

# The linear expansion hyperspherical universe

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## Abstract

From Karlsson's formula  $\Delta \ln(1+Z)=0.206$  and the polar effect, we realize that the half periodic parameter of redshift is  $\Omega=\pi k/c=0.206$ , in theory, we finally explain why the great wall is at redshift  $Z=0.079$  in redshift space; We have defined quasar as the early star nearby the position poles and opposite poles ( $\alpha=n\pi$ ,  $n=1, 2, 3\dots$ ), and given the answer for two difficult problems of theirs; Based on the course of explanation for redshift space, we have reason to think that our universe might be the linear expansion hyperspherical universe.

**Key words:** large scale structure of universe, bolometric flux, luminosity distance, quasars, galaxies, redshift space, redshift periodicity.

## 1. Introduction

As a matter of convenience, it is better for us to use the term "the polar effect of hyperspherical universe" instead of "the lens effect of cosmic entire hyperspherical space" (Deng Xiaoming 2005a, b) [1][2], and hereinafter referred to as "the polar effect". In the present paper, we will show more characteristic of the polar effect in detail. First of all, we will make two corrections.

Correction 1: We have misdeemed that the integral periodic parameter of redshift is  $\Omega=2\pi k/c=0.206$  since the year 1992 (Deng Xiaoming) [3]. Now we accept that the realization of Karlsson's statistical peak value may well be attributable to the polar effect. the celestial bodies nearby the position poles ( $\alpha=2n\pi$ ) and the opposite poles [ $\alpha=(2n+1)\pi$ ] show nothing different to an observer in physical characteristics, where  $n=0, 1, 2, 3\dots$ , and the period of Bolometric flux formula is  $\pi$ , therefore we may define Karlsson's formula  $\Delta \ln(1+Z)=0.206$  [4][5][6] as redshift periodic formula  $\Delta \ln(1+Z)=\Omega_h=\pi k/c=0.206$ , where  $\Omega_h=\pi k/c$  is half periodic parameter of redshift [1].

Correction 2: We have gotten another mistake to believe that "the great wall" in redshift space is located at  $\alpha=\pi$  in our model before [1]. There will be much discussion about this issue infra, and an exciting result will come out.

## 2. The farther exploration or analysis for polar effect

As we know, two forms of Bolometric flux formula in hyperspherical universe can be written as:

$$l = \frac{L}{4\pi R^2(t_0)(1+Z)^2 \sin^2 \alpha}, \quad (1)$$

$$l = \frac{L}{4\pi R^2(t)(1+Z)^4 \sin^2 \alpha} \quad (2)$$

Where L is the absolute luminosity of an emission source at time t and l is its brightness observed by us at time  $t_0$ . If we place ourselves at the origin of coordinates  $\alpha$ , then Eq. (1) will be engaged. In general case, we should find out the functional relations between Z and  $\alpha$ , like  $Z=f(\alpha)$ . In fact, it is very difficult for almost all other hyperspherical model except the linear case like  $R(t)=kt$ . Be different from what we did before, we will not only use the linear case to carry out discussion farther, but also try to prove that our universe probably verge on the linear case indeed.

There is  $k\alpha/c=\ln(1+Z)$  for the linear case, and we have gotten the half periodic parameter of redshift  $\Omega_h=\pi k/c$  [1], for convenience, we use  $\Omega$  instead of  $\Omega_h$ , and marshal the two formulas, then

$$\Omega\alpha/\pi=\ln(1+Z), \text{ or } e^{\Omega\alpha/\pi}=(1+Z), \text{ or } Z=e^{\Omega\alpha/\pi}-1. \quad (3)$$

Substituting Eq. (3) to Eq. (1), and in order to distinguish from the case discussed before [1][2], we also use  $L_0$  and  $l_0$  instead of L and l, then we have

