A possible way to identify the "fingerprint" of the universe

Deng Xiaoming

Chief Engineer Office, Kaiming Engineering Consultancy
1607-1612, Huatian Building,
6, North Xiaomachang, Haidian District, Beijing, PRC 100038

dxmchina@yahoo.com.cn

Abstract

There is a phenomenon that the inverse image of a given celestial object could in principle be seen in negative directions in a closed universe which there is no horizon problem, but it is difficult to detect the individual case in practice. The large-scale distribution of galaxies in this matter has been discussed. Although there are many adverse factors, a possible way to identify the distribution pattern of galaxies is shown in the present paper.

Key words: large scale structure of the universe, map of the universe, topology of the universe, redshift space, distribution of galaxies, galaxies evolution.

1. Introduction

There is a phenomenon that electromagnetic wave may in principle make more than one turn around the universe before reaching the observer in a simply-connected hyperspherical model which there is no horizon problem. To such a source, at a given position in space, are in general associated many images with different redshifts [1][2]. In the present paper, our prime concern is that we could see the front and back images of a celestial object in positive and negative directions. It means that both geodesics link a spatial position to the observer at present time. But in fact, it is difficult to find such a separate specimen.

According to the linear expansion hyperspherical model [1][2], the gross amount of matter in the universe are distributed in the region redshift $0<Z<0.510$ or comoving coordinate $0<\alpha<2\pi$. In the observational sense, if observational depth reach the redshift 0.229 or $\alpha=\pi$ after an all sky survey, it means that we already see the gross amount of matter in the universe. Beyond the redshift 0.229, we would see some galaxies twice in the opposite direction.

We have discussed about the logarithmic map of the universe (J. Richard Gott III, et al. 2005) [3] (Deng Xiaoming 2007) [4]. Most of the celestial objects are SDSS galaxies on the map in the region run from the redshift 0.01 to 0.510 ($\alpha<2\pi$). This region is also our fundamental concern. Especially, the pattern of our universe is vivid in the region run from the redshift 0.01 to 0.229 ($\alpha<\pi$), and this area contains all famous cosmic natural wonders, such as the great wall and the finger of God etc. Because these patterns possess essential characteristic of our universe, we might as well regard them as the "fingerprint" of the universe. In the region $\alpha=\pi$ to 2π or the redshift 0.229 to 0.510, It looks a bit faint but the ridge along redshift 0.362 in vertical direction is obvious, and the valley along the redshift 0.510 in vertical direction is still visible [4].

As for the "fingerprint", we have been exploring a possibility that the effect of gravitation feedback [5] may help to build the big pattern in the linear expansion closed universe. Properly speaking, we could not account for its formation, but show a possible way to identify the cosmic "fingerprint" by the method that is similar to comparison with adjacent chart in geodesy.

2. Correction and new formula derivation

For that end, we will show the individual case first. We have discussed on this issue before (Deng Xiaoming 2005 and 2006) [1] and [2], but the wrong correlative formula were obtained. In order to put right the mistake, we will show the formula re-derivation below.

See Fig 1, Supposing that our Earth is at E (time is t_0), and a same celestial object was at P when time was t_p and at N when time was t_n. the same celestial object emitted electromagnetic wave moving toward us in both positive and negative direction respectively. If the celestial object is at the coordinates α (α<π), and its coordinates in reverse direction is 2π-α. Substituting both α and 2π-α into redshift formula $\frac{k\alpha}{c} = \ln(1+Z)$ [1][2], we obtain $\frac{k\alpha}{c} = \ln(1+Z_p)$ and $\frac{k(2\pi-\alpha)}{c} = \ln(1+Z_n)$. Conflating both, then $\frac{2k\pi}{c} = \ln[(1+Z_p)(1+Z_n)]$. By substituting k=Ωc/π [2] into the left equation, we obtain

$$2\Omega = \ln[(1+Z_p)(1+Z_n)] \quad \text{or} \quad Z_n = \frac{e^{2\Omega}}{1+Z_p} - 1. \tag{1}$$

Where Z_p and Z_n are redshifts of the same celestial object taken in positive and negative directions.

