Chapter 13

Structure of the Grand Universe

The 8,450 galaxies with distances of between 5 and 36 million light-years can be plotted in three dimensions. More than half of these are concentrated in the fan-shaped structure formed by the Superuniverse Wall, when viewed from above. When viewed from the side looking along the plane of the grand universe, a section of this wall is seen to form a V-shaped structure with the apex oriented in the direction of the Isle of Paradise, just as described by the Perfector of Wisdom.

The estimated distance to the far border of the grand universe of ~23 Mly, based upon a 4 Mly radius for Orvonton and the internal structure of the grand universe, is comparable to the distance at which the rate of space expansion has been measured to abruptly change from 67 to 74 kilometers per second per megaparsec. The center of distribution of the galaxies within ~23 Mly is found to be located at a distance of ~9 Mly in the approximate direction of Paradise, as indicated by the CMB dipole.

1. Three-Dimensional Structure

There are a total of 8,450 objects with valid CMB distances between 5-36 Mly. These distances are calculated using the generally accepted value of 73 $\pm$ 5 kms^{-1}/Mpc for the rate of cosmic expansion. It is known that galaxies which are gravitationally bound together in the Local Group do not have any proper motion due to space expansion. This invalidates CMB distance calculations within about 4 Mly (1.2 Mpc). A minimum distance of 5 Mly is selected to exclude these invalid Hubble flow calculations. However, according to the Guide for NASA's Extragalactic Database, significant uncertainty still attaches to CMB distance calculations for objects with velocities below 500-700 km/s or distances of less than 22-31 Mly. [56]

There is no apparent theoretical explanation for this uncertainty in CMB distance calculations between 5 and 31 Mly. Galaxies within this range are not gravitationally bound to the Local Group and appear to move with the Hubble flow. Recent studies have found that the peculiar radial velocities of galaxies within this range are relatively small, on average, so their observed redshift velocities should be mostly explained by their proper motion due to space expansion. Nevertheless, with the development of new redshift-independent distance measures over the last few decades, enough significant discrepancies between these and Hubble flow distance calculations have been clearly identified to prompt this caution on the Guide page for NED. There is something occurring within about 30 Mly of us which causes significant discrepancies between CMB and redshift-independent distance calculations.

These discrepancies appear to be related, at least in part, to a significant change in the rate of space expansion. Within about 22.8 Mly (7 Mpc) the rate of space expansion is about 10 percent less than the generally used value of 73 kms^{-1}/Mpc. It was measured at 67 kms^{-1}/Mpc by the well-known astrophysicist R. Brent Tully in 2008. [57] In an analysis of galaxy motions within about 130 Mly, Tully finds that the Hubble constant suddenly changes from 67 kms^{-1}/Mpc to 74 kms^{-1}/Mpc at a distance of approximately 23 Mly. Tully first identified this discontinuity in the rate of space expansion in 1988 and called it the "local velocity anomaly." Tully identifies the galaxies within 23 Mly as being part of a structure he calls the Local Sheet.

