IV. Science

Huge, Newly Discovered Cosmic Structures Defy Modern Cosmology

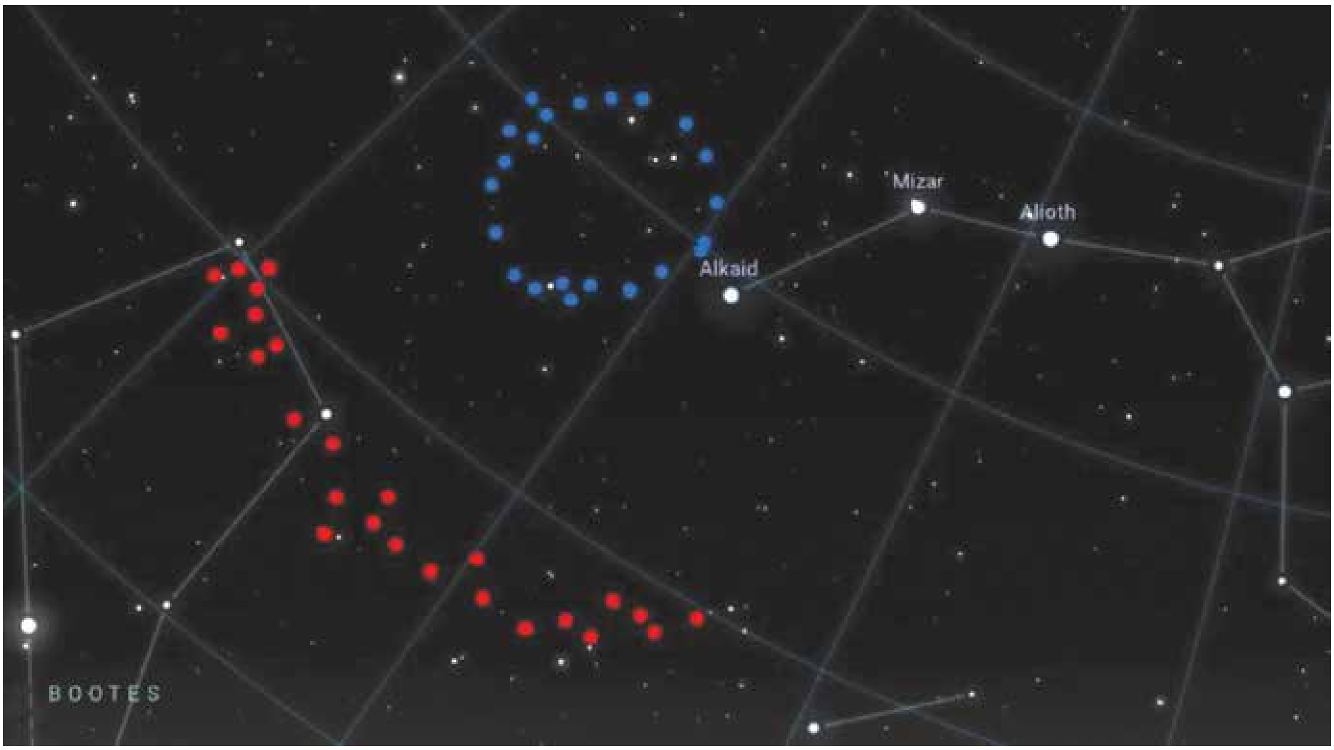
by Janet G. West

> *"... it is the knowledge of necessary and eternal truths that distinguishes us from the mere animals and gives us Reason and the sciences, raising us to the knowledge of ourselves and of God...."*
>
> *—Gottfried Wilhelm Leibniz*

July 11—Since the James Webb Space Telescope first began transmitting images, its discoveries have astounded professional astronomers and the general public alike; its dazzling clarity of far-off nebulae, stars, galaxies and planets have covered the pages of publications and the internet, and have challenged many of our current theories.

