How does the quantum structure of electromagnetic waves describe quantum redshift?

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Abstract

The paper introduces quantum redshift. By using the quantum structure of the electromagnetic waves, we can describe the redshift. Losing the quanta masses along the traveling in the space is the reason of the decreasing the frequency of the electromagnetic waves. Recursive quantum redshift predict distance of the objects by calculating the z parameter of the waves since they have emitted. Non-recursive quantum redshift is a fast and good approximation of the recursive quantum redshift. The distances in the quantum redshift is less than the distances in the accelerated expansion space theory. The paper provides z parameter of distances between zero and 12 billion light years.

Introduction

Cosmic redshift or shift in spectral lines is a powerful tool for calculating the distance of the objects in the universe. It belongs to the electromagnetic waves area and usually happens when the wavelength of a wave decrease by traveling in the space. The measurement parameter of the cosmic redshift is z. The value of the z usually is a positive number, and more distance is equal to the greater z value. In some cases, the value of the z is negative, and we have Blueshift.

Although the redshift is known by name of the Edwin Hubble [1], Vesto Slipher (1875-1969) was the first astronomer who measured it [2]. Also, the redshift of the cosmic waves has measured by Carl W. Wirtz (1922) and the Swede Knut Lundmark (in 1924) [3,4].

There are many theories for describing the behavior of the wave in the space and increasing its wavelength. Doppler effect is the most similar theory that has been used for investigating the cosmic redshift [5-9]. In the Doppler effect, changing the wavelength is due to changing of the distance between emitter and observer during the traveling of the wave between them. In 1848 Hippolyte Fizeau proposed that cosmic redshift is like the Doppler effect. In 1968 William Huggins measured the velocity of the stars by using the Doppler effect formula. According to this method, objects that come toward us have the Blueshift, while objects that move away have the redshift.

Using spectral lines and the Doppler effect method showed that the speed of some stars and galaxies should be more than the speed of light. This issue disagreed with Einstein's special relativity [13-16]. Hence, the expanding universe theory is proposed. In the expanding space theory, the distance between two objects in the space will be increased along the time even they do not move. In the expanding space theory, the reason for the redshift of the waves is expanding the space. Also, by increasing the distance between the objects their expansion rate will be increased.

If we accept the expansion of the space, we should find dark energy that makes this expansion. The expanding space theory has two problems. The dark energy is not discovered yet, and not possible to build a realistic model of the universe on modes of unrestrained expansion [17].

The gravitational redshift is another theory that tries to describe the spectral displacement by using general relativity [18-22]. Although there is a significant redshift for massive objects, it is a weak effect for non-massive stars.

The purpose of this work is to represent recursive quantum redshift and non-recursive quantum redshift for measuring the distance of the objects. Concepts of the quanta mass [23] and quantum structure of the electromagnetic waves [24] are the main parts of this theory. In the quantum redshift, regardless of the frequency of the wave, each period of the wave conclude equal number of the quanta masses. The number of the quanta masses in each period will be decreased by traveling in the space, hence the energy of the wave will be decreased.

The quantum redshift disagreed with the accelerated expansion of the space; hence the results of the quantum redshift show that the real distances of the objects are less than the distances that have been obtained in the expanding space theory.

Recursive quantum redshift

The frequency of the wave is equal to the total number of the k boxes that carry in a second. On the other hand, while k boxes move in a vacuum, in each second, one quantum of the mass will be decreased from each k box. Hence, in each second, the total number of the decreased quanta masses that have distributed in 299792458 meters is equal to the frequency of the wave at that time multiplied by the p or $f_{t_n} * p$ where p is the number of the quanta masses that will be decreased in each second from each k box and f_{t_n} is the frequency of the wave at the start of each second or total number of the k boxes that wave carry in a second.