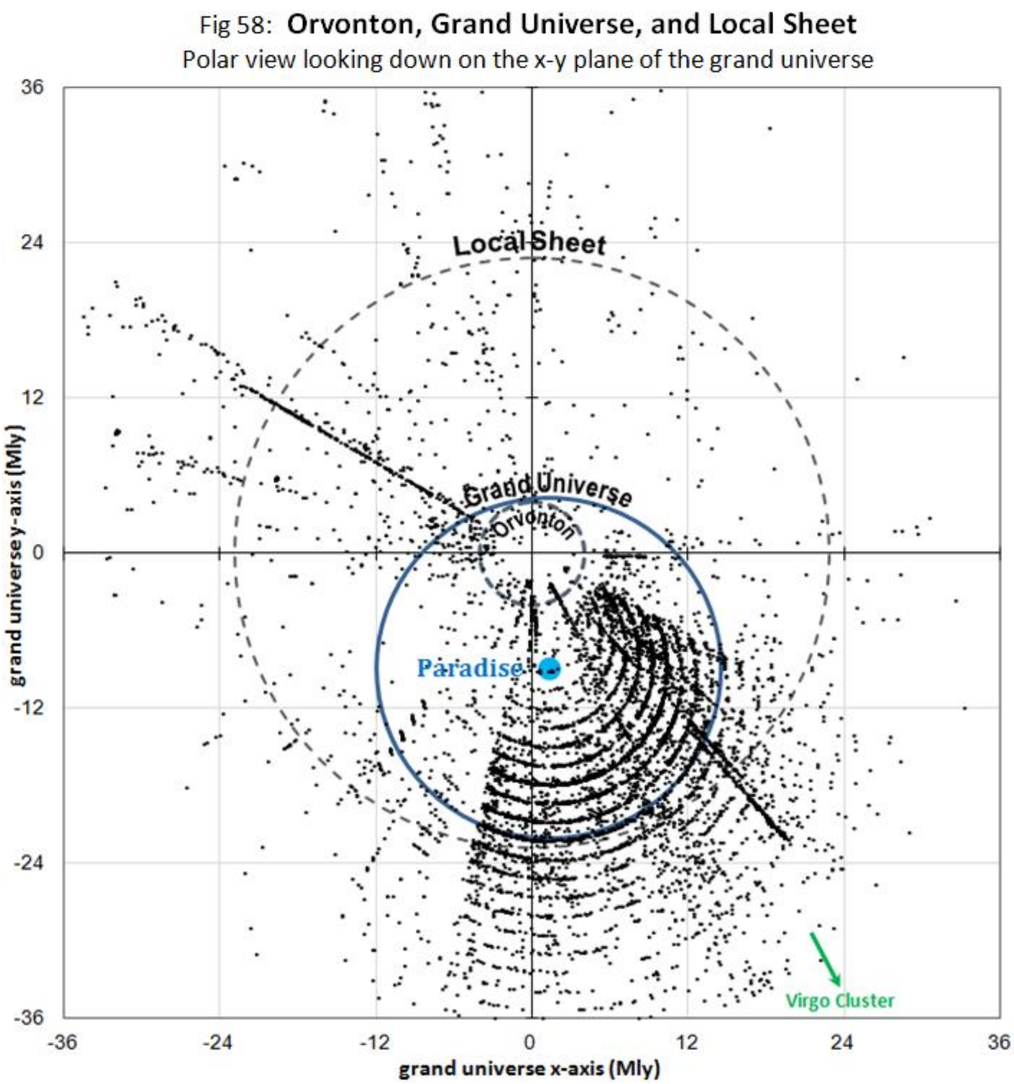
Using Tully's empirically determined expansion rate of 67 km/s, the 8,450 objects with valid CMB distances within 5-36 Mly can be plotted in three dimensions. The following formulae convert grand universe longitude $\boldsymbol{\alpha}$ and latitude $\boldsymbol{\beta}$ and radial distance $\boldsymbol{r}$ into three-dimensional Cartesian coordinates (x, y, z).