$$l_0 = \frac{L_0}{4\pi R^2(t_0)e^{2\Omega\alpha/\pi} \sin^2 \alpha} \quad (4)$$

Where  $L_0$  are the absolute luminosity of emission sources located in coordinates  $\alpha$  (For large-scale survey,  $L_0$  may be regarded as the mean of absolute luminosities),  $l_0$  is their brightness observed by us at  $\alpha=0$  (time  $t_0$ ). Without doubt, there is evolution of emission sources (such as stars and galaxies), and it is reasonable to put the case that the earlier the time, the greater the value of  $L_0$ . Many authors have discussed about this subject, and J. A. Peacock has given that “the luminosity of a galaxy is expected to decline as a power of time:  $L_G \propto t^{-0.5}$ ”, in his bookmaking (1999) [7]. If we suppose that  $L_0=\varepsilon t^{-\sigma}$  or written as  $L_0=\varepsilon/t^\sigma$  (where  $\varepsilon$  is a coefficient and  $\sigma$  is the power), from this we may deduce that  $\sigma>0$ . In the case of  $R(t)=kt$ , we have  $R(t_0)/R(t)=t_0/t=1+Z$ , and  $L_0=\varepsilon/t^\sigma=\varepsilon(1+Z)^\sigma/t_0^\sigma$ . Substituting Eq. (3) to it, we obtain  $L_0=\varepsilon e^{\sigma\Omega\alpha/\pi}/t_0^\sigma$ . If we substitute this equation to Eq. (4), then

$$l_0 = \frac{\varepsilon}{t_0^\sigma 4\pi R^2(t_0)e^{(2-\sigma)\Omega\alpha/\pi} \sin^2 \alpha} \quad (5)$$

From Eq. (5) we may deduce that  $\sigma<2$ , because  $\frac{\varepsilon}{t_0^\sigma 4\pi R^2(t_0)}$  can be regarded as a constant,

otherwise  $\lim_{\alpha \rightarrow \infty} l_0(\alpha)=\infty$ . This author have done a lot of calculations under  $0<\sigma<2$ , and find that  $\sigma$  has a very small effect on Eq. (4), so we have cause for considering  $L_0$  as a constant since galaxy formation.

Note that  $L_0$  here mostly express two kinds of emission sources, one is galaxies and another are stars (including quasars). See Eq. (4), if let  $\mu_0 = \frac{L_0}{4\pi R^2(t_0)}$  ( $\mu_0$  is a constant), we obtain