If result of the $f_{t_n} * p$ be less than the q, the frequency will not be decreased and this operation will be continued t_n seconds until the sum of the lost quantum of the masses for all the k boxes reaches to q. After passing t_n seconds wave has concluded f_{t_n} k boxes that all of them are not the full field, hence some of them will be destroyed and send their remain quanta masses to others, this operation will be decreased frequency of the wave. The amount of the t_n is given by:

$$t_n = \left\lceil \frac{q}{f_{t_n}} \right\rceil \tag{1}$$

Where the t_n is the counts of seconds that k boxes lose their quanta masses until the sum of the lost quantum masses reaches the capacity of the one k box (q). If $\mathrm{f}_{\mathrm{t}_\mathrm{n}} > \mathrm{q}$ then $\mathrm{t}_\mathrm{n} = 1$.

The total number of the decreased quanta masses in t_n second is given by:

$$\mathrm{S}_{t_n} = t_n * f_{t_n} * p + R_{t_{n-1}} \tag{2}$$

$$R_{t_0} = 0$$

Where S_{t_n} is the total number of the lost quanta masses in the t_n seconds and $R_{t_{n-1}}$ is the remain number of division $\frac{S_{t_n}}{q}$ in the previous step ($0 \le R_{t_{n-1}} < q$).

After passing t_n seconds and reaching the number of the lost quanta masses (S_{t_n}) to greater than the capacity of the one k box (q), k boxes will be reconstructed and the wave will be lost some k boxes by sharing remain quanta masses of lost k boxes for fulling fields remain k boxes. Hence, frequency will be decreased. Equation is given by:

$$f_{l_n} = \left\lfloor \frac{S_{t_n}}{q} \right\rfloor \tag{3}$$

Where f_{l_n} is the amount of the frequency that will be decreased.

Table.1 illustrates the parameters of the quantum redshift in each step.

Table.1: Parameters of the Recursive quantum redshift in each step.

f_{t_n}	$t_n = \left\lceil \frac{q}{f_{t_n}} \right\rceil$	$S_{t_n} = R_{t_{n-1}} + t_n * f_{t_n} * p$ $(R_{t_0} = 0)$	f_{l_n}	$R_{t_n} = S_{t_n} - f_{l_n} * q$	$f_{t_{n+1}} = f_{t_n} - f_{l_n}$
$f_{t_1} = f_{emit}$	$\left\lceil \frac{q}{f_{t_1}} \right\rceil$	$S_{t_1} = R_{t_0} + t_1 * f_{t_1} * p$	$\left\lfloor \frac{S_{t_1}}{q} \right\rfloor$	$R_{t_1} = S_{t_1} - f_{l_1} * q$	$f_{t_2} = f_{t_1} - \left\lfloor \frac{S_{t_1}}{q} \right\rfloor$
$f_{t_2} = f_{t_1} - \left\lfloor \frac{S_{t_1}}{q} \right\rfloor$	$\left\lceil \frac{q}{f_{t_2}} \right\rceil$	$S_{t_2} = R_{t_1} + t_2 * f_{t_2} * p$	$\left\lfloor \frac{S_{t_2}}{q} \right\rfloor$	$R_{t_2} = S_{t_2} - f_{l_2} * q$	$f_{t_3} = f_{t_2} - \left\lfloor \frac{S_{t_2}}{q} \right\rfloor$
$f_{t_3} = f_{t_2} - \left\lfloor \frac{S_{t_2}}{q} \right\rfloor$	$\left\lceil \frac{q}{f_{t_3}} \right\rceil$	$S_{t_3} = R_{t_2} + t_3 * f_{t_3} * p$	$\left\lfloor \frac{S_{t_3}}{q} \right\rfloor$	$R_{t_3} = S_{t_3} - f_{l_3} * q$	$f_{t_4} = f_{t_3} - \left\lfloor \frac{S_{t_3}}{q} \right\rfloor$
$f_{t_n} = f_{t_{n-1}} - \left\lfloor \frac{S_{t_{n-1}}}{q} \right\rfloor$	$\left\lceil \frac{q}{f_{t_n}} \right\rceil$	$S_{t_n} = R_{t_{n-1}} + t_n * f_{t_n} * p$	$\left\lfloor \frac{S_{t_n}}{q} \right\rfloor$	$R_{t_n} = S_{t_n} - f_{l_n} * q$	$f_{t_{n+1}} = f_{t_n} - \left\lfloor \frac{S_{t_n}}{q} \right\rfloor$