$$x = \boldsymbol{r} \cos \boldsymbol{\beta} \cos \boldsymbol{\alpha}$$

$$y = \boldsymbol{r} \cos \boldsymbol{\beta} \sin \boldsymbol{\alpha}$$

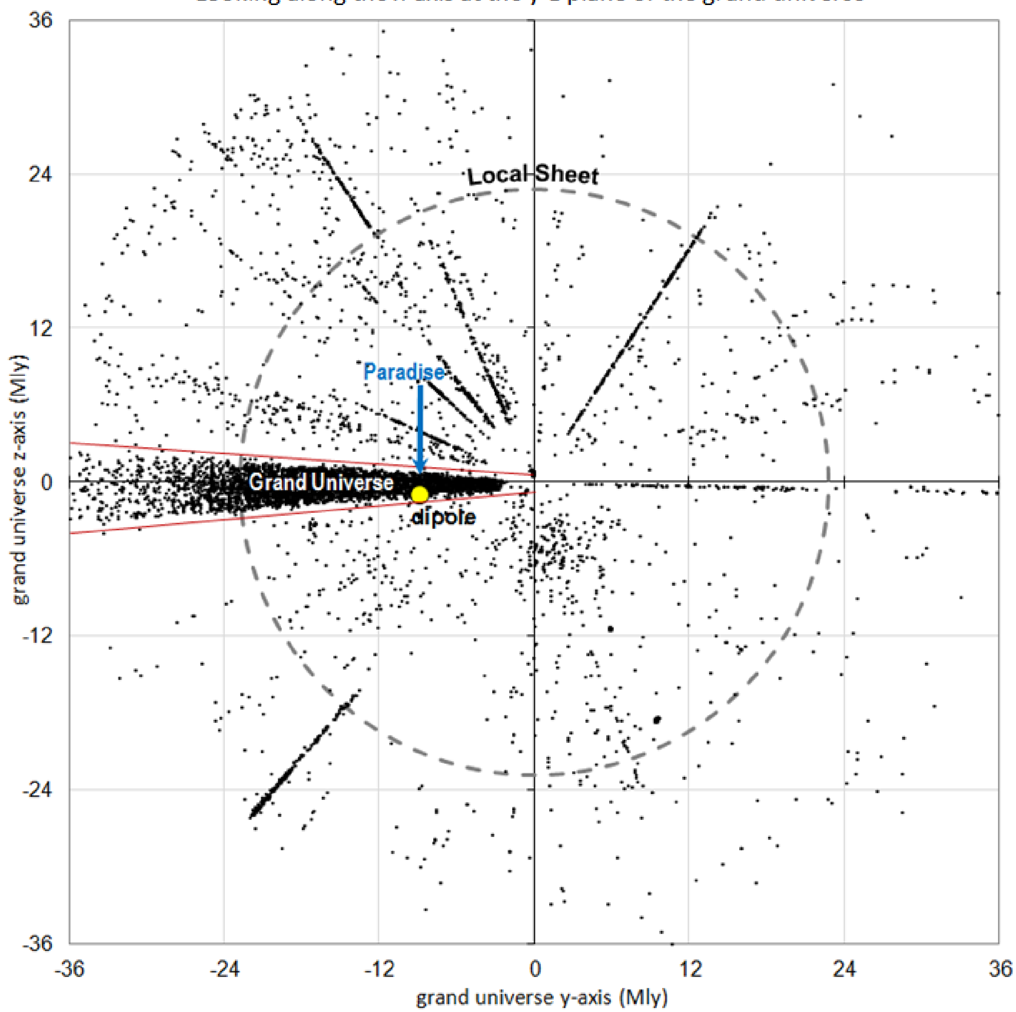
$$z = \boldsymbol{r} \sin \boldsymbol{\beta}$$

The x and y coordinates define locations on the grand universe plane. Grand universe and galactic longitudes and latitudes are the same at the nodes where the planes intersect ($\text{lon.} = 32.89°$, $\text{lat.} = 0°$ and $\text{lat.} = 212.89°$, $\text{lat.} = 0°$) but differ at all other values. The positive x-axis points north toward zero degrees of grand universe longitude and latitude, which equates to $l = 15.69°$, $b = 28.47°$ in galactic coordinates.



In the polar view of the 8,450 objects within 36 Mly (figure 58) the wedge-shaped circular section forming a fan-like pattern extending downward and to the right is the Superuniverse Wall contained between grand universe longitudes α = 258-333°. The apparent ribs tracing out the body of the fan are made up of galaxies which have the same heliocentric redshifts. The border for Orvonton at 4 Mly is shown, as well as the tentative location of Paradise about 9.2 Mly (2.31 x 4) distant. Paradise lies in the longitudinal direction of the CMB dipole but in the gravitational plane of the grand universe at α = 278.13°, β = 0° (galactic coordinates l = 258.96°, $\mathbf{b}$ = 52.87°). The tentative border of the superuniverse space level is drawn at 13.2 Mly (9.2+4.0)) from Paradise. The far border of the space level at 22.4 Mly is derived from the revealed internal structure of the grand universe. This is nearly the same as the distance to the border of Tully's Local Sheet at 22.8 Mly. Tully finds a sudden change in the rate of space expansion at this distance. We are told there is some change in the "space-forces existing in this zone of relative quiet which encircles the seven superuniverses." **12:1.14** A change in the rate of space expansion appears to qualify as such a change.