$$l_0 = \frac{\mu_0}{e^{2\Omega\alpha/\pi} \sin^2 \alpha} \quad (6)$$

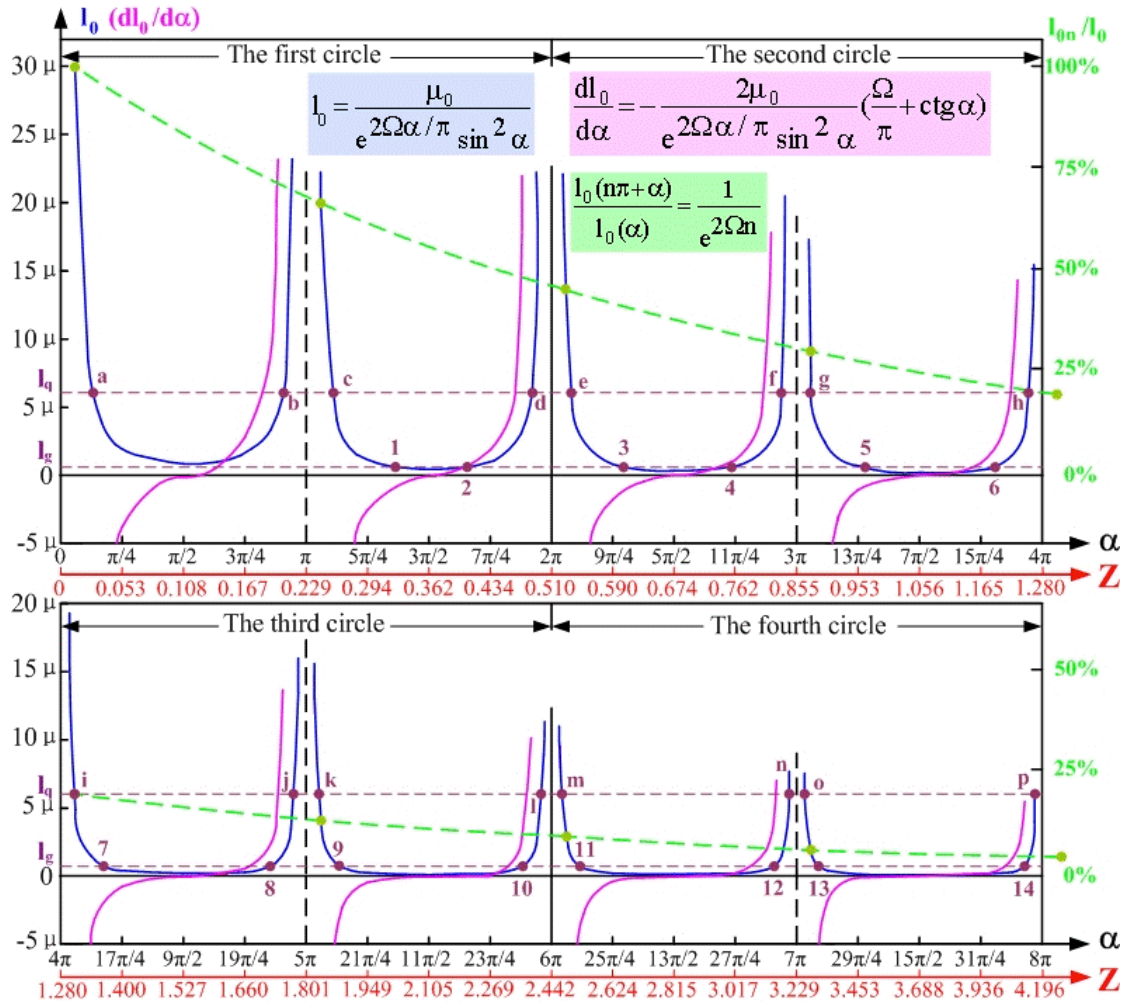
The derived function of Eq. (6) is

$$\frac{dl_0}{d\alpha} = -\frac{2\mu_0}{e^{2\Omega\alpha/\pi} \sin^2 \alpha} \left( \frac{\Omega}{\pi} + \text{ctg}\alpha \right) \quad (7)$$

Eq. (7) can be use to give a description of optical variability caused by the peculiar motion of emission sources (such as stars and galaxies. For quasars, we will redefine it later).

The half periodic attenuation of Bolometric flux at identical phase position in percentage is  $I_0(n\pi+\alpha)/I_0(\alpha)=1/e^{2\Omega n}$ ,  $n=0, 1, 2, 3\dots$

Fig 1 will unfold above formulas. The redshift coordinates is given by Eq. (3) (if  $\Omega=0.206$ ).



**Figure 1 Bolometric flux  $I_0$ , its derived function and the attenuation with  $\alpha$**

We have already fully discussed about the polar effect in hyperspherical universe before [1][2], and here we will not iterate what we did but give some new information. First we should declare that although one set of formulas are used on Fig 1, it is quite different for us to describe star or galaxy. Because the absolute luminosity of galaxy is much greater than star's (not the same order of magnitudes), and we will describe galaxies or stars (quasars) separately with the aid of the same figure.

(1) First we give the rendering of galaxies (forget stars or quasars). See Fig 1, suppose that we can see all of galaxies within the area  $\alpha=0$  to  $\pi$ , also expressed as  $(0, \pi)$ . Maybe we may see all of galaxies in  $(\pi, 2\pi)$  too, but in order to carry out our discussion, we subjectively assume that some galaxies couldn't be seen within the area  $[n\pi, (n+1)\pi]$ ,  $n=1, 2, 3\dots$ , and if  $I_g$  (see the lower dashed) express the minimal Bolometric flux of galaxies that can be discerned by receiver, it is seen that

the invisible region (1, 2), (3, 4), (5, 6)...will widen out with  $\alpha$  increasing, accordingly, the visible region (0, 1), (2, 3), (4, 5)...will narrow down. This phenomenon attribute to the polar effect of hyperspherical universe. There must be some periodicity for galaxies distribution in observations, and as the distance gets farther, the periodicity shows clearer. Of course, we will see the multiples ghost images of a galaxy in same direction when  $\alpha > 2\pi$ .

Another interesting cosmic landscape is that we would see our Milky Way nearby (not too far from) the coordinates  $\alpha=2\pi$ ,  $Z=0.510$ , or in the region  $\alpha=7\pi/4 \sim 9\pi/4$  or redshift  $Z=0.434 \sim 0.590$  (owing to peculiar motion not just at  $\alpha=2\pi$  otherwise we would drop into the death focus of the Milky Way [1][2]). She must be a bright spiral galaxy and probably has been on record as an ordinary galaxy. Note that her direction of rotation would be positive or opposite depends on if her real location  $\alpha > 2\pi$  or not [2], and if the gyroscopic action was still in effect, her direction of rotating axis must be close to today's. If we could find out the ghost image of the Milky Way nearby  $\alpha=2n\pi$ ,  $n=2, 3, 4...$  too, the law of motion of her might be speculated. It is also possible for us to find out her reverse image in reverse direction. Supposing that we find out the Milky Way at  $\alpha=2\pi+\Delta\alpha$ , and in reverse direction, she should be at  $\alpha=2\pi-\Delta\alpha$ . If  $Z_p$  and  $Z_n$  respectively express the redshifts of her observed from positive and negative direction, according to Eq. (3) and  $k=c\Omega/\pi$ , we obtain

