Axisymmetric Galaxy Distribution and the Center of the Universe

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The validity of Hubble’s law defies the determination of the center of the big bang expansion, even if it exists. Every point in the expanding universe looks like the center from which the rest of the universe flies away. In this article, the author shows that the distribution of apparently circular galaxies is not uniform in the sky and that there exists a special direction in the universe in our neighborhood. The data is consistent with the assumption that the tidal force due to the mass distribution around the universe center causes the deformation of galactic shapes depending on its orientation and location relative to the center and our galaxy. The location of the center is estimated to be at a distance $\sim 0.88/h$ Gpc in the direction of $l = 135^\circ \pm 30^\circ$ and $b = -35^\circ \pm 20^\circ$ in galactic coordinates $(\alpha = 01h 36m, \delta = +26d 50m$ in equatorial J2000.0 or in the direction of the Constellation Pisces. Further study of the deformation of galaxies such as triaxial galaxies and non-axisymmetric spiral galaxies can be utilized for a more accurate determination of the universe center.

95.80.+p, 98.65.-r, 98.80.-k, 98.90.+s

Since the discovery of Hubble’s law in 1929, and the big bang interpretation of its data, the question lingers whether a center for the expansion exists and if so where. The Hubble law, $v = H_0 r$, yields the relationship, $v_2 - v_1 = H_0 (r_2 - r_1)$ for any two galaxies with positions and velocities, $r_1$, $v_1$ and $r_2$, $v_2$ respectively, where $H_0 = 100 h$ km/s Mpc is the Hubble constant (with $h = 0.5 \sim 0.85$). The last equation implies that every point appears to be the center of the expansion. Besides, the distribution of galaxies surrounding us seems to be isotropic on some large distance scale. Fig. 1 (a) shows the distribution of 23,011 bright galaxies in galactic coordinates compiled in RC3 [1]. The galaxies in the galactic plane are missing for the obvious reason that they are prevented from observation due to our own Milky Way. Plots in equatorial coordinates and supergalactic coordinates show a similar uniform distribution. The numbers of galaxies on the two sides of the galactic plane are 12,323 in the north and 10,628 in the south with a ratio of 1.1651. The difference in these numbers may be partly due to a statistical fluctuation and partly due to a historical bias in observation in the past. Anyway, any study hereafter can be normalized with this ratio. The galaxies in the galactic plane are missing for the obvious reason that they are prevented from observation due to our own Milky Way. Plots in equatorial coordinates and supergalactic coordinates show a similar uniform distribution. Fig 3 (a)-(d) shows the distribution of 23,011 bright galaxies in galactic coordinates compiled in RC3 [1]. The galaxies in the galactic plane are missing for the obvious reason that they are prevented from observation due to our own Milky Way. Plots in equatorial coordinates and supergalactic coordinates show a similar uniform distribution. The numbers of galaxies on the two sides of the galactic plane are 12,323 in the north and 10,628 in the south with a ratio of 1.1651. The difference in these numbers may be partly due to a statistical fluctuation and partly due to a historical bias in observation in the past. Anyway, any study hereafter can be normalized with this ratio. The validity of Hubble’s law defies the determination of the center of the big bang expansion, even if it exists. Every point in the expanding universe looks like the center from which the rest of the universe flies away. In this article, the author shows that the distribution of apparently circular galaxies is not uniform in the sky and that there exists a special direction in the universe in our neighborhood. The data is consistent with the assumption that the tidal force due to the mass distribution around the universe center causes the deformation of galactic shapes depending on its orientation and location relative to the center and our galaxy. The location of the center is estimated to be at a distance $\sim 0.88/h$ Gpc in the direction of $l = 135^\circ \pm 30^\circ$ and $b = -35^\circ \pm 20^\circ$ in galactic coordinates $(\alpha = 01h 36m, \delta = +26d 50m$ in equatorial J2000.0 or in the direction of the Constellation Pisces. Further study of the deformation of galaxies such as triaxial galaxies and non-axisymmetric spiral galaxies can be utilized for a more accurate determination of the universe center.

(i) Apparently circular galaxies are not distributed uniformly in the sky. If the orientations of galaxies are distributed at random, Fig 2 (a)-(c) should show statistically uniform distributions. It definitely shows the directionality.

(ii) The southern part is more compact compared to the northern part. Since a closed curve surrounding the pole is extended to all longitudes in Fig 1 (a), the views in other coordinates, supergalactic coordinates in Fig 2 (b) and equatorial coordinates J2000.0 in Fig 2 (c), provide intuitively clearer distribution plots. Fig 2 (b) shows similar shapes for both, northern and southern, distributions. The normalized ratio of the northern to the southern distribution is (682)/(416)/(1.1651) = 1.4071. The shapes in supergalactic coordinates in Fig 2 (b) match this ratio. Note that the left and right blobs in Fig 2 (b) approximately correspond to those in the north and the south in Fig 2 (a).