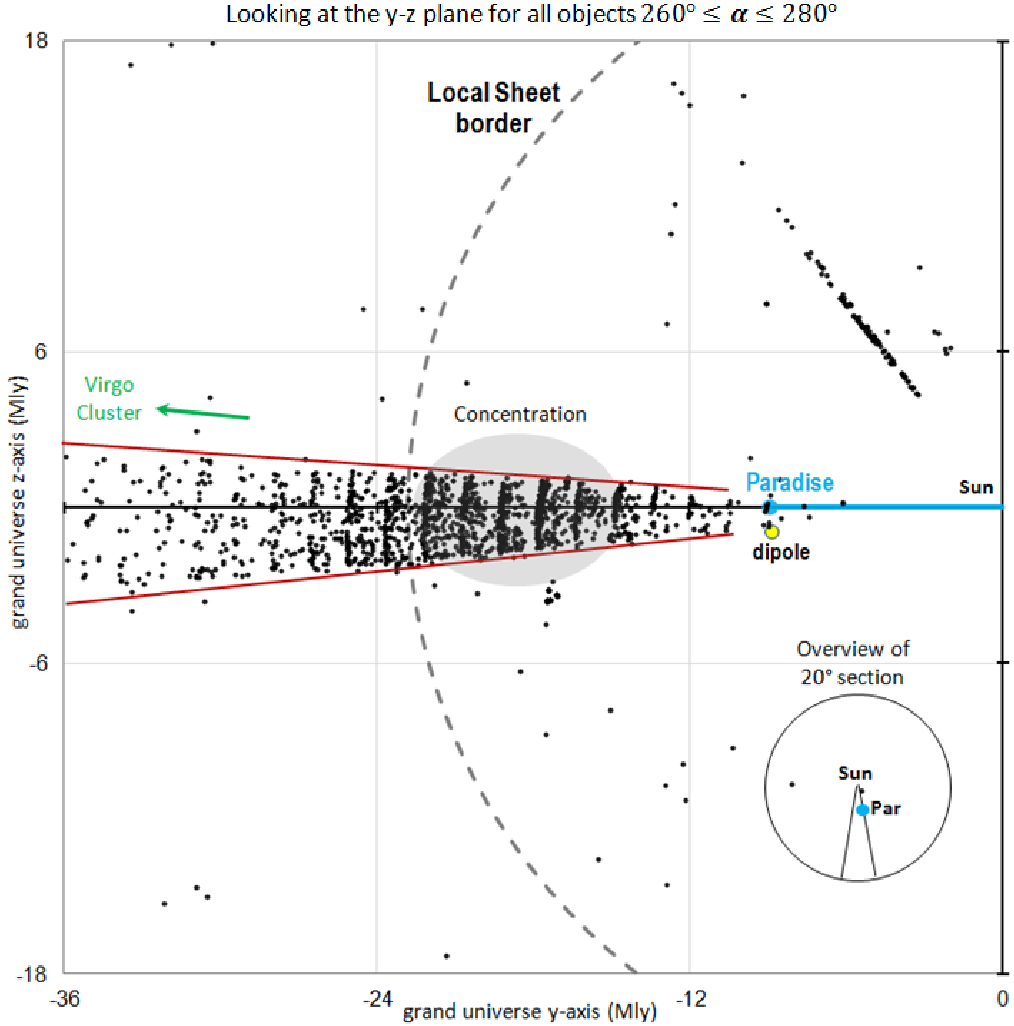
Fig 59: **Side View of the Grand Universe**
Looking along the x-axis at the y-z plane of the grand universe



The calculation of distance in the CMB frame depends upon the direction of an object relative to the CMB dipole, which has grand universe coordinates of α = 278.13°, β = −5.66° (l = 264.14°, b = 48.26° in galactic coordinates). For a given redshift, distance measured relative to the CMB frame is always greatest in the direction of the dipole. The direction to the CMB dipole points to the opposite side of the grand universe, and structurally the Isle of Paradise must lie between us and this opposite point. The longitude of Paradise is established by the CMB dipole. The latitude is established by the gravitational plane of the grand universe.

Fig 60: **20 Degree Segment of Objects within 5-36 Mly**

Looking at the y-z plane for all objects 260° ≤ α ≤ 280°



Looking at the grand universe from the side (figure 59), the thickness forms a distinctive V-shape on the Virgo side as predicted by revelation. There should be approximately as many objects on the right side in the Andromeda direction, because gravitational rotation requires a symmetrical distribution of mass, but there are no valid CMB distances within ~5 Mly of the sun. The V-shape of the Superuniverse Wall in cross-section is much more apparent when looking at a 20 degree longitudinal span of the sky on the opposite side of the grand universe.

The upper and lower surfaces are clearly delineated, and the density of galaxies decreases dramatically above and below these surfaces. There is a peak density in the concentration of galaxies between 15 and 22 Mly within this V-shape, where the central core of the superuniverse space level is located.