$$4\Omega = \ln[(1+Z_p)(1+Z_n)] \text{ or } Z_n = e^{4\Omega/(1+Z_p)} - 1 \quad (8)$$

If  $\Omega=0.206$ , then  $Z_n = e^{0.824/(1+Z_p)} - 1$ . Another identifiable character is both positive and reversed images with opposite direction of rotation. Of course, with the help of  $Z_p$  and  $Z_n$ , we may find out another clue for the law of motion of the Milky Way.

According to the discussion above, and then we also can make this deduction: If the space region of large-scale survey for redshift is completely symmetrical in positive and negative direction, and as long as the sample space is big enough, the galaxies in both region should be equal in amount, species, spin direction for spiral galaxies and the angle between our sightline and their diagnostic shape in the region  $[2n\pi, 2(n+1)\pi]$ ,  $n=1, 2, 3...$ , especially in the region (0,  $2\pi$ ), if there is no invisible region, this deduction should be strictly tenable.

(2) Now we give the rendering of stars or quasars (Do forget galaxies!), although the same Fig 1 is engaged, the situation change a lot for the absolute luminosity  $L_0$  or coefficient  $\mu_0$  of stars or quasars is much smaller than galactic. In fact, the minimal Bolometric flux of galaxies that can be discerned by receiver is equal to stellar in principle. If the minimal Bolometric flux of stars or quasars is expressed as  $l_q$  (see the upper dashed), we have  $l_q=l_g$  (imagine that the vertical coordinates is compressed in the case of star or quasar).

First we should define quasar as the early star nearby the position poles and the opposite poles ( $\alpha=n\pi$ ,  $n=1, 2, 3...$ ) [1][2]. Yes! Star and quasar probably are congener celestial body, the sole different thing is their position. See Fig 1, we may describe them in this way, within the region of  $\alpha$  (0, a), all of celestial bodies with stellar scale are stars, and assume that in the region (b, c), (d, e), (f, g), (h, i)..., all of celestial bodies with stellar scale were regarded as quasars.

Thus, this seem to be clear. See Fig 1 again, we may explain two difficult problems about quasar: (1) If all of early star with the same  $L_0$  (or  $\mu_0$ ), the nearer the position poles or opposite poles, the greater the value of Bolometric flux  $l_0$ , it is obvious that the early star is not on the ordinary luminosity distance, so the super radiation of quasars is a kind feint; (2) With the help of Eq. (7), it is seen that optical variability of quasar is very sensitive to a small displacement nearby the position poles and opposite poles ( $\alpha=n\pi$ ,  $n=1, 2, 3...$ ), and if the displacement is caused by the peculiar motion of early star, it is easy to solve the problem too. We also can make this deduction:

the nearer the position poles or the opposite poles, the brighter the quasars and the greater the value of optical variability.

As for the optical variability, some samples show randomness and another show some kind of periodicity, we suppose that it is depended on the kinestate of early star and the angle between our sightline and its orbital plane. Of course, the optical variability of quasar show us a very important dynamics information in early time, and hereby we may make good use of the immemorial trail to check if the low of dynamics discovered in solar system still in effect during that time, if so, and then we may even determine the mass for a quasar.

We also may make this conclusion: All of the quasars observed in all directions in the sky are the multiple ghost images of early stars located within the area near by both the position poles and the opposite poles ( $\alpha=n\pi$ ,  $n=1, 2, 3\dots$ ). See Fig 1, since the visible region (b, c), (d, e), (f, g)...of quasars are much narrower than (2, 3), (4, 5), (6, 7)...of galaxies, that is why redshift periodicity of quasars is more obvious than galactic.

### 3. The linear expansion hyperspherical universe and redshift space

SDSS spectroscopic survey shows a good sample for distribution of galaxies in the universe. Thereinto, the representative sample is Fig 2 (Blanton et al. 2003) [8]. One of the principal challenges in cosmology is to explain this figure. Through repeated measurements and calculation, we find that the linear expansion hyperspherical model is competent in challenging this puzzle.

