Structures Too Big for the Big Bang

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<u>Basic issue</u>: That astronomers have found evidence of superclusters of galaxies and of quasars (and voids) that are so large they are not explicable by current theories. But structures too big for the Big Bang are not too big for God.

Beginning in the 1970's there was an effort to determine what has been called the "peculiar motion" of galaxies. This is referring to the motion of galaxy clusters relative to other galaxies. Scientists wanted to determine if the universe would continue expanding forever or eventually stop expanding and recollapse. So they started looking at the motion of galaxies that are "local" versus galaxies that are very distant. Here "local" means a few hundred million light years. Compare this to the estimated size of the observable universe, which would put the edge of the observable universe about 46 billion light-years away from us (recent estimate).

In 1975 it was reported that our own galaxy was moving at a velocity of about 500 km/sec. This was something the scientific community was skeptical of at first. There was an effort to improve estimates of the speeds of galaxies. So scientists had the idea to measure velocities in relation to the cosmic microwave background radiation, since it is uniform in all directions. So in 1977 it was found that our solar system was moving about 400 km/sec and that the Local Group of Galaxies that we are in is moving at about 600 km/sec. (So the Milky Way and the Andromeda galaxy for instance are both in this group.) These speeds were much more than what was expected. This was discussed in an article by well-known astronomer Alan Dressler, in Scientific American from September 1987, called the "Large-Scale Streaming of Galaxies.¹"

Cosmological Questions

One question raised by scientists is how did our Local Group of galaxies come to be moving at such a speed? Another question is how did these clusters get so big? Could gravity pull galaxies into these clusters, even in billions of years? Some have even said that these findings challenge an important assumption in Big Bang theory, called the Cosmological Principal. The Cosmological Principle is the assumption that even you could look at the universe on a large-enough scale the universe as a whole would be uniform in density. This assumption implies that if we could map the locations of galaxies at large enough distances, the clustering would become small and insignificant in comparison to the universe as a whole. But surprising things have been found about galaxy clusters since 1987. The universe is made up of clusters of clusters of galaxies that astronomers did not expect to exist at such large distance scales. This challenges Big Bang theory, at least in the view of some astronomers. The problem

has gotten bigger and bigger over the years as scientists have found there are clusters of galaxies that cover vast unimaginable distances and they all seem to have significant speeds. At the largest distances measuring the speeds of the clusters becomes very uncertain. But it raises the question of how could the galaxy clusters be accelerated to such speeds? Even 14 billion years may not be enough time for such large superclusters to be accelerated by gravity to these speeds.

Consider where we are in the universe. We are in the Milky Way galaxy (now thought to be a Barred Spiral type galaxy) and the Milky Way is part of a cluster of neighbor galaxies called "The Local Group." Sounds kind of hum-drum, but our Local Group of galaxies is moving toward a larger supercluster made of several other galaxy clusters called the Hydra-Centaurus supercluster. But the article suggests there must be an even greater supercluster beyond Hydra-Centaurus. (Note that the Hydra cluster is about 100 million light-years in size.) This large supercluster, unidentified in the 1987 Scientific American article has been referred to as the Great Attractor. In more recent years the Hydra-Centaurus supercluster was found to be part of a larger cluster called the Norma Cluster and both Norma and Centaurus are part of an even bigger supercluster called Laniakea. So you could say that the Laniakea supercluster (or some say hypercluster) is our "home" supercluster. The name "Laniakea" means "immense heaven" in Hawaiian. One article describing the discovery of the Laniakea cluster in 2014 described it this way: "This so-called Laniakea Supercluster is 500 million light-years in diameter and contains the mass of one hundred million billion Suns spread across 100,000 galaxies.^{2,37} Wikipedia describes the Laniakea supercluster this way: "The Laniakea Supercluster encompasses approximately 100,000 galaxies stretched out over 160 megaparsecs (520 million light-years). It has the approximate mass of 10^{17} solar masses, or a hundred thousand times that of our galaxy 4''

Recently discovered supercluster – the BOSS Great Wall!