The results of the equation $\frac{S_n}{q}$ is not an integer number, hence a few numbers of k boxes will be remained, and we should consider them in the next operation, hence:

$$R_{t_n} = S_{t_n} - f_{l_n} * q \tag{4}$$

on the other hand,

$$f_{t_{n+1}} = f_{t_n} - f_{l_n} \tag{5}$$

where

$$f_{emit} = f_{t_1} \tag{6}$$

and

$$f_{obs} = f_{t_{n+1}} \tag{7}$$

in the quantum redshift

$$\mathrm{f_{t_{n+1}}} = \mathrm{f_{t_n}} - \left[\frac{\mathrm{S_{t_n}}}{\mathrm{q}}\right] \tag{8}$$

also

$$f_{t_n} = f_{t_{n-1}} - \left[\frac{\mathrm{S}_{t_{n-1}}}{q}\right] \tag{9}$$

and

$$f_{t_{n-1}} = f_{t_{n-2}} - \left[\frac{\mathrm{S}_{t_{n-2}}}{q}\right]$$

hence

$$f_{t_{n+1}} = f_{t_{n-1}} - \left[\frac{\mathrm{S}_{t_{n-1}}}{q}\right] - \left[\frac{\mathrm{S}_{t_n}}{q}\right]$$

so

$$f_{t_{n+1}} = f_{t_{n-2}} - \left[\frac{\mathrm{S}_{t_{n-2}}}{q}\right] - \left[\frac{\mathrm{S}_{t_{n-1}}}{q}\right] - \left[\frac{\mathrm{S}_{t_n}}{q}\right]$$

or

$$f_{t_{n+1}} = f_{t_1} - \sum_{k=0}^{n-1} \left[\frac{\mathrm{S}_{t_{n-k}}}{q}\right] \tag{10}$$

using (6) and (7)

$$f_{obs} = f_{emit} - \sum_{k=0}^{n-1} \left[\frac{\mathrm{S}_{t_{n-k}}}{q}\right] \tag{11}$$

on the other hand,

$$z = \frac{f_{emit} - f_{obs}}{f_{obs}}$$

using (11)

$$z = \frac{f_{emit} - f_{emit} - \sum_{k=0}^{n-1}\left[\frac{S_{t_{n-k}}}{q}\right]}{f_{emit} - \sum_{k=0}^{n-1}\left[\frac{S_{t_{n-k}}}{q}\right]}$$

so

$$z + 1 = \frac{f_{emit}}{f_{emit} - \sum_{k=0}^{n-1}\left[\frac{S_{t_{n-k}}}{q}\right]} \tag{12}$$

The equation (11) provides the amount of the frequency in the next step based on the frequency of the previous step. Also, the equation (1) provides the time for decreasing frequency in each step. In the quantum redshift for calculating the distance of a remote galaxy we use the total time of traveling the wave between the galaxy and the observer, the equation is given by:

$$\mathrm{t} = \sum_{i=1}^{n} t_i \tag{13}$$

so

$$d = c * \sum_{i=1}^{n} t_i \tag{14}$$

In the equations (13) and (14) amount of the parameter n is not specified at the first. These equations represent recursive procedure; hence we need a computer program that according to the f_{obs} step by step calculate previous frequencies and time of that step until the frequency reaches to the f_{emit}.

Approximating recursive quantum redshift to non-recursive quantum redshift

Although environmental parameters such a temperature, have an impact on the p, in a normal space we can use it as a constant value. Also, the value of the q is invariant, On the other hand, in the equation (4), the amount of the R_{t_n} is too small and we can omit it. A simple relationship between $f_{t+1}$and f_t in each second is given by:

$$f_{t+1} = f_t - f_t \times \frac{p}{q} \tag{15}$$

where p = 1, q = 89875518173474223, and $\frac{p}{q}$ =1.1126500523422173523 57E-17

Hence, t seconds after emitting, f_{obs} would be obtained depend on f_{emit} by this equation:

$$f_{obs} = f_{emit}\left(1 - \frac{p}{q}\right)^t \tag{16}$$

The equation (16) is a non-recursive quantum redshift.Table.2 shows the changes of the frequency in consequence seconds, respectively.