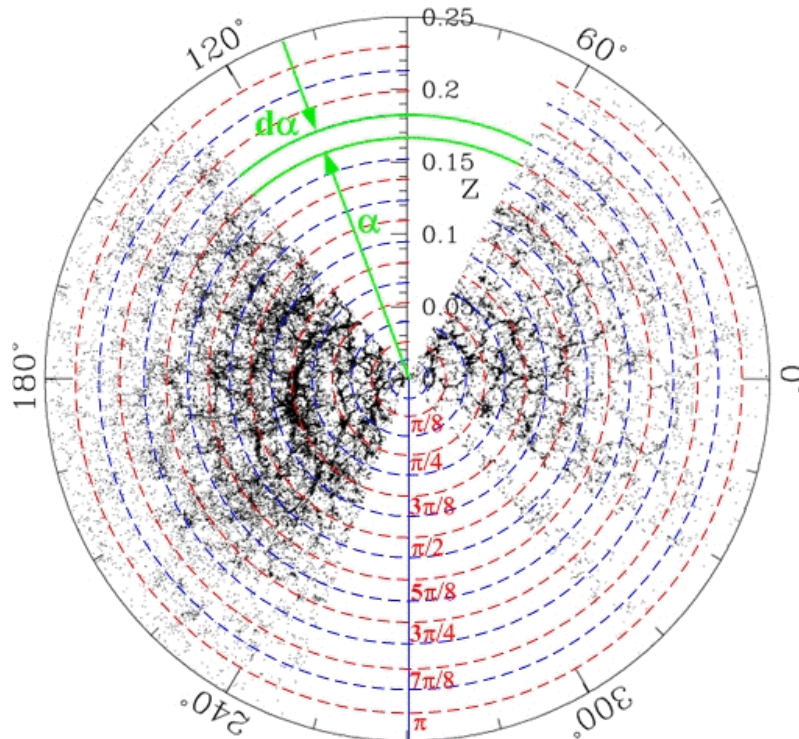


Figure 2 Blanton et al. (2003) (astro-ph/0210215), Large-Scale Structure sample. This author add concentric circles coordinate and correlative sign.

We will give the galaxy counts formula in the case of the expansion hyperspherical universe.

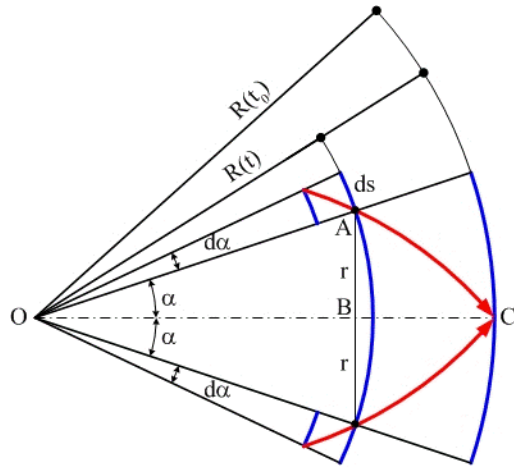


Figure 3 Formula derivation for galaxy count in hyperspherical universe

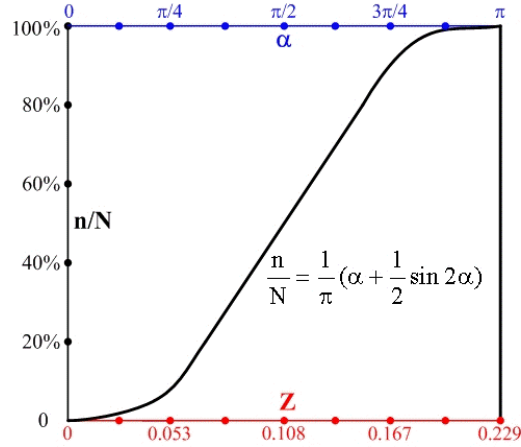


Figure 4 The integral distribution of galaxies from 0 to π

See Fig 3, supposing that our position is at point C, the volume of spherical shell on a certain even depth of celestial sphere is  $dV=4\pi r^2 ds=4\pi R^3(t)\sin^2\alpha d\alpha$  for  $r=R(t)\sin\alpha$  and  $ds=R(t)d\alpha$ . Supposing that the entire matter or the total number of galaxies in the universe keep in conservation since formation, and if the total number of galaxies is expressed as N (a constant), we obtain the galactic number density formula