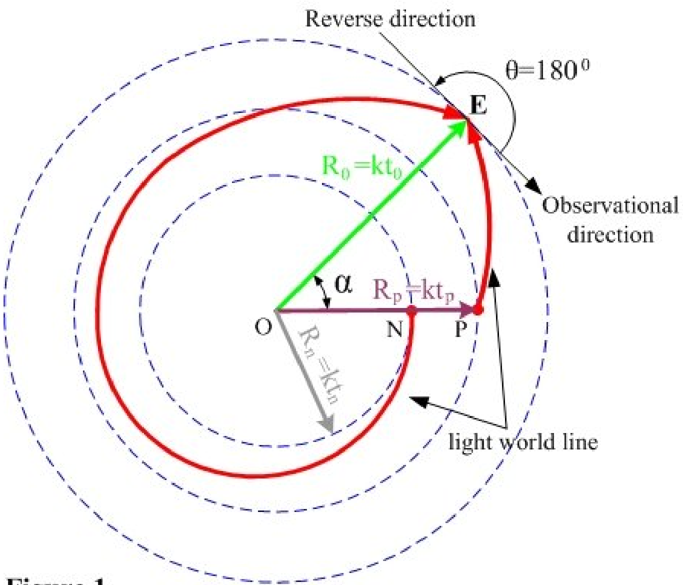


Figure 1

Supposing that our Earth is at E (time is t_0), and a same celestial object at P when time was t_p and at N when time was t_n respectively emitted electromagnetic wave moving toward us in both positive and negative direction.

As we know $\frac{R_0}{R} = \frac{t_0}{t} = 1 + Z$, on this issue, we have $\frac{t_0}{t_p} = 1 + Z_p$ and $\frac{t_0}{t_n} = 1 + Z_n$, or written as:

$$t_p = \frac{t_0}{1 + Z_p} \tag{2}$$

$$t_n = \frac{t_0}{1 + Z_n} \tag{3}$$

Subtracting Eq. (3) from Eq. (2), and substituting Eq. (1) into it, then

$$\frac{t_p - t_n}{t_0} = \frac{Z_n - Z_p}{e^{2\Omega}}, \text{ or } \Delta t = t_p - t_n = \frac{Z_n - Z_p}{e^{2\Omega}} t_0 \tag{4}$$

Where $\Delta t = t_p - t_n$ is the difference of the electromagnetic wave travel time of a same celestial object seen in positive and negative directions; t_0 is so-called the age of the universe. We need call attention to that though there are several reliable methods for dating of matter, the age of the universe can not be accurately measured based on the Hubble constant in hyperspherical universe.

We may show an example of Eq. (4). If the redshift of a same celestial object is Z_p=0.108, the redshift of the same celestial object in reverse direction will be Z_n=0.362 according to Eq. (1), and substituting both redshifts into Eq. (4), (note: Ω=0.206 [2]) then

$\Delta t = t_p - t_n$=0.168 t_0.