The CMB dipole is placed 9.3 Mly away and 920,000 ly directly beneath the Isle of Paradise. "Space seemingly originates just below nether Paradise." **11:2.11** The CMB dipole is thought to be caused by the motion of the sun relative to the co-moving CMB reference frame. The CMB radiation supposedly originates in the universe's uniform temperature of 3000° **K** at the time of last scattering more than 13 billion years ago. However, the existence of the universal plane of creation revolving about Paradise, demonstrated later, disproves these ideas about the origin of the CMB radiation and the cause of space expansion. Within the context of revealed cosmology the CMB dipole is a peak temperature that is directly related in some way to the phenomenon of space expanding from an absolutely stationary location "just below nether Paradise."

2. Border of the Grand Universe

There are techniques for measuring distance which do not rely upon redshift measurements. The strong correlation between the absolute luminosity and pulsations of Cepheid variable stars was the first "standard candle" used to measure cosmic distances. This relationship was discovered in 1908 by Henrietta Swan Leavitt. This technique is referred to by an Archangel: "In one group of variable stars the period of light fluctuation is directly dependent on luminosity, and knowledge of this fact enables astronomers to utilize such suns as universe lighthouses or accurate measuring points for the further exploration of distant star clusters." **41:3.10**

The light from Cepheid variables fluctuates in intensity over a period of a few days to a few months. The period of fluctuation is directly related to the absolute magnitude (inherent luminosity) of the star. The longer the period of fluctuation is, the more luminous the star is. When the period of fluctuation has been established for a Cepheid, its absolute magnitude M can be calculated. The apparent magnitude m of the star is its observed brightness. Subtracting the absolute from the apparent magnitude gives the distance modulus (m-M) for the star, the relative change in magnitude. Since luminosity is inversely proportional to the square of the distance, the distance modulus is related to the distance by the following formula, where r_{pc} is in parsecs:

$$(m - M) = 5\log_{10}\left(\frac{r_{pc}}{10}\right)$$

or alternatively

$$r_{pc} = \sqrt{\left(100^{\frac{m-M}{5}}\right)100}$$

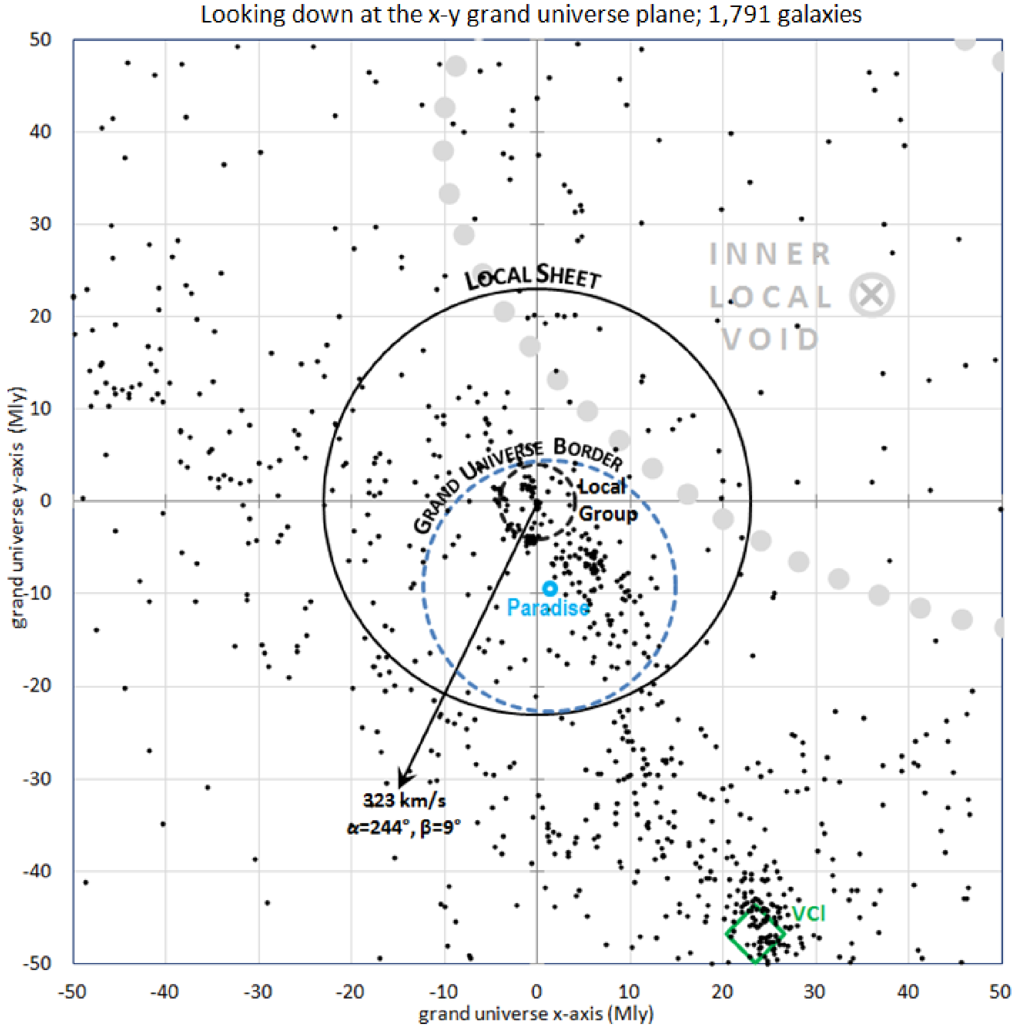
The TRGB technique (Tip of the Red Giant Branch) is based upon the theory of stellar evolution. In the later stages of stellar evolution some stars become red giants, and these giant stars all have the same absolute magnitude. Red giants have a higher characteristic metallicity, particularly of iron, and their absolute magnitude is relatively uniform and remains constant for billions of years. Once a red giant is identified, its absolute magnitude is known to within ± 10 percent. Since its apparent magnitude can be observed, its distance modulus establishes how far away it is.