$$\rho = \frac{N}{2\pi^2 R^3(t)}, 0 \leq \alpha < \pi.$$

The number of galaxies in the spherical shell is:

$$dn = \rho dV = \frac{2N}{\pi} \sin^2 \alpha d\alpha. \tag{9}$$

The definite integral of it from 0 to α is given by  $n = \int_0^\alpha \frac{2N}{\pi} \sin^2 \alpha d\alpha = \frac{N}{\pi} (\alpha - \frac{1}{2} \sin 2\alpha)$ .

This is the formula of integral distribution of galaxies from 0 to α. If change its form in percentage, then

$$\frac{n}{N} = \frac{1}{\pi} (\alpha - \frac{1}{2} \sin 2\alpha). \text{ (Deng Xiaoming 2002)[9]} \tag{10}$$

Eq. (10) can also be called as galaxy counts formula, see Fig 4, from 0 to π, we already see all of the galaxies in the universe.

Changing the form of Eq. (9), we obtain

$$\frac{dn}{d\alpha} = \frac{2N}{\pi} \sin^2 \alpha \tag{11}$$

Eq. (11) is a very important distillation function, and its physical significance is the number of galaxies distributed in the differential interval of α. See Fig 5, it will be maximum value at  $\alpha=n\pi+\pi/2$  and be minimal value (=0) at  $\alpha=n\pi$ , where  $n=0, 1, 2, \dots$  (intuitively, see also Fig 6 below).

In order to explain the distribution of galaxies found by the SDSS redshift survey, first we have to do some mathematical treatment to project the distribution of galaxies in the hyperspherical

universe on planar sector diagram.

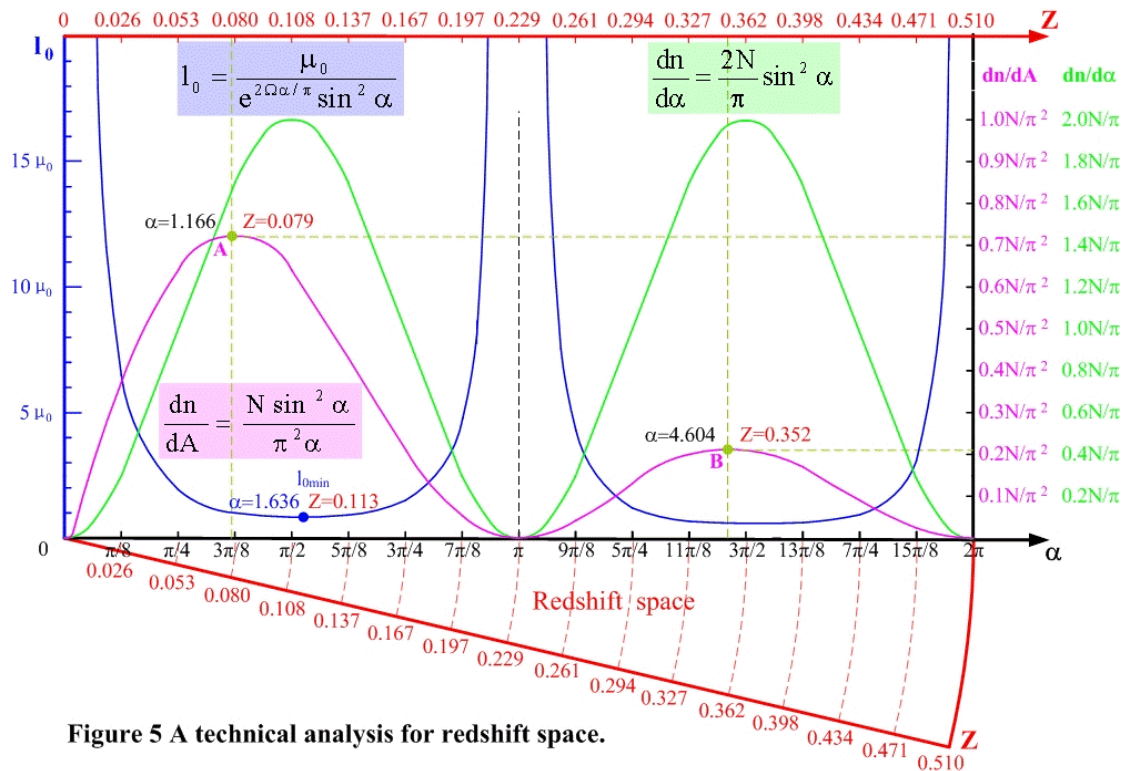


Figure 5 A technical analysis for redshift space.