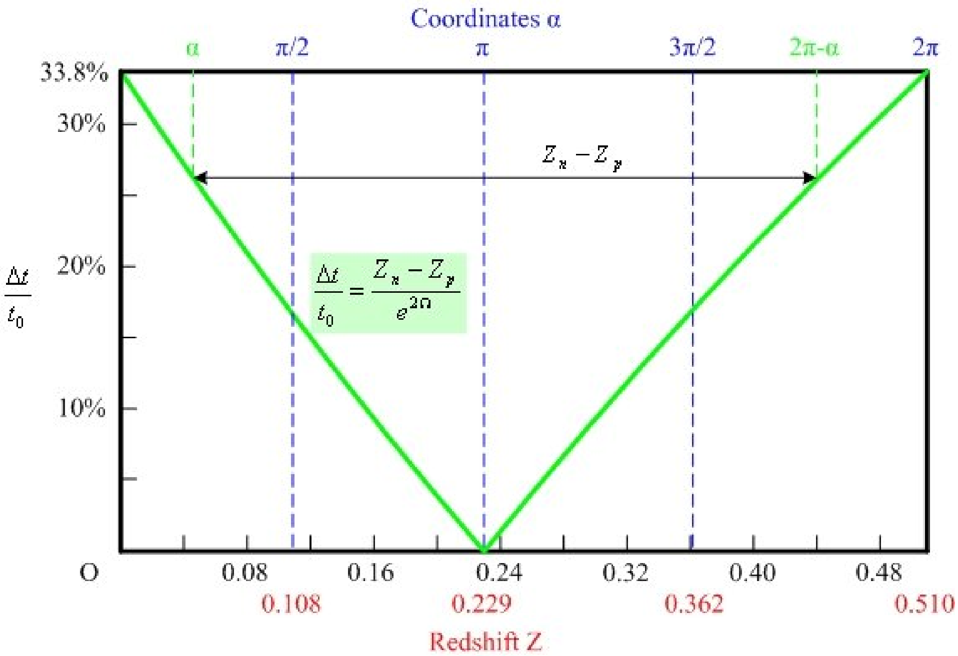


Figure 2 The time difference Δt of the same celestial object seen in positive and negative directions take maximum 33.8% of t_0 nearby us and tend to zero nearby redshift 0.229 or pole α=π

It means that Δt is 16.8% of the age of the universe. For instance, if the age of the universe was 15 billion years (imaginary), the time difference of the same celestial object seen in positive and negative directions should be Δt=2.52 billion years. It is seen that there is a prodigious evolutive disparity between the features of the same celestial object seen in both positive and negative directions in this case.

In the ordinary course of events, see Fig 2, the time difference Δt of a same celestial object seen in positive and negative directions is proportional to Z_n-Z_p, and take maximum 33.8% of t_0 when the positive image is nearby us and tend to zero when the positive image is nearby redshift 0.229 or pole $\alpha=\pi$. Because pole π is so-called the source of "death focus" [1][2], we could not see the same celestial object just at pole π otherwise we would be laid in ashes.

3. Identification of the large-scale distribution pattern of galaxies

We have shown individual case above, but in actual observation, it is difficult to identify a same celestial object in positive and negative directions, because there is a time difference Δt, and during this period, the celestial object was tremendously changed not only in position caused by peculiar motion but also in its form because of evolution. We hope for that things would improve on large scale distribution of galaxies, if we pore deeply on this matter, we couldn't say for certain if we can identify cosmic "fingerprint" in large-scale case, because there are many adverse factors. According to the distribution graph of galaxies [2][4] and the discussion above, we face with such a dilemma, in the region around $\alpha=\pi/2$ or redshift 0.108, although there are sufficient galaxies to form pattern, see also Fig 2, the time difference Δt between both features seen in positive and negative directions is about 16.8% of the age of the universe. It means that the features of both sides would differ widely in their patterns. In contrast, in the region around pole π or redshift 0.229, the time difference Δt is shorter, but there aren't sufficient galaxies to form pattern because the size of celestial sphere is smaller [4]. There may be a happy medium region between both extreme cases to meet our need. Anyway, we can figure a way for identification in theory.