Table.2: Parameters of the non-Recursive quantum redshift in each step.

Time	Frequency	f_{l_t}	$f_{obs}= f_{emit}- f_{l_t}$	f_{obs}
1	f_{emit}	$f_{emit} \times \frac{p}{q}$	$f_{emit} - f_{emit_m} \times \frac{p}{q}$	$f_{emit}(1-\frac{p}{q})$
2	$f_{emit}(1-\frac{p}{q})$	$f_{emit}(1-\frac{p}{q}) \times \frac{p}{q}$	$f_{emit}\left(1-\frac{p}{q}\right) -$ $f_{emit}(1-\frac{p}{q}) \times \frac{p}{q}$	$f_{emit}(1-\frac{p}{q})(1-\frac{p}{q})$ $=f_{emit}(1-\frac{p}{q})^2$
3	$f_{emit}(1-\frac{p}{q})^2$	$f_{emit}(1-\frac{p}{q})^2 \times \frac{p}{q}$	$f_{emit}(1-\frac{p}{q})^2 -$ $f_{emit}(1-\frac{p}{q})^2 \times \frac{p}{q}$	$f_{emit}\left(1-\frac{p}{q}\right)^2 \times \left(1-\frac{p}{q}\right)$ $=f_{emit}(1-\frac{p}{q})^3$
t	$f_{emit}(1-\frac{p}{q})^{t-1}$	$f_{emit}(1-\frac{p}{q})^{t-1} \times \frac{p}{q}$	$f_{emit}\left(1-\frac{p}{q}\right)^{t-1} -$ $f_{emit}(1-\frac{p}{q})^{t-1} \times \frac{p}{q}$	$f_{emit}(1-\frac{p}{q})^t$

Calculating time by using frequency

By using the equation of the non-recursive quantum redshift and according to the definition of the z we can calculate the time between the emitter and observer.

$$z = \frac{f_{emit}-f_{obs}}{f_{obs}} \tag{17}$$

using (16)

$$z = \frac{f_{emit}-f_{emit}\left(1-\frac{p}{q}\right)^t}{f_{emit}\left(1-\frac{p}{q}\right)^t} \tag{18}$$

so

$$z = \frac{1-\left(1-\frac{p}{q}\right)^t}{\left(1-\frac{p}{q}\right)^t} \tag{19}$$

or

$$z + 1 = \frac{1}{\left(1-\frac{p}{q}\right)^t} \tag{20}$$

$(1-\frac{p}{q})$ is a constant value, hence

$$z + 1 = \frac{1}{\beta^t} \tag{21}$$

where

$$\beta = 1 - \frac{p}{q} \tag{22}$$

so

$$t = \log_\beta\left(\frac{1}{Z+1}\right) \tag{23}$$

On the other hand, p = 1 and q = 89875518173474223, hence

$$\beta = 0.99999999999999999888735 \tag{24}$$

Calculating distance by using frequency

The equation (16) represents the relationship between the f_{emit} and f_{obs}.

$$f_{obs} = f_{emit}\left(1 - \frac{p}{q}\right)^t$$

on the other hand,

$$t = \frac{d}{c} \tag{25}$$

hence

$$f_{obs} = f_{emit}\left(1 - \frac{p}{q}\right)^{\frac{d}{c}} \tag{26}$$

so

$$\frac{f_{obs}}{f_{emit}} = \left(1 - \frac{p}{q}\right)^{\frac{d}{c}}$$

or

$$\frac{d}{c} = \log_{\left(1 - \frac{p}{q}\right)}\left(\frac{f_{obs}}{f_{emit}}\right)$$

using (22)