See also Fig 2, the area of torus with radius  $\alpha$  is  $dA=2\pi\alpha d\alpha$  and substituting it to Eq. (9), we obtain

$$\frac{dn}{dA} = \frac{N \sin^2 \alpha}{\pi^2 \alpha} \tag{12}$$

It is another very important distillation function, and its physical significance is the number of galaxies distributed in the area of torus. We also may define Eq. (12) as galactic number density formula on plan, See Fig 5.

If  $\frac{d}{d\alpha} \left( \frac{dn}{dA} \right) = \frac{N(\alpha \sin 2\alpha - \sin^2 \alpha)}{\pi^2 \alpha^2} = 0$ , then  $\text{tg}\alpha=2\alpha$ , we may find the position of an extremum:  $\alpha_A=1.166$  in  $(0, \pi)$  and  $\alpha_B=4.604$  in  $(\pi, 2\pi)$ .... Substituting each of them to Eq. (3) ( $\Omega=0.206$ ), we obtain the maximum value of galactic number density at redshift  $Z_A=0.079$  in  $(0, \pi)$  and at redshift  $Z_B=0.352$  in  $(\pi, 2\pi)$ . It is perfect that the theoretical value fit with the observation value. Thus, we have already gotten the answer why “the great wall” is there ( $Z_A=0.079$ )! If there isn’t invisible region in  $(\pi, 2\pi)$ , see also Fig 1 and Fig 5, we will see another peak value at  $Z_B=0.352$ .

See Fig 5, the minimal Bolometric flux  $I_{0\text{min}}$  in  $(0, \pi)$  is at  $\alpha=1.636$  or  $Z=0.113$ , see also Fig 1, and it is difficult for us to estimate if  $I_g$  is greater than  $I_{0\text{min}}$  or not. If  $I_g$  is really greater than  $I_{0\text{min}}$ , it means that some galaxies couldn’t be seen nearby  $\alpha=1.636$  or  $Z=0.113$ , that is to say, there are some lost galaxies in sample space around redshift  $Z=0.113$ .

It is a pity that there isn’t any integrated observation data on hand, otherwise Eq. (10), (11), (12) are provable, and then the total number of galaxies  $N$  in the universe might be ascertained. By the way, Eq. (10), (11), (12) are tenable for any kind of the expansion hyperspherical universe, and for

the accurate positioning of “the great wall” in redshift space, only on coordinate conversion from  $\alpha$  to  $Z$ , the computational process involved in linear case.

Yes, our universe may be the linear expansion hyperspherical universe indeed, otherwise there is no way in theory to give such a precise redshift position for “the great wall”.

#### 4. The sketch of our hyperspherical universe

We (Deng Xiaoming 2006a) [10] have mentioned that there are two kinds of observers in the universe: the one are the ordinary observers in three-dimensional hyperspherical space, like us on a planet at a certain proper time; another is “the fundamental observer” in four-dimensional Euclidian space. The scenes of the universe presented to each observer’s eye are quite different. The former is the real observer, who can see some astronomical phenomena or periodicity caused by the polar effect [1][2], and the latter is the observer imagined by us, who can “see” nothing different with the scene described by the cosmological principle and think what kind of universe should be based on the knowledge gained. Neither the former nor the latter is wrong, the different scenes observed are caused by different standpoints.