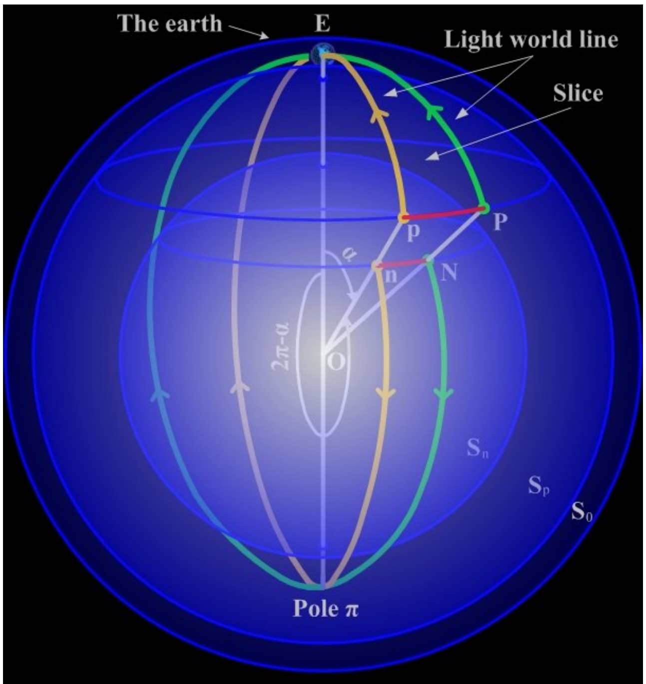
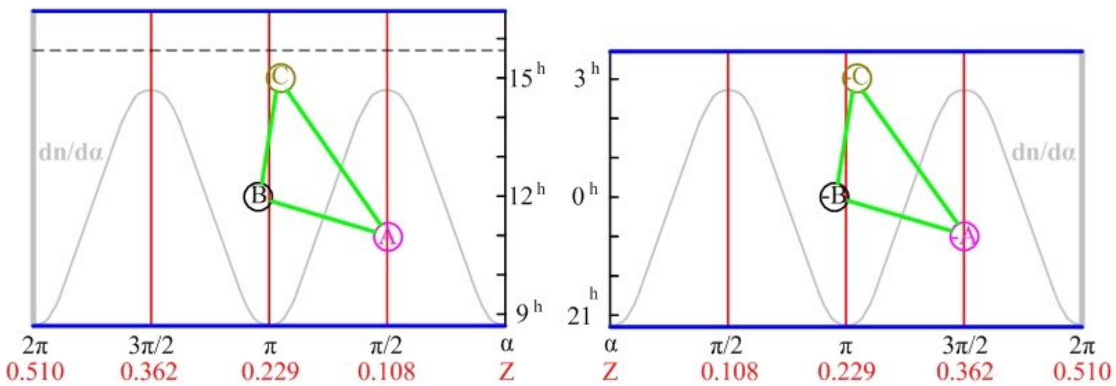


Figure 3 Slice survey in the linear expansion hyperspherical universe

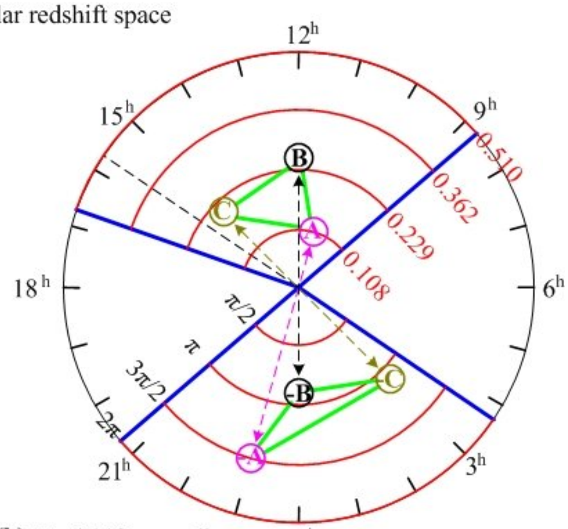
See Fig 3, we use two-dimensional sphere to describe three-dimensional case. on the assumption that our earth is located at E on the surface S_0, quasi spherical triangle pEP denotes a slice survey in positive direction and the slice in negative direction is nEN (by way of pole π). The red arc pP on surface S_p express a survey depth in positive direction at time t_p (coordinate α), and the survey depth in negative direction is red arc nN on surface S_n at time t_n (coordinate 2π-α). Radial line np or NP may express time difference $\Delta t = t_p - t_n$.