Of equal importance, although with less coverage in the mainstream media, has been the recent discoveries of two new, very large structures in space. One, the Great Arc, was discovered in 2021 by a team of researchers at University of Central Lancashire (UCLan) in England, led by Alexia Lopez, who is a doctoral candidate in cosmology. The second, the Big Ring, was discovered by the same team in January 2024.

These new discoveries join the ranks of some 40 other great structures dotting the observable universe;



Stellarium

Figure 1. Two immense cosmic structures of galaxies and galaxy filaments, the Great Ring and the Giant Arc, imaged near the Constellation Boötes. These huge structures are not only near each other in the visible sky, but at a similar distance from Earth.

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these two rank with some of the largest. These large cosmic structures are composed of groupings of galaxies, galaxy filaments, gamma ray bursts (GRB), and quasars (such as the Huge Large Quasar Group, or H-LQG). One such structure, the Pisces–Cetus Supercluster Complex (discovered in 1987) is about 1 billion light-years across, and contains other superstructures, such as the Laniakea Supercluster, which subsumes the Virgo Supercluster (Virgo SC, at 110 million light-years across), which in turn contains the Local Group (about 10 million light-years in diameter)—a collection of at least 80 galaxies including our own Milky Way.

Our galaxy is a mere 105,700 light-years in diameter (**Figure 1**). Thus, we're describing a cosmological great structure 10,000 times the size of the Milky Way galaxy.

Great Arc and Big Ring; How Were They Discovered?

The team that discovered the newly found large structure in 2021—the Great Arc—also included adviser Dr. Roger G. Clowes (both Lopez and Clowes are from UCLan's Jeremiah Horrocks Institute), and collaborator Gerard M. Williger from the University of Louisville in the United States. The Great Arc spans 3.3 billion light-years (an ordered structure 30,000 times as large as the Milky Way galaxy), and is composed of galaxies, galactic clusters, gas and dust. It is located 9.2 billion light-years away, and stretches across approximately one-fifteenth of the radius of the entire observable universe.

To put this into perspective for Earth observers: A full moon takes up about one-half degree in the night sky; if the Great Arc were visible, it would span about 10 degrees. If you stretch out your arm to the sky and hold up your fist with its back facing you, its width spans about 10 degrees.

The Big Ring, discovered by Lopez and her team in 2024, is in the same region of sky as the Great Arc, near the constellation Boötes. Boötes can be located in the sky by starting at the long handle of the Big Dipper and arcing across the sky to the bright orange star Arcturus, forming the base of the constellation Boötes, which resembles a kite.

This large structure is 9.2 billion light-years from Earth, and has a diameter of about 1.3 billion light-years. If it could be visible from Earth, it would span 7 degrees in the sky, or the width of 15 full moons.

The researchers discovered that the galaxies within it don't all lie in the same plane, but present a coiled or corkscrew configuration.

Challenge to Accepted Cosmology

Both superstructures were discovered from observations and data from the 2.5-meter telescope of the Sloan Digital Sky Survey (SDSS) at Apache Point in New Mexico, which is conducting several survey missions at once, including the Milky Way Mapper, the Local Volume Mapper and the Black Hole Mapper; it provides the collected data free to the public.

Sky and Telescope explained how these structures were discovered, using the data from the SDSS:

> Both the Giant Arc and the newly discovered Big Ring showed up indirectly, via the absorption lines seen in the spectra of many thousands of distant quasars—active galaxies powered by supermassive black holes. Matter along the telescope's line of sight to a quasar absorbs light at specific wavelengths. In particular, the team is looking for absorption of ionized magnesium atoms (MgII)—both in galaxies and in the gas between them.
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> Due to the expansion of the universe, the wavelength of MgII absorption shifts to the red side of the spectrum (longer wavelengths) when the absorber is farther away—a phenomenon known as *redshift*. By measuring the precise redshifts of many absorption lines, the team can calculate the distance to matter lying between the quasar and us, enabling the discovery of three-dimensional patterns.
>
> On the basis of a comprehensive statistical analysis of the data, Lopez and her coauthors concluded that the Big Ring they've found is "real and statistically significant," adding it to a growing list of large-scale structure candidates. These structures are in tension with the accepted cosmological principle, which holds that matter in the universe is similarly distributed, when you zoom out to large enough scales.
>
> Indeed, according to the ΛCDM model, in which the evolution of the universe is dominated by dark energy (Λ) and cold dark matter (CDM), there hasn't been enough time since the Big Bang to form gravitationally bound structures

larger than 1.2 billion light-years or so. (Note that large-scale structures such as the Giant Arc and the Big Ring grow as the universe expands, so these dimensions are given for the present epoch.)

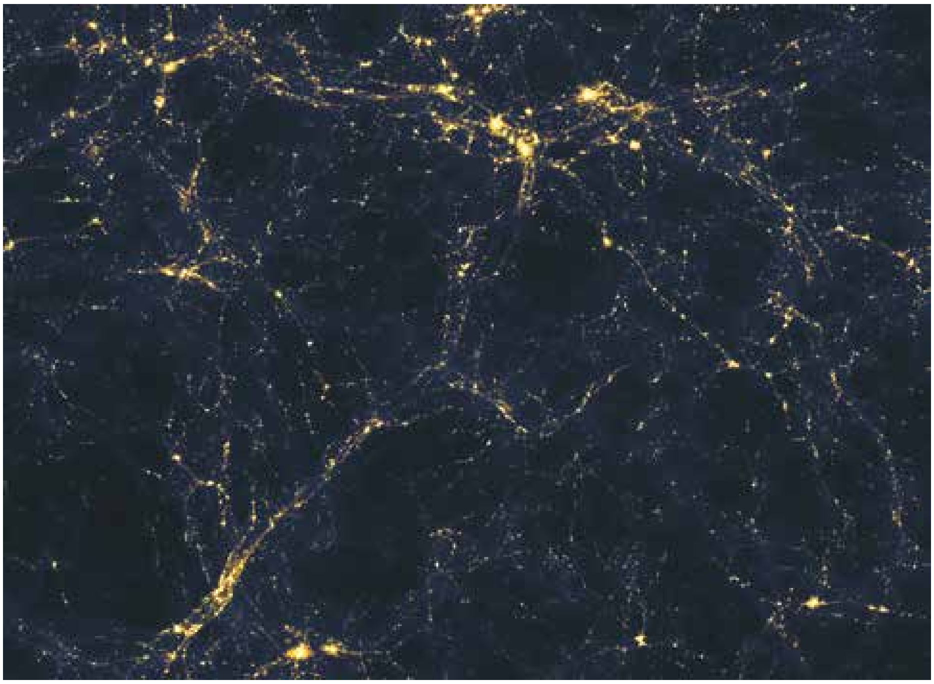

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Figure 2. "Galaxy filaments" are the largest known structures in space, massive thread-like structure containing galaxies, stars, novae, gas and dust.

The redshift is the apparent increase in the wavelength emitted by a light source—in this case a galaxy—moving away from an observer; its speed and distance can be calculated using Hubble's Law (or Constant). Blue light wavelengths are shorter than those of red, so if a galaxy were approaching the Earth, it would be detected shifting toward blue wavelengths—a "blueshift"; galaxies that are moving away from us show a redshift.

Galaxies can appear to be moving away from each other at an increasing rate, due to the overall expansion of the universe specified by current theory. And, this would be the same to an observer on any galaxy—all galaxies are moving away from each other, and an added surprise to scientists is that the ones furthest away from us are accelerating as they move away.

The Cosmological Principle

The Cosmological Principle is widely accepted, and asserts that when viewed on a large enough scale, the properties of the universe will be homogeneous and isotropic; the universe will appear to be the same to all observers anywhere within it.

