Cosmological model by cosmological principle
— 1 Size of cosmos —

We try to describe cosmological model by logic based on cosmological principle. Logic covers also domain that we cannot observe. We may add inference, if necessary.

According to cosmological principle, size of cosmos is infinite. Definition of infinity depends on mathematics. Cosmological principle is valid all over cosmos. It should not contradict with observation results and physical laws at all. Cosmological principle loses its value, if it contradicts with even one of them.

In this paper, space means 3-dimensional domain including its inner objects. Cosmos consists of space and time.

According to the principle, it is said that cosmos, on the large scale, is homogeneous. This means that there is no special position in cosmos. In other words, the principle says that any observer on any position in cosmos will generally see the same scene. This means also that, on the small scale, each observer on different position in cosmos may watch different scene.

It has been reported that celestial body(1) was found in 13 billion light-years (ly) far from the earth. According to cosmological principle, the view from the place(1) of celestial body(1) will be similar with that from the earth.

From cosmological principle, watching from the place(1) of celestial body(1), other celestial body(2) will be found in 13 billion ly far place(2) from place(1) . The location of celestial body(2) will be 26 billion ly far from the earth. Moreover from there, celestial body(3) will be found in 13 billion ly away, that is, in 39 billion ly far place(3) from the earth. Repeating this, we can recognize the existence of celestial body in infinitely far distance. This means that the size of cosmos is infinite. "billion" can be replaced by "million".

[(1),(2) and (3) are suffixes for discrimination.]

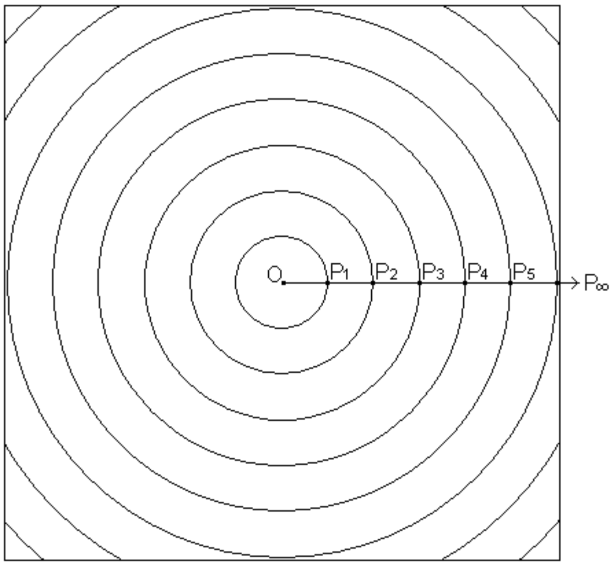
Hubble discovered celestial bodies (galaxies) distant from the earth were receding from the earth. His discovery was combined with expansion of cosmos.

Expansion theory is correct only in case that the size of cosmos is finite. However, in case that the size of cosmos is infinite, Hubble's discovery cannot be combined with expansion of cosmos. Nobody can observe expansion itself. Expansion is an inference. Expansion and receding are different matters. **There is no expansion, because infinity does not change its size.** Hubble's "receding" will be caused by other reason. "Receding" may be to keep balance against strong gravity toward inside of cosmos. For, even light is shut in by the gravity. As a conclusion, we can say that **cosmos is closed and it has wall.**

According to cosmological principle, cosmos is isotropic. This means that scenes in cosmos look similar in any direction. In other words, we can say that we cannot decide absolute direction. If we wish to decide direction in cosmos, we have to depend on a celestial body. So we take the earth as an origin to decide direction. Rotation, revolution and other movements of celestial bodies are recognized only by decided origin.

If we ask whether there is center of cosmos whose size is infinite. The answer is yes. The reason is that the distance from everywhere to the wall is equally infinite. If not equal, cosmos becomes not homogeneous. Then, it is inconsistent with cosmological principle. So the earth and any other positions in cosmos are center of cosmos.

Fig.1－A Cosmological model



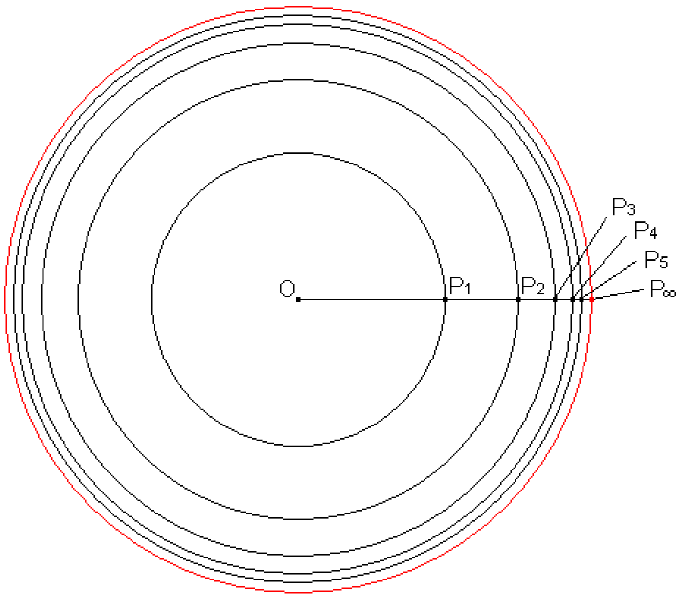
Cosmological principle and expansion theory are incompatible.

If we insist on expansion theory, cosmological principle will be denied. If we accept cosmological principle, expansion theory loses its value.

We try to draw diagram of cosmos based on cosmological principle. As diagrams of expansion model are often seen in books etc., so they are omitted.