An article on the PBS website, apparently from a Nova TV program, tells about the B.O.S.S. Great Wall of galaxies. B.O.S.S. stands for Baryon Oscillation Spectroscopic Survey, part of a larger mission called the Sloan Digital Sky Survey, Part III. The article is called "BOSS Supercluster Is So Big It Could Rewrite Cosmological Theory.⁵"

Quotes from this:

"The BOSS Great Wall is a tight network of four superclusters. The largest two form a stretchedout wall of galaxies that's about 1.2 billion light years long." . . .

"It looks like we have a structure that is bigger than anything else: like two Sloan Great Wall scale structures right next to each other," said Heidi Lietzen of the Institute of Astrophysics at the University of La Laguna in Spain, who was the lead author of the new study. "The question now is: is it too big for our cosmological theories?"

How should these superclusters be explained?

An article in New Scientist by Stephen Battersby in 2011 has a good explanation of the issue.⁶

"We know that the universe was smooth just after its birth. Measurements of the cosmic microwave background radiation (CMB), the light emitted 370,000 years after the big bang, reveal only very slight variations in density from place to place. Gravity then took hold and amplified these variations into today's galaxies and galaxy clusters, which in turn are arranged into big strings and knots called superclusters, with relatively empty voids in between....

On even larger scales, though, cosmological models say that the expansion of the universe should trump the clumping effect of gravity. That means there should be very little structure on scales larger than a few hundred million light years across."

Some Theories Proposed to Explain the Superclusters:

1) "Coagulating dark energy". Dark energy a theoretical concept for something causing the universe to expand in an accelerating way. But Dark Energy is normally thought to be uniform, so this is wondering, what if it isn't uniform.

2) Maybe Einstein's theory of gravity doesn't work on these vast distance scales. Do we need a new theory of gravity for large distances?

3) Could dust or stars in our own galaxy be confusing the data somehow? This seems unlikely considering the care put into the analysis of the data but there are uncertainties.

4) Could the universe have a fractal structure? This means it has a structure that repeats at all scales of distance. The question this raises is why would the Big Bang do this? This requires a mathematical order of a kind that would be hard to explain as coming from the Big Bang.

Or, does this suggest supernatural creation by a Creator-God? Superclusters could have had their structure from the beginning, so they would not necessarily form due to gravity at all.

An Even Bigger Problem – Quasar Superclusters

In 2013 it was reported that scientists had discovered a cluster of 73 quasars that stretches across a region over 4 billion light-years in size!^{7,8} This has been called the Huge Large Quasar Group, or Huge LQG.^{7,8} Quasars are believed to be Black Holes, often at the center of galaxies. Astronomers are uncertain how one quasar could form, so how could 73 of them form into a cluster? One theory for quasar formation is that two galaxies, both of which have a Black Hole at their centers, would collide. The galaxies would pass through each other but the Black Holes

are thought to merge into one object like a quasar. How many galaxies would have to collide to form a cluster of 73 quasars? Also, the Huge LQG has another quasar cluster relatively near it with 34 quasars in it. Below is a graphic map of the Hugh LQG and it's smaller neighbor LQG, taken from the technical paper publishing it in the Monthly Notices of the Royal Astronomical Society.⁸



Figure 1 Sky angular distribution of the 73 quasars of the Huge-LQG (redshift z = 1.27, circles), is shown, together with that of the 34 quasars of the CCLQG cluster.

Below is a quote from the abstract of the MNRAS technical journal on the Huge LQG.⁸

"A large quasar group (LQG) of particularly large size and high membership has been identified in the DR7QSO catalogue of the Sloan Digital Sky Survey. It has characteristic size (volume1/3) ~500 Mpc (proper size, present epoch), longest dimension ~1240 Mpc, membership of 73 quasars and mean redshift z = 1.27... This new, Huge-LQG appears to be the largest structure currently known in the early Universe. Its size suggests incompatibility with the Yadav et al. scale of homogeneity for the concordance cosmology, and thus challenges the assumption of the cosmological principle."