Fig 3 (a)-(d) shows the distribution of galaxies with $R_{25} = 0.01-0.10$, $0.11-0.20$, $0.21-0.40$ and $0.41-1.00$. They do not show a distinct directionality except for a higher density in the neighborhood of $(135d, -35d)$. The total number of galaxies, the numbers in the north and south as well as the normalized north/south ratio are given for sliced values of $R_{25}$ in Table 1. In summary, a distinct directionality exists only for $R_{25} = 0.00$, and not for the other values of $R_{25}$.

An important question is what is the meaning of this directionality in the distribution of apparently circular galaxies. The author suggests that the existence of a center of the universe is consistent with the presented data and computes the distance and the direction to the center. He also suggests a future study for improving the determination of these important cosmological parameters.
Galaxies are subject to tidal forces due to the gravity of the masses which are contained in a sphere of radius equal to the distance from the center to the galaxies in question. Circular galaxies in the radial direction from the center through us stay circular in the presence of tidal forces, while those in the direction perpendicular to the radial seen from us are deformed by the squeeze and stretch of tidal forces and therefore become elliptical. This explains the directionality in Fig. 2 (a)-(c).

The direction to the center must be towards the south, since the southern part in Fig. 2 (a) is more compact and less in number compared to the northern part. The central value is in the neighborhood of $l =135^\circ$ and $b = -35^\circ$. The distance to the center, R, can be estimated from the relationship $(R+L)/(R-L) = (1.4071)^{1/2}$, where L is the average distance to the bright galaxies in RC3, which is assumed to be $75$ h$^{-1}$ Mpc. Then we obtain $R = 11.74 L = 0.88h^{-1}$ Gpc. This is $1/3.4$ of the Hubble distance, $cH_0^{-1}$, or equivalently $z = 0.35$. The absence of a node for each blob in Fig 2 (d) is consistent with this solution, i.e., the center cannot be inside the bright galaxies compiled in RC3. It is a remarkable coincidence that the value of $z = 0.35$ is the point where departure from the Hubble law starts to reveal itself.

The average positions of the distributions in the north and south in Fig.2 (a) or equivalent ones in (b) and (c), are not diametrically opposite. This implies that local fluctuation of galaxy distributions influences the gravitational lines of force, so that the average positions are displaced from a radial direction. In fact, there is up to a 16 percent of disparity between the numbers of galaxies in the two hemispheres in the RC3 compilation, as mentioned earlier.

If the matter density is constant, it produces a gravitational force that is linear in the radial direction, thus yielding a tidal force that is spherically symmetric and attractive. Obviously, such a tidal force does not explain the data of Fig.2 (a)-(c). Although the assumption of homogeneity and isotropy in the Friedman-Robertson-Walker metric yields a constant matter density at a fixed time, experimental evidence for those assumptions is yet to come. As a matter of fact, the analysis of this letter finds that the matter density of the universe is not constant. Finally, the author suggests that the deformation of galaxies by the cosmic tidal forces which was discussed in this letter should be taken into account for the systematic study of triaxiality of galaxies and asymmetric spiral galaxies. From statistical analysis of these galaxy deformations, one may be able to reach a more accurate determination of the new cosmological parameter, the position of the center of the universe.

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[1] de Vaucouleurs, G. et. al., Third Reference Catalogue of Bright Galaxies, Vol I-III (Spring-Verlag, New York, 1991).
[2] Perlmutter, S. et. al., Discovery of a supernova explosion at half the age of the Universe. Nature 391, 51-54 (1998).
[3] Binney, J. & Tremaine, S., Galactic Dynamics, (Princeton University Press, Princeton,1987).
[4] Schoenmakers, R. H. M., Franx, M. and de Zeeuw, P. T., Measuring non-axisymmetry in spiral galaxies. MNRAS 292, 349-364 (1997).
[5] Schoenmakers, R. H. M., Asymmetries in Spiral Galaxies, (University Press, Veenendaal, 2000) and references therein.
| Range of R25 | Total | North | South | North/South Normalized Ratio |
|------------|-------|-------|-------|-----------------------------|
| 0.00-0.00  | 1098  | 682   | 416   | 1.4071                      |
| 0.01-0.10  | 4573  | 2330  | 2243  | 0.8916                      |
| 0.11-0.20  | 4448  | 2322  | 2126  | 0.9374                      |
| 0.21-0.30  | 3286  | 1714  | 1572  | 0.9358                      |
| 0.31-0.40  | 2246  | 1148  | 1098  | 0.8974                      |
| 0.41-0.50  | 1638  | 861   | 787   | 0.9281                      |
| 0.51-1.00  | 4045  | 2210  | 1835  | 1.0337                      |