$$d = c \times \log_\beta\left(\frac{f_{obs}}{f_{emit}}\right) \tag{27}$$

Calculating distance by using z

Using equations (20) and (25)

$$z + 1 = \frac{1}{\left(1-\frac{p}{q}\right)^{\frac{d}{c}}} \quad (27)$$

or

$$z + 1 = \left(1 - \frac{p}{q}\right)^{-\frac{d}{c}} \quad (28)$$

so

$$-\frac{d}{c} = \log_{\left(1-\frac{p}{q}\right)}(z + 1) \quad (29)$$

using (22)

$$d = \ -c * \ \log_{\beta}(z + 1) \quad (30)$$

Discussion

In the real world, scientists obtain the parameter z of the objects in the space and calculate their distance to the observer. The equation (14) provides a recursive quantum redshift method for calculating the distance of the objects while the equation (30) represents a non-recursive quantum redshift method. The advantage of the non-recursive quantum redshift method is its higher speed of the calculation. For calculating the distance of the object by using the equation (14) we need a computer program and fast computer, but equation (30) is a simple equation that could be calculated by a professional calculator. The only restriction of the equation (30) is the value of the β, it is too close to the 1, and for calculating $\log_{\beta}$ we need a calculator that supports this kind of calculation. In this paper, we have used an online calculator from this internet address https://keisan.casio.com/calculator.

However, we should compare the results of both methods to ensure that the results of the non-recursive quantum redshift method are reliable. For this reason, we wrote a program and calculate the parameter z for distances between zero to almost 8 billion light-years. This range of distances covers z parameters between zero and 12. In the table.3 the columns (1) and (2) represent the relation between the special distances and their z value in the recursive quantum redshift, respectively. We should consider that result in the quantum redshift is not in agreement with the accelerated expansion universe theory, hence the distances that would be obtained from each z by the quantum redshift would be less than the distances that has been calculated by the accelerated expansion universe method.

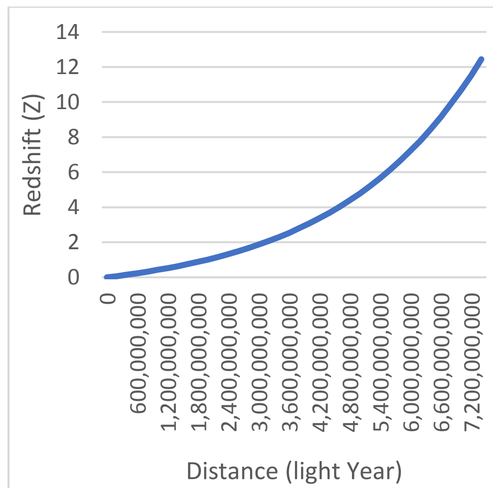
In the next step, we used all z parameters in the column (2) for calculating the distances of the objects in equation (30). The results have been shown in the column (3). The difference between the two methods is too small, and less than $1 * 10^{-5}$ percent, hence results of the non-recursive quantum method are reliable.

Table.3: Comparing distances in the Recursive quantum redshift and non-Recursive quantum redshift.