The current theory holds that if the universe weren't becoming more uniform, clumps of matter attracting other clumps, would have caused the universe to contract under its own gravitational pull, rather than expand.

Additionally, modern cosmology puts a so-called "upper size limit" on large-scale structures at 1.2 billion light-years, maintaining that the Universe isn't old enough to have produced structures that are larger.

But, not only are the Big Ring and Giant Arc greater than this limit, but there are eight others (that we know of) which are also humungous, the largest being the Hercules—Corona Borealis Great Wall estimated to be 9.7-10 billion light-years across.

In a statement, Alexia Lopez admitted—

> Neither of these two ultra-large structures is easy to explain in our current understanding of the universe…. And their ultra-large sizes, distinctive shapes, and cosmological proximity must surely be telling us something important—but what exactly?
>
> The Cosmological Principle assumes that the part of the universe we can see is viewed as a "fair sample" of what we expect the rest of the universe to be like. We expect matter to be evenly distributed everywhere in space when we view the universe on a large scale, so there should be no noticeable irregularities above a certain size.
>
> Cosmologists calculate the current theoretical size limit of structures to be 1.2 billion light-years; yet both of these structures are much larger–the Giant Arc is almost three times bigger and the Big Ring's circumference is comparable to the Giant Arc's length.
>
> From current cosmological theories we

> didn't think structures on this scale were possible. We could expect maybe one exceedingly large structure in all our observable universe. Yet, the Big Ring and the Giant Arc are two huge structures and are even cosmological neighbors, which is extraordinarily fascinating….
>
> The Big Ring and Giant Arc are the same distance from us, near the constellation of Boötes the Herdsman, meaning they existed at the same cosmic time, when the universe was only half of its present age. They are also in the same region of sky, at only 12 degrees apart when observing the night sky. Identifying two extraordinary ultra-large structures in such close configuration raises the possibility that together they form an even more extraordinary cosmological system.

Lopez presented her team's results at the 243rd meeting of the American Astronomical Society in New Orleans in early January. The paper can be found here.

Some other cosmic structures which are larger than the presumed limit:

The Hercules–Corona Borealis Great Wall (HCB): This structure was discovered in 2013 by a team of American and Hungarian astronomers István Horváth, Jon Hakkila and Zsolt Bagoly while analyzing data from the Neil Gehrels Swift Observatory (formerly known as the Swift Gamma-Ray Burst Mission). The Great Wall is 7-10 billion light-years in width, depending upon angle of view; it is a galaxy filament.

A galaxy filament (**Figure 2**) is a massive thread-like structure containing galaxies, stars, novae, gas and dust, which are mega-light-years in size. They are the largest known structures in space. They're called "structures" because they are clusters of these celestial objects, with large areas of seemingly empty space between then.

Gamma ray bursts are studied because they are the highest energy radiation and are produced only by supernovae, collisions of neutron stars, or matter flung out violently by a black hole. Thus, they can serve as markers for areas of great mass, and indicators of large structures.

During their research, the scientists recorded an unusually high volume of gamma rays emanating from about 10 billion light-years away, concentrated in the region of the Hercules–Corona Borealis constellations. They themselves had doubts as to the veracity of what they had discovered, but through re-checking their own calculations, plus observations made by other researchers, have confirmed its existence.

The Sloan Great Wall (SGW): A Princeton University research team announced its discovery in 2003; it is a giant wall of galaxies and galaxy filaments that measures 1.37 billion light-years in length, and is about one billion light-years away, located in the region of the Corvus, Hydra and Centaurus constellations (**Figure 3**).

The existence of structures as large as the SGW and HCB is difficult to explain, because there has been so little time since the Big Bang for gravity to pull together such vast quantities of matter.

The team was comprised of J. Richard Gott III, Mario Jurić, and six other team members, and it was based on data from the SDSS and the 2dF Galaxy Redshift Survey (Two-degree-Field Galaxy Redshift Survey).