Bigger Still – The Hercules-Corona-Borealis

The Huge LQG is still not the largest structure we know of. There is a massive super-supercluster even bigger. It could be as much as 10 Billion Light-Years in size and it is called the Hercules-Corona-Borealis. It was found by astronomers who were looking into another mystery, some very distant objects called Gamma Ray Bursters (GRB's). These objects are a big powerful mystery. They are very very far away and can give off incredible amounts of energy. They have brief bursts of gamma rays and X-rays followed by infrared radiation. Scientists aren't sure what they are, so they describe them by what they do. There was a region of space that was unusually high in gamma rays. Gamma rays are emitted from certain nuclear reactions. It was discovered that in this region of space there was at least 19 GRB objects covering a vast distance.

The scientific paper reporting the discovery of this supercluster described it this way:

"The GRB cluster at $z \approx 2$ appears to identify the presence of a larger angular structure that covers almost one-eighth of the sky. This encompasses half of the constellations of Bootes, Draco, and Lyra, and all of the constellations of Hercules and Corona Borealis. This structure has been given the popular name of the Hercules-Corona Borealis Great Wall, or Her-CrB GW.

We estimate the size of the Her-CrB GW to be about 2000–3000 Mpc across. Few limits on its radial thickness exist, other than because it appears to be confined to the $1.6 \le z < 2.1$ redshift range. This large size makes the structure inconsistent with current inflationary Universal models because it is larger than the roughly 100 Mpc limit thought to signify the End of Greatness at which large-scale structure ceases.⁹ "

Note that the authors of the above paper make the point that in some ways the cosmological principle does seem to fit some observations about the density of the universe. But these superclusters do not fit current theories and they continue to surprise scientists.

These discoveries of very large structures demand a non-Big Bang theory. More examples could be listed. Also there are also vast regions of space that seem to be voids, with very little matter in them. There are other cosmological models being explored by astronomers and physicists from various points of view. In 2004 an open letter was published in New Scientist that listed the names and institutions of scientists who were willing to go on record as questioning the Big Bang. Since 2004 this list of scientists has grown. It now has 218 scientists and engineers listed as well as a number of others. Supernatural creation is only one alternate approach considered today by some individuals with Ph.D.'s in Physics or Astronomy. Astronomers should be commended for exploring non-Big Bang models.

References

- Dressler, Alan. "The Large-Scale Streaming of Galaxies," Scientific American, Sept. 1987, pp. 46-54.
- National Radio Astronomy Observatory. "Newly identified galactic supercluster is home to the Milky Way." ScienceDaily. ScienceDaily, 3 September 2014. <u>http://www.sciencedaily.com/releases/2014/09/140903133319.htm</u>
- 3. R. Brent Tully, Hélène Courtois, Yehuda Hoffman, Daniel Pomarède. "The Laniakea supercluster of galaxies." Nature, 2014; 513 (7516): 71 DOI: 10.1038/nature13674
- 4. https://en.wikipedia.org/wiki/Laniakea_Supercluster
- 5. Gearin, Conor. "BOSS Supercluster Is So Big It Could Rewrite Cosmological Theory," <u>http://www.pbs.org/wgbh/nova/next/physics/boss-supercluster-is-so-big-it-could-rewrite-cosmological-theory</u> (published March 11, 2016)
- 6. Battersby, Stephen. "Largest cosmic structures 'too big' for theories" New Scientist, June 21, 2011. See also Physical Review Letters, DOI: 10.1103/PhysRevLett.106.241301.
- Royal Astronomical Society (RAS). "Biggest structure in universe: Large quasar group is 4 billion light years across." ScienceDaily. ScienceDaily, 11 January 2013. <u>http://www.sciencedaily.com/releases/2013/01/130111092539.htm</u>
- 8. Clowes, Roger G., Harris, Katheryn A., et. al. "A structure in the early Universe at $z \sim 1.3$ that exceeds the homogeneity scale of the R-W concordance cosmology" Monthly Notices of the Royal Astronomical Society, 429, pp. 2910–2916 (2013). DOI:10.1093/mnras/sts497
- Horváth, Istvan, Bagoly, Zsolt, Hakkila, Jon, and Toth, L. V. "New data support the existence of the Hercules-Corona Borealis Great Wall" Astronomy and Astrophysics, vol. 584, A48 (2015) DOI: <u>https://doi.org/10.1051/0004-6361/201424829</u>