Quantu0m redshift		
Recursive (Light Year)	**z**	**non-Recursive (Light Year)**
0	0	0.00
200000000	7.27496578431443E-02	199,999,996.17
400000000	0.150791769911269	399,999,847.59
600000000	0.234511509968063	599,999,918.85
800000000	0.324321765161994	799,999,840.27
1000000000	0.420665803908163	1,000,000,003.75
1200000000	0.524018677229894	1,199,999,854.50
1400000000	0.634890525686787	1,399,999,870.08
1600000000	0.753828278288702	1,599,999,908.87
1800000000	0.881418650808816	1,799,999,852.61
2000000000	1.01829126919994	1,999,999,926.79
2200000000	1.16512135640523	2,200,000,038.65
2400000000	1.32263320410299	2,400,000,046.88
2600000000	1.4916040729006	2,600,000,154.96
2800000000	1.67286727326276	2,799,999,998.31
3000000000	1.86731773894792	3,000,000,278.65
3200000000	2.07591394054181	3,200,000,105.53
3400000000	2.29968547810483	3,399,999,972.96
3600000000	2.53973686481081	3,600,000,288.70
3800000000	2.79725145446597	3,800,000,242.78
4000000000	3.07350020087448	4,000,000,240.60
4200000000	3.36984631250519	4,200,000,475.17
4400000000	3.68775041010491	4,400,000,030.00
4600000000	4.02878349955558	4,600,000,508.16
4800000000	4.39462526741326	4,800,000,234.50
5000000000	4.78708308587525	5,000,000,563.39
5200000000	5.20809053879242	5,200,000,164.35
5400000000	5.65972667649254	5,400,000,021.60
5600000000	6.14421900960585	5,599,999,816.89
5800000000	6.66395841536164	5,799,999,782.31
6000000000	7.22150797871657	5,999,999,505.14
6200000000	7.8196205688986	6,199,999,726.63
6400000000	8.46124702783795	6,400,000,348.99
6600000000	9.14954723504131	6,599,999,706.28
6800000000	9.88792379542136	6,799,999,825.86
7000000000	10.6800171696252	6,999,999,978.93
7200000000	11.529738551343	7,200,000,913.62
7400000000	12.4412667049743	7,399,999,630.26

Fig.1 illustrates the relationship between distances and their z parameters in the quantum redshift theory. By increasing the distance, the z will be increased more. Meanwhile, this graph shows that the percent of the increase in the z parameter is more than the increasing percentage of the distance. This agrees with the real data of the universe.

Fig.1: distances and their z parameters in the quantum redshift



Another thing that we should consider is the value of the β. Although, the value of the q is invariant (q = 89875518173474223), the value of the p is not constant. In this paper, we assumed that the parameter p is the number of quanta masses that each individual k box of the wave lose in each second and it could be depend on the environmental parameters such as the temperature of the space, hence the obtained distances in the quantum redshift theory should be assumed as the nearest distance of the object. However, we should consider that there is no restriction to decrease one quanta mass from all k boxes at the same time, p is the average number of the decreased quanta masses in a second.

Fig.2 shows a simple model of k boxes and period of the wave. Fig.3 illustrates a three-dimensional model of the virtual k boxes. Each k box contains $q = c^2 + c + 1$ quanta masses where c = 299792458. Although the capacity of all k boxes is invariant, k boxes are not full field at the all-time.

Fig.2: two-dimensional view of an electromagnetic wave and virtual k box

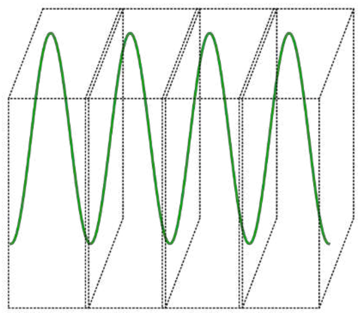
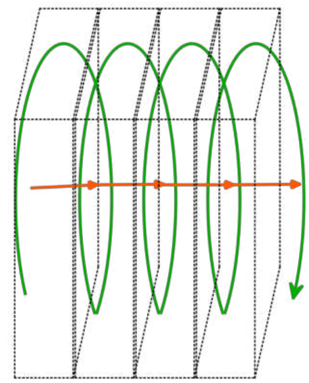


Fig.2: Three-dimensional view of an electromagnetic wave and virtual k box



Conclusion

Quantum redshift predicts distance of the objects in the space. All electromagnetic waves have made of equal number of quanta masses in each period. Losing the quanta masses along the traveling in the space is the reason of decreasing the frequency of the waves.

For the equal z parameters, the distances that obtain by the quantum redshift is less than the same distance in the accelerated expansion space theory. The error of the non-recursive quantum redshift is less than $1 * 10^{-5}$ percent to recursive quantum redshift.