King Ghidorah Supercluster: A team led by the National Astronomical Observatory of Japan (NAOJ) and Hiroshima University discovered this structure. The largest supercluster ever detected, it includes at least 19 galaxy clusters, is about 5.5 billion light-years away, and is 1.5 billion light-years across.

The name refers to King Ghidorah, a fictional monster, or *kaiju*, from a 1964 Japanese science fiction film. The lead author, Dr. Rhythm Shimakawa, Project Assistant Professor at NAOJ, says—

> Indeed, the probability of finding such a supercluster about 5.5 billion light-years away, was 50-50 based on the data from the Subaru Telescope's strategic program. We plan to further investigate the three-dimensional structure and the morphology of the galaxies by using such instruments as Subaru Telescope's PFS (wide field spectrograph) and the Euclid space telescope in the near future.

Mankind's Discoveries Can Shape the Universe

Although it may be too soon to say that the Cosmological Principle has been overturned, we can look at some of the assumptions of the theory to see how they may influence us; for example,

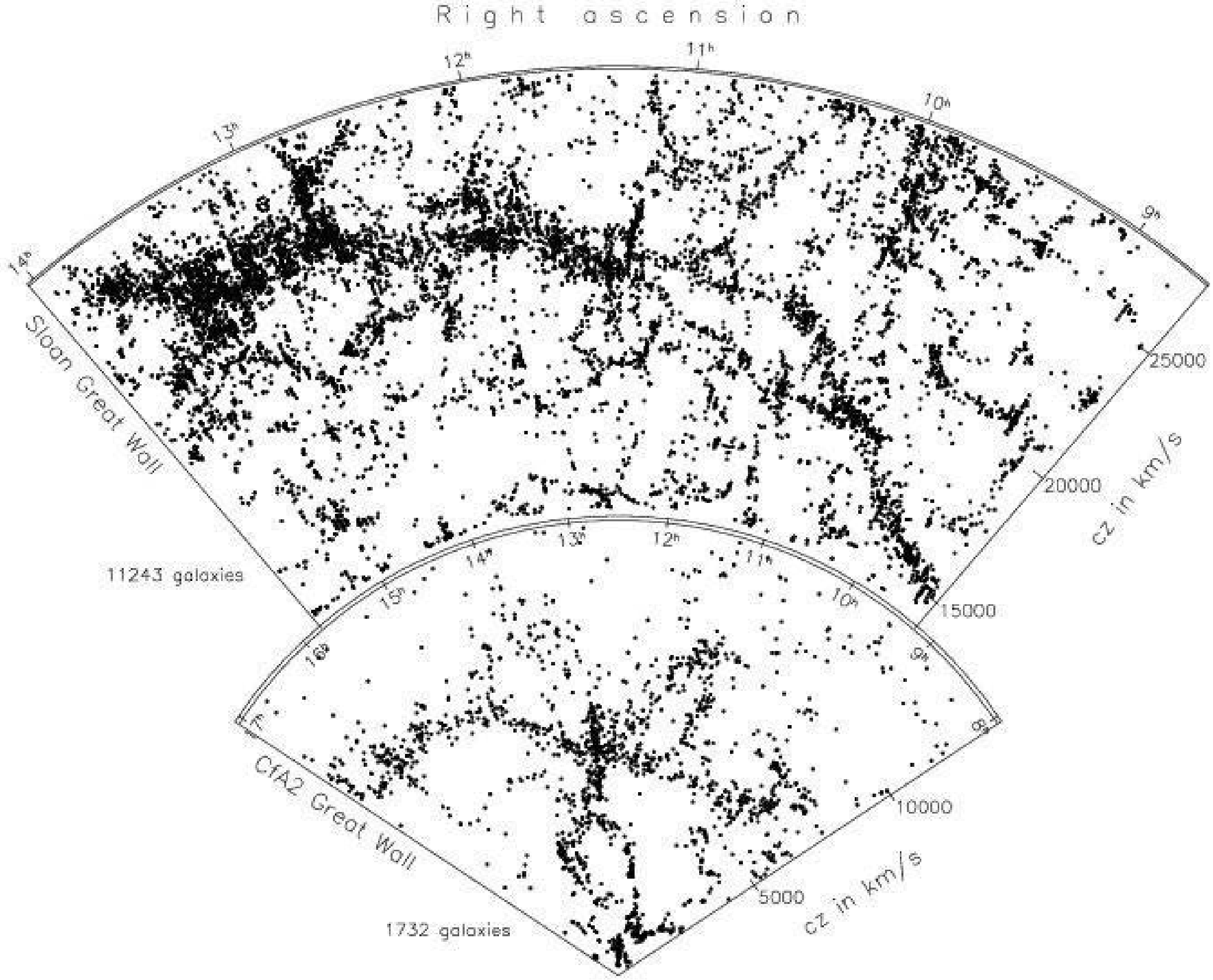

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Figure 3. A mapping of the cosmological structure known as the "Great Wall."

in physical economics, where the Second Law of Thermodynamics—entropy—is defined as a "law." Is it a law?

If we are to believe that entropy rules the relationships within the universe, then we would have to deny the existence of our planet, let alone mankind.

From its earliest beginnings, the development of Earth (as just one example) shows that even non-living processes tend toward increasing order, structure, and energy throughput—not increasing homogeneity. The dynamics and interaction of abiotic, biotic and nöetic forces at work are developed in great detail in the works of Vladimir Vernadsky, most notably his 1926 book *The Biosphere*.

Is the hypothesis that space extends as flat and homogeneous in all directions, truly valid for how the universe works?