These and other techniques for estimating distance are used in a 2008 paper by the highly respected astrophysicist R. Brent Tully of the University of Hawaii. [57] In his 2008 paper Tully uses a list of 1,791 galaxies with redshift-independent distances to analyze the peculiar and proper motions of galaxies in our local cosmic neighborhood. [58] These galaxies have heliocentric velocities which are generally less than 3,000 km/s ($z < 0.01c$), which is equivalent to a proper distance of about 134 Mly (41 Mpc where $H_0 = 73\,\text{kms}^{-1}/\text{Mpc}$). These redshift-independent distances are believed to be accurate to within ± 10 percent, according to Tully. This list is a small subset of the galaxies within this range, but their number and dispersion are believed sufficient to reach some reasonably firm conclusions.

In this paper Tully demonstrates that galaxies within a radius of approximately 7 Mpc (~23 Mly) from the Milky Way form a structure he calls the Local Sheet. The galaxies of the Local Sheet are distinguished from those more than 23 Mly distant in two ways. On average, galaxies within 23 Mly have relatively small peculiar motions with respect to each other. Using redshift-independent distances, Tully finds that they form a relatively stable and coherent grouping, once the proper motion of space expansion is factored out.

Secondly, there is a dramatic difference in the rate of space expansion for galaxies within the Local Sheet and those beyond its borders. Tully finds that the Hubble constant changes from 67 $\mathrm{kms^{-1}/Mpc}$ for galaxies within 7 Mpc of us to 74 $\mathrm{kms^{-1}/Mpc}$ for galaxies at greater distances. At about 23 Mly there is "an abrupt break in the amplitude and direction of galaxy motions." [57] This abrupt change in amplitude and direction is an anomaly, since the rate of space expansion is expected to be relatively constant beyond the borders of the Local Group. The 1,791 redshift-independent distances examined by Tully "place the local velocity anomaly in glaring relief" and "have strongly confirmed the existence of a velocity discontinuity at ~7 Mpc." [57] Tully offers a speculative hypothesis based upon gravitational instability theory to explain this unexpected finding.

Fig 61: **Peculiar Motion of the Local Sheet per Tully**
Looking down at the x-y grand universe plane; 1,791 galaxies



The 22.8 Mly to this velocity discontinuity is in good agreement with the estimated distance of 22.5 Mly to the far border of the grand universe. The local velocity anomaly and the sudden change in the rate of space expansion both occur at the distance to the relatively quiet space zone separating the superuniverse and first outer space levels. It is also at this distance that the counterclockwise revolution of the superuniverse space level gives way to the clockwise revolution of the first outer space level.