Keep on seeing Fig 3, it is our usual practice to straighten light world line (PE, pE and NE, nE) to form two fan-shaped (with vertical angles) redshift spaces on plan (redshift cone diagram). As we discussed before [4], such an anthropic factor would poses an optical illusion. Especially, the density distribution of galaxies would be factitiously diluted with the increase of redshift distance.

In fact, this process is a kind of projection. See also Fig 3, we can project the galaxies in slices (pEP and nEN by way of pole π) onto not only geminate fan-shaped (with vertical angles) spaces on plan but also two flat sheets as J. Richard Gott III, et al. did [3]. It is the rectangular sheets that may fully reveal the distribution characteristics of galaxies [4].



(a) Rectangular redshift space



(b) Redshift cone diagram 0^h

Figure 4

If the region (9^h, 15^h) is appointed as positive direction, the region (21^h, 3^h) must be negative direction. Triangle (A)(B)(C) or (-A)(-B)(-C) represent distribution pattern of galaxies in redshift space.

Provided that we have two kinds of projective spaces, See Fig 4, we should choose a direction to be positive first. If the region (9^h, 15^h) is appointed as positive direction, the region (21^h, 3^h) must be negative direction. Forgetting about the adverse factors mentioned above, if there are several distinct characteristic points, like (A), (B) and (C) in the region (9^h, 15^h) of redshift space, and their reverse points (-A), (-B) and (-C) in negative direction would be shown in the region (21^h, 3^h).

It is seen that every points has its coordinates, for example, if the coordinates of individual point (A) in positive direction is α and 11^h, point (-A) in negative direction should be 2π-α and 23^h.

In this case, triangle (A)(B)(C) or (-A)(-B)(-C) represent distribution pattern of galaxies in redshift space. It is seen that there isn't any change in shape between triangle (A)(B)(C) and (-A)(-B)(-C) in rectangular redshift space, see Fig 4 (a), but triangle (A)(B)(C) and (-A)(-B)(-C) vary greatly in shape from the region (9^h, 15^h) to (21^h, 3^h) in redshift cone diagram, see Fig 4 (b).

In order to stress that the difficulty we faced, see also Fig 4 (a), point (A) is in the region around α=π/2 or redshift 0.108, although there are sufficient galaxies to form pattern because distribution density of galaxies dn/dα take peak value there, the time difference Δt between both features (A) and (-A) seen in positive and negative directions is about 16.8% of the age of the universe (see Fig 2). It means that the features of both sides would differ widely in their patterns. In contrast, see point (B) or (C), in the region around pole π or redshift 0.229, the time difference Δt between (B) and (-B) or (C) and (-C) is shorter, but there aren't sufficient galaxies to form pattern because the distribution density of galaxies dn/dα approach zero there. That is why we may hope for a happy medium region between both extreme cases to meet our need.

4. Discussion

We have shown a possible way to identify the "fingerprint" of the universe in section 3. It may be used to check samples in practice, but it's worth noting that the samples must be perfect. We have no suitable samples in hand at present. We think that a so-called perfect samples should have distinct texturize not only in the region redshift Z<0.229 or α<π but also in the region 0.229< redshift Z<0.510 or π<α<2π, unfortunately past samples that we had seen tend to be dim in the region 0.229< redshift Z<0.510 or π<α<2π.