Cosmos is drawn as a 3-dimensional sphere with infinite radius. Fig.1－A shows a section of cosmos cut by a plane. Any section will do. The edge of the section is a circle with radius of infinity. Since any position in cosmos is center of cosmos, everywhere in the circle becomes center of the circle.

Fig.1－B Cosmological model (Onion style)



We try to draw circles with a common center O. We take a positive number "a" arbitrarily as unit of radius. a is to be unit of measure of distance (time) in which light ran. O is applied to any position of cosmos. Then, in Fig.1－A,

$OP_1=a$, $OP_2=2a$, $OP_3=3a$, $OP_4=4a$, $OP_5=5a$, ….

Intervals of circumferences are

$OP_1=P_1P_2=P_2P_3=P_3P_4=P_4P_5.....=a$.

Geometry of Fig.1－A is Euclidean.

These circles spread endlessly wide, so that we cannot draw all of them in a piece of paper.

We cannot see infinity there. For the sake of convenience, we try to transform Fig.1－A to visualize infinity. We obtain Fig.1－B by following process in which new measure is adopted, so that infinity becomes visible.

Let "b" be a positive number greater than 1. In Fig.1－B,

$OP_1=a$, $P_1P_2=a/b$, $P_2P_3=a/b^2$, $P_3P_4=a/b^3$, $P_4P_5=a/b^4$,….., $P_nP_{n+1}=a/b^n$.

The bigger n is, the denser circumferences become. We call it "Onion style of cosmos".

Hence, $OP_1=a$, $OP_2=a+a/b=a(b^2-1)/(b(b-1))$, $OP_3=a+a/b+a/b^2=a(b^3-1)/(b^2(b-1))$,

$OP_4= a+a/b+a/b^2+a/b^3=a(b^4-1)/(b^3(b-1))$, …..

Generally,

$OP_n=a(b^n-1)/(b^{n-1}(b-1))$.

Finally,

if $n\to\infty$, then $OP_n\to ab/(b-1)= OP_\infty$.

Fig.1－B is of a transformation of Fig.1－A. As a numerical example, we take a=1/2 and b=2, then,

$OP_1=1/2$, $P_1P_2=1/4$, $P_2P_3=1/8$, $P_3P_4=1/16$, $P_4P_5=1/32$,…..

Generally,

$P_nP_{n+1}=P_{n-1}P_n/2$.

Moreover,

$OP_1=1/2$, $OP_2=3/4$, $OP_3=7/8$, $OP_4=15/16$, $OP_5=31/32$, …..

Generally,

$OP_n=(2^n-1)/2^n$.

And $OP_\infty=1$.

Hence we can see infinity (red circle in Fig.1－B).

Geometry of Fig.1－B itself is Euclidean and substantially equivalent to Fig.1－A, though the measures are different.

We send light from O of Fig.1－A, then the light goes to P_1,P_2,P_3,P_4,…. Light passes OP_1, P_1P_2, P_2P_3, P_3P_4,…..in equal time, respectively, as their intervals are equal. Similarly we send light from O of Fig.1－B, then light also goes to P_1,P_2,P_3,P_4,….of Fig.1－B. Light passes OP_1, P_1P_2, P_2P_3, P_3P_4,…. in equal time, respectively, though their intervals are not seen equal. Light cannot arrive at P_∞ (wall of cosmos) within finite time. From geometrical point of view, Fig.1－B is non-Euclidean in relation to running light.

Table 1－1 Distances between selected interval in Fig. 1－A and Fig. 1－B

Inter-val	Fig. 1－A (Euclidean)		Fig. 1－B (Euclidean)		Fig. 1－B (non-Euclidean)	
	a>0	a=1/2	a>0, b>1	a=1/2, b=2	a>0	a=1/2
OP_1	a	1/2=0.5	a	1/2=0.5	a	1/2=0.5
P_1P_2 OP_2	a 2a	1/2=0.5 2/2=1	a/b $a(b^2-1)/(b(b-1))$	1/4=0.25 3/4=0.75	a 2a	1/2=0.5 2/2=1
P_2P_3 OP_3	a 3a	1/2=0.5 3/2=1.5	a/b^2 $a(b^3-1)/(b^2(b-1))$	1/8=0.125 7/8=0.875	a 3a	1/2=0.5 3/2=1.5
P_3P_4 OP_4	a 4a	1/2=0.5 4/2=2	a/b^3 $a(b^4-1)/(b^3(b-1))$	1/16=0.0625 15/16=0.9375	a 4a	1/2=0.5 4/2=2
P_4P_5 OP_5	a 5a	1/2=0.5 5/2=2.5	a/b^4 $a(b^5-1)/(b^4(b-1))$	1/32=0.03125 31/32=0.96875	a 5a	1/2=0.5 5/2=2.5
P_5P_6 OP_6	a 6a	1/2=0.5 6/2=3	a/b^5 $a(b^6-1)/(b^5(b-1))$	1/64=0.015625 63/64=0.984375	a 6a	1/2=0.5 6/2=3
OP_∞	∞	∞	$ab/(b-1)$	1	∞	∞

Table 1－2 Comparison of proposing cosmology and prevailing one.

	Proposing cosmology	Prevailing cosmology
Size	Infinite	finite
Wall	Exist	Exist
Center	Exist(numberless)	Exist(only, geometric)

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References

Hubble, E. P., (1929), A relation between distance and radial velocity among extra-galactic nebulae, (PNAS)

Kirshner, R. P. and others, (2003), Hubble's diagram and cosmic expansion, (PNAS)