Tully's list of 1,791 galaxies is used to create the above chart by transforming their galactic coordinates into grand universe coordinates and using their redshift-independent distances. In this polar view the Virgo Cluster is about 54 Mly away. Bordering the Local Sheet in the upper right quadrant of the chart is the boundary of the Inner Local Void, a region that is nearly empty of galaxies. According to Tully, this void begins at the edge of the Local Group and "must be really empty" of galaxies. Its center lies about 36 Mly (11 Mpc) from us in the direction $\boldsymbol{\alpha} = 32°$, $\boldsymbol{\beta} = -3°$ ($\boldsymbol{l} = 30°$, $\boldsymbol{b} = -0.6°$). Looking in this direction, the far wall of the Inner Local Void appears to be around 65 Mly (20 Mpc) distant, although Tully remarks that this distance is quite uncertain.

This Inner Local Void forms an oblate spheroid. It is about 60 Mly deep along our line of sight and about 103 Mly (32 Mpc) in diameter in the plane perpendicular to our line of sight. It sits between and connects two much larger voids. The Northern Local Void is about 463 Mly (142 Mpc) in diameter, and its center is approximately located upon the plane of the grand universe at $\boldsymbol{\alpha} = 6°$, $\boldsymbol{\beta} = -4°$ ($\boldsymbol{l} = 16°$, $\boldsymbol{b} = 21°$). [59] The Southern Local Void is about 502 Mly (154 Mpc) across, and its center lies almost exactly upon the plane of the grand universe at $\boldsymbol{\alpha} = 232°$, $\boldsymbol{\beta} = -1°$ ($\boldsymbol{l} = 223°$, $\boldsymbol{b} = 16°$). [59] Tully refers to these three connected voids collectively as the Local Void and characterizes it as being extremely large, a supervoid.

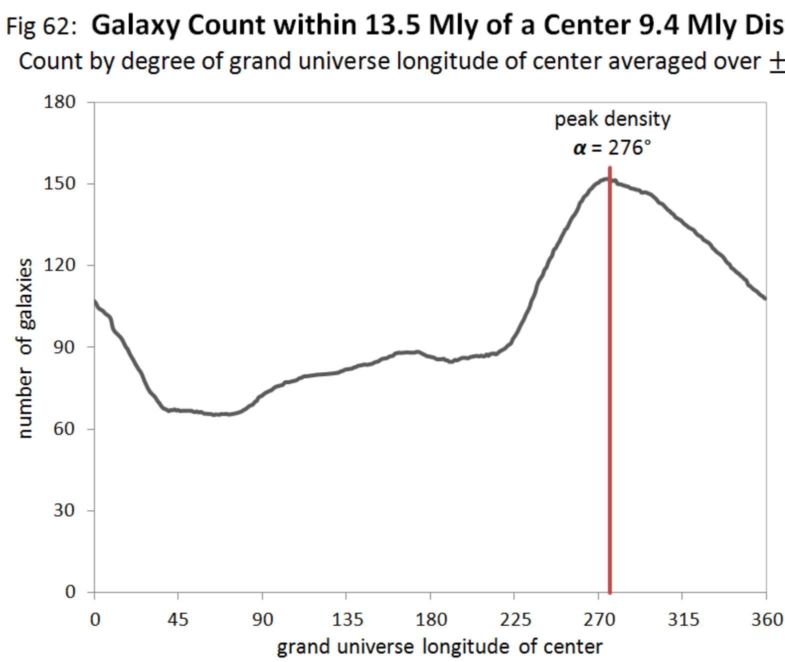
The galaxies within the Local Sheet's radius of about 23 Mly have small peculiar velocities relative to each other which Tully finds average out to about 40 km/s. This includes the Local Group. The Milky Way is not at the center of mass for the Local Group in the current understanding, but Tully uses it as the center of the Local Sheet. Tully also finds a relatively small peculiar velocity for the Local Group (Orvonton) with respect to the Local Sheet of 66 km/s. This small velocity relative to the other superuniverses is compatible with the idea of Orvonton's revolution. Since Orvonton is in common revolution with the other six superuniverses about the Isle of Paradise, the average peculiar velocities between the galaxies of the seven superuniverses should be relatively small on average.