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Figures

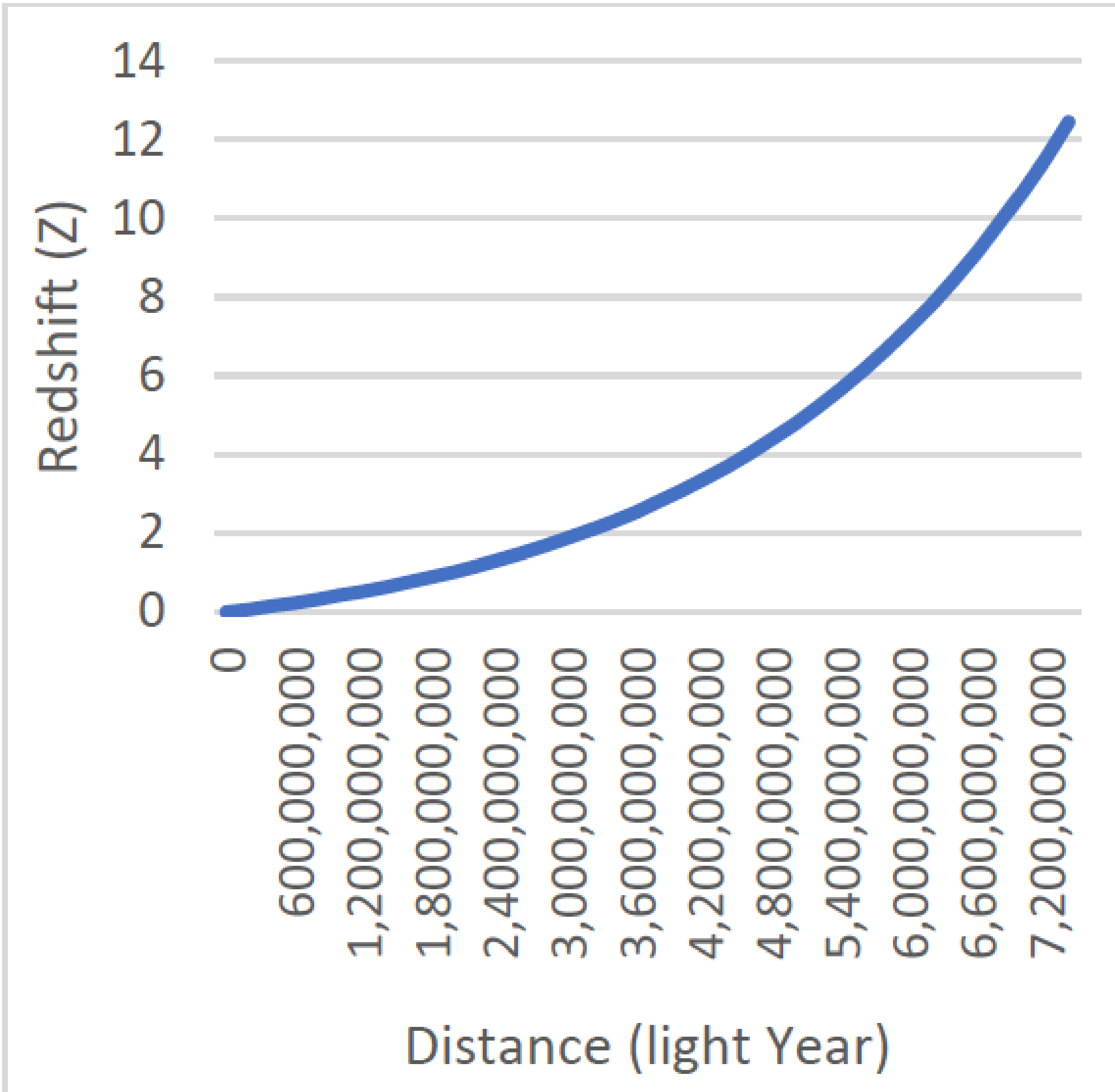

Figure 1

distances and their z parameters in the quantum redshift

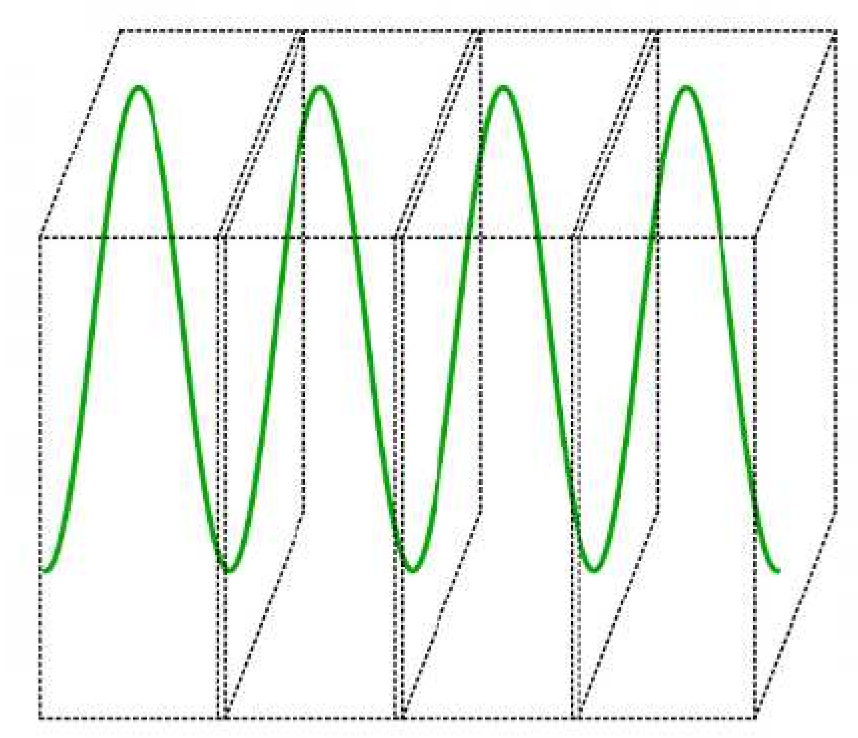