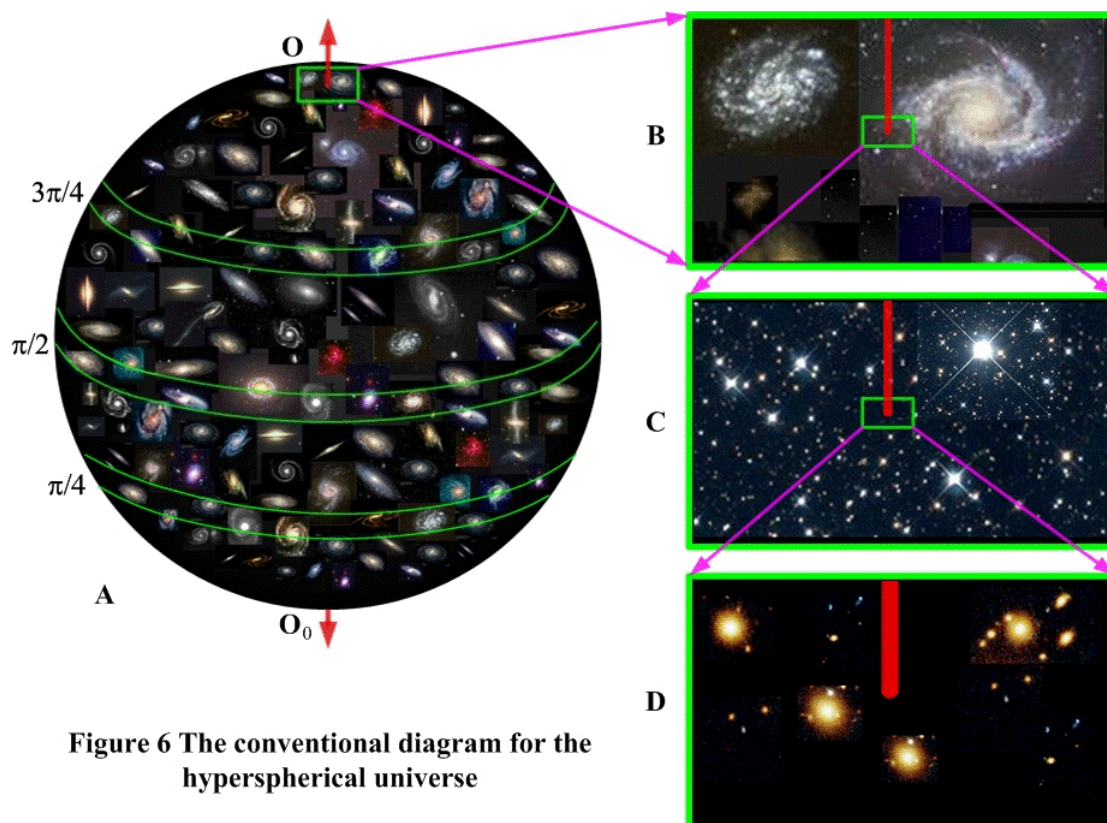


Figure 6 The conventional diagram for the hyperspherical universe

See Fig 6, to correspond with the cosmological principle, for the fundamental observer galaxies present homogeneous distribution. Supposing that we are at the position pole  $O_0$ , there are two spiral galaxies nearby the opposite pole  $O$ , for the ordinary observer like us (note that this time we were two dimensional creature on the spherical surface) the scene of the universe is distorted by the polar effect, and the two spiral galaxies must be brighter than others. If the image around the opposite pole  $O$  is enlarged three times, we will see that the arm endings of the right galaxy is nearby the pole  $O$  in image B and its enlarged image C. All want to show is image D, there are several early stars around the opposite pole  $O$ , and such were quasars in our view!

Scattered problems: Some authors have noticed the cases that quasars close to bright galaxies (Arp, H 1987, Karlsson, K. G. 1990) [11][12]. With the help of Fig 6 and see also Fig 1, this phenomena is understandable; The position pole  $O_0$  and the opposite pole  $O$  are not fixed, both float every moment because there is peculiar motion; In order to understand Eq. (11) intuitively, see also Fig 6, the number of galaxies distributed in the interval of  $\alpha$  ( $\pi/2, \pi/2+d\alpha$ ) come to maximum.

## 5. Conclusions

- (1) From Karlsson's formula  $\Delta \ln(1+Z)=0.206$  (1971, 1973, 1977) [4][5][6] to redshift periodic formula  $\Delta \ln(1+Z)=\Omega$  and propose for the polar effect (Deng Xiaoming 1992, 2005a and b) [3][1][2], and this time we realize that the half periodic parameter of redshift is  $\Omega=\pi k/c=0.206$ , we finally explain why the great wall is there ( $Z=0.079$ ) in redshift space;
- (2) We have defined quasar as the early star nearby the position poles and opposite poles ( $\alpha=n\pi$ ,  $n=1, 2, 3\dots$ ), and given the answer for two difficult problems of theirs;
- (3) Based on the course of explanation for redshift space, we have reason to think that our universe might be the linear expansion hyperspherical universe, and then we get sudden comprehension of that you should ask why time is increasing first when you want to know why space is expanding.

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