After accounting for the proper motion of space expansion, Tully analyzes the peculiar motions for galaxies beyond 23 Mly and finds a net motion of the whole Local Sheet with respect to surrounding galaxies of 323 ± 25 km/s toward $\boldsymbol{l}$ = 220 ± 7°, $\boldsymbol{b}$ = 32 ± 6°. This direction transforms to $\boldsymbol{\alpha}$ = 244 ± 7°, $\boldsymbol{\beta}$ = 9 ± 6° in grand universe coordinates, which is just 9 degrees above the grand universe plane. This apparent net motion of the Local Sheet, roughly along the gravitational plane of the grand universe, is consistent with the dynamics of the alternate revolutions of the superuniverse and the first outer space levels. From our location near Uversa in Orvonton, which is relatively near the Milky Way galaxy, we would expect to detect an average peculiar motion toward the nearby galaxies of outer space in one direction along the gravitational plane of the grand universe and an average recessional motion in the opposite direction. This general phenomenon is observed in Tully's study.

3. The Grand Universe and the Local Sheet

The grand universe is a smaller region within the Local Sheet and is oriented about a different center. The Local Sheet identified by Tully has a radius of 22.8 Mly (7 Mpc), as measured from our location. The grand universe has a radius of 13.2 Mly about a center 9.2 Mly away in the direction of $\boldsymbol{\alpha}$ = 278.13°, $\boldsymbol{\beta}$ = 0° in grand universe coordinates. There are 236 galaxies in Tully's list of 1791 galaxies contained within the volume of the Local Sheet. One means of distinguishing the smaller volume of the grand universe from the larger volume of the Local Sheet is to find the longitude at which the number of galaxies in the grand universe volume is greatest.

By the internal structure of the grand universe, the distance to the far border should be 5.62 times the radius of Orvonton. If the distance to the far side is taken as the 22.8 Mly (7 Mpc) radius of the Local Sheet, this makes the radius of Orvonton 4.06 Mly (22.8/5.62). This calculated radius for Orvonton is reasonable, since it falls roughly in the middle of current estimates for the radius of the Local Group, which range from 3.4 to 4.4 Mly. If this radius of 4.06 Mly is used for Orvonton, then the distance to Paradise is 9.39 Mly (4.06 × 2.31). Since the grand universe is in gravitational revolution, its boundary should be roughly circular. The grand universe can be modeled as a sphere with a radius of 13.45 Mly. The center of this sphere is 9.4 Mly distant, but it could lie in any direction along the grand universe plane. The number of galaxies contained within a sphere of radius 13.45 Mly should be greatest when this sphere is centered on the longitude of Paradise, if the galaxies within Tully's list are sufficiently representative of the local distribution.



The highest galaxy count of 154 galaxies occurs at the grand universe longitude $\alpha = 276°$. A sphere of radius 13.45 Mly with its center 9.4 Mly distant in the direction $\alpha = 276°$ and $\beta = 0°$ has 20.4 percent of the Local Sheet's volume, but 65 percent of all galaxies (154/236) within the Local Sheet. The density of galaxies within this sphere is more than three times greater (3.2x) than the galactic density within the volume of the Local Sheet as a whole. This concentration of galaxies at this longitude differs by just two degrees from the direction to Paradise of α = 278.13°, $\beta = 0°$, as established by the CMB dipole and the gravitational plane of the grand universe. Additionally, the simple average of the latitudes of these 154 galaxies is 0.5 degrees, so there is symmetry in their distribution above and below the gravitational plane.

It is notable that Tully's list of 1791 galaxies and the list of 8,450 objects with Hubble flow distances between 5-36 Mly are selected using unrelated criteria.

Tully's criteria ignore the redshift of objects, while the list of 8,450 objects with valid CMB distances is built from redshift measurements. Furthermore, Tully's list does not contain any galaxies that are located within the borders of the Superuniverse Wall. These two data sets are constructed independently of one another using different criteria. Yet Tully's data is consistent with the distance and direction to Paradise as well as the radius and gravitational plane of the grand universe. These two data sets mutually confirm one another. The Isle of Paradise is approximately 9.2 Mly distant in the direction $\boldsymbol{\alpha} \cong 278°, \boldsymbol{\beta} \cong 0°$ ($\boldsymbol{l} \cong 259°, \boldsymbol{b} \cong 53°$).