( S = 0.693894 \times 10^{-9} \text{ meter/sec}^2 \) hence the practical experiments were not able to detect the minor values. The light speed will increase by 1 meter in every 45 years. That means, the current speed of the light is 299,792,458 m / s, it will increase to 299,792,459 m / s after 45 years. The famous \( C = N \lambda \) equation is affected with the change and it’s clear that frequency is not changing but the wavelength was affected with light speed change.

Our universe is completely filled with dark energy, the mass particles will be generated when the dark energy interact with light photons. The universe acceleration is not just constant, it is actually decreasing but it’s not negatively decreasing. The generated mass particles does not have a constant mass for ever, the mass of particles decreases with respect to time but interesting thing is, the Plank constant is going to be constant forever, it’s the one of universal constant.

1. Matter Particles having zero kinetic energy act as Regular matter
   Kinetic Energy =0
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   Kinetic Energy = negative energy = (−Ve) energy
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