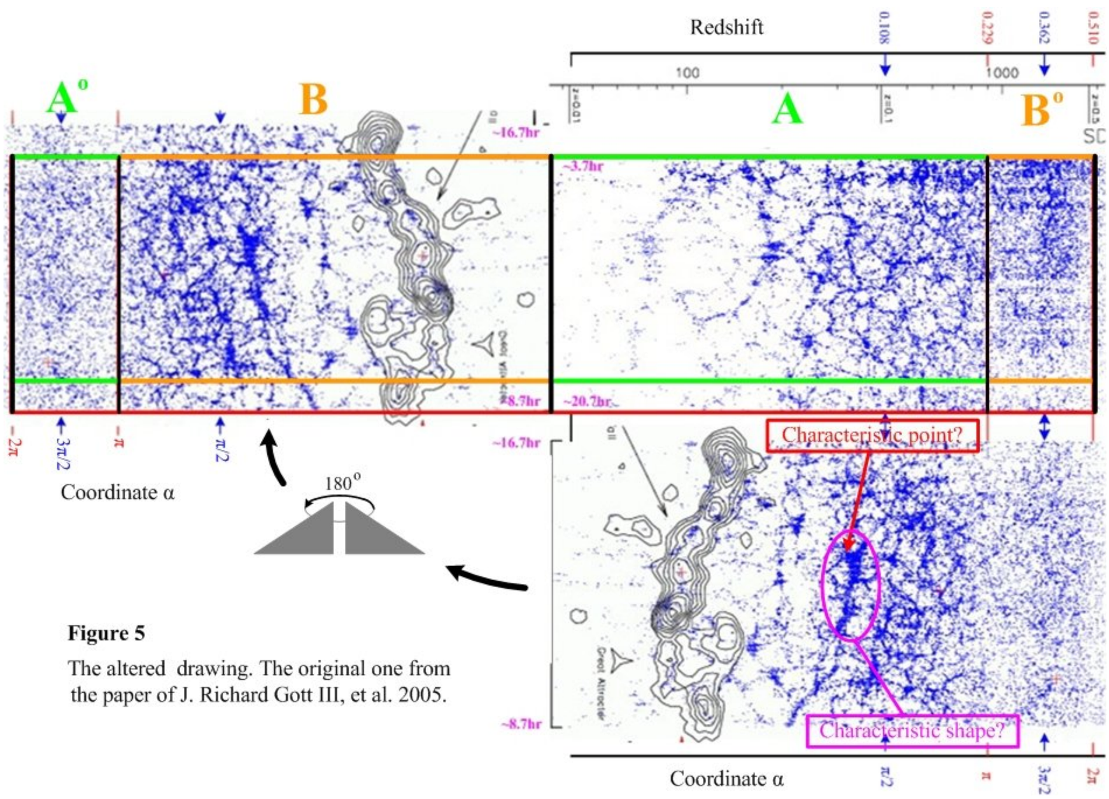


Figure 5
The altered drawing. The original one from the paper of J. Richard Gott III, et al. 2005.

Anyway, we may just as well give an example here. See Fig 5, we use the map of J. Richard Gott III, et al. to show an actual process. To turn the lower image 180 degrees about axis (16.7hr, 8.7hr) and move up to align with upper image, we got the image that looks the same as Fig 4 (a). By way of contrast Fig 5 is a logarithmic map. According to Fig 4 (a), two comparable regions are A, A^o and B, B^o respectively in Fig 5. It is seen that characteristic points or shapes are quite distinct in the region redshift $Z<0.229$ or $\alpha<\pi$ but dim in the region $0.229<$ redshift $Z<0.510$ or $\pi<\alpha<2\pi$.

In order to avoid any misunderstanding, we have to reiterate that this example is not a complete sample for our case to compare and identify distribution pattern of galaxies because it is too dim in the region $0.229<$ redshift $Z<0.510$ or $\pi<\alpha<2\pi$ to reveal anything. Our main aim is just to show a way for future samples. We hope for that the archaic clues or traces of some distribution characteristics used for comparison might be preserved. For instance, if we could verify a formal likeness of some characteristic points or shapes between the region redshift $Z<0.229$ seen in positive direction and $0.229<$ redshift $Z<0.510$ seen in negative direction, it would help to verify the topology of the universe further.

5. Conclusion

Although there are many adverse factors, we have shown a possible way to identify the "fingerprint" of the universe. We shall be looking for a future sample or 3D map that can reveal distinct texturize in the region $0.229<$ redshift $Z<0.510$ or $\pi<\alpha<2\pi$ to test our prophecy. Even though there are not palpable likeness between both regions, such as A and A^o or B and B^o (see also Fig 5), we may follow some clues or traces by comparison, like the theory of continental drift, to identify the drift of distribution of galaxies in the universe.

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