Figure 2

two-dimensional view of an electromagnetic wave and virtual k box

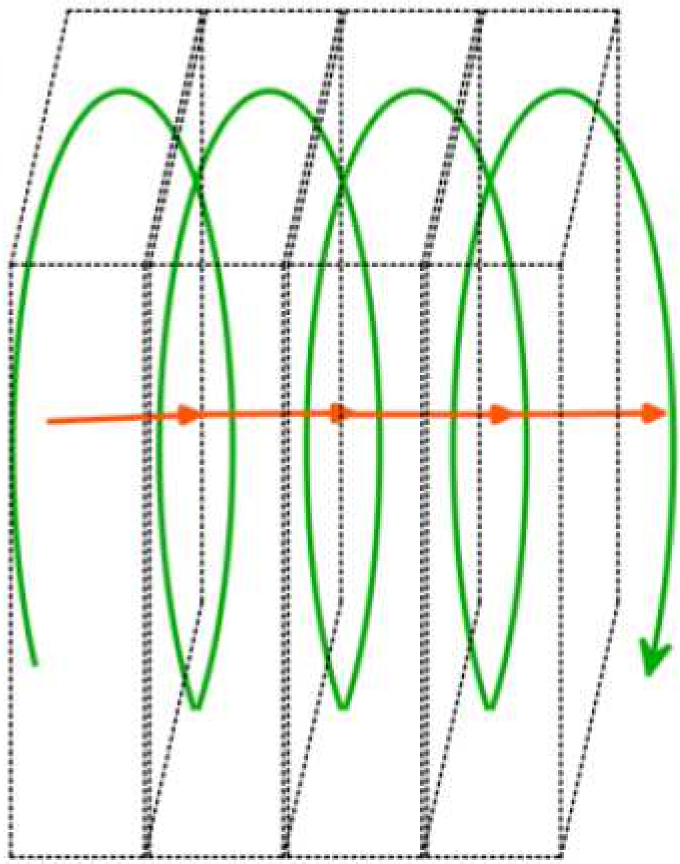

Figure 3

Three-dimensional view of an electromagnetic wave and virtual k box