Scientists have been grappling with many paradoxes in cosmology that have been brought to light with increasingly powerful telescopes and other scientific instruments. For example, even though the idea of the "redshift" of galaxies is generally accepted as some kind of measure of the Universe, it still assumes linear space and time. But, if the Universe is still expanding, then "somehow" more space (and the vacuum associated with it) has to be created to account for the expansion—where does that come from?

The late economist and scientist, Lyndon H. LaRouche, Jr., addressed this in an introduction to a translation of work by Bernhard Riemann, "Riemann Refutes Euler: Background to a Breakthrough," on Oct. 18, 1995 in the *21st Century Science & Technology* Winter 1995 edition (and reprinted in *EIR*, March 17, 2017):

> The origin of modern mathematics lies in what is commonly identified as a "Euclidean" notion of simple space-time. This idea of space-time pretends to represent the real universe, which it does not represent. It is an idea which is not a creation of the senses, but, rather, of the naive imagination. We merely imagine that space is defined by three senses of direction (backward-forward, up-down, side-to-side), and imagine that these might be extended without limit, and in perfectly uninterrupted continuity. We imagine that time is a single, limitless dimension of perfect continuity: backward-forward. Taken together, these presumptions of the imagination define a four-dimensional space-time manifold, or, in other words, a quadruply-extended space-time manifold.
>
> The naive imagination attempts to locate perceptible bodies and their motions within such a quadruply extended manifold. It may be said fairly that our imaginary space-time manifold is used as a kind of mental mirror, upon which we attempt to project reflections of motion of bodies in space-time. The result of such projections is a simple "Euclidean" sort of algebraic mathematics, which, we soon discover, is not a mathematics of the real universe.

LaRouche also emphasized that the generally-accepted theory of how the universe developed cannot account for the existence of mankind.

Standard descriptions of the Universe include, or are intended to include the idea, not only that the Earth is small, but that mankind is very, very small. Objectively, this can appear to be true—after all, our entire solar system is approximately one-half light-year in diameter. In some crude instances, the description includes a comparison that man on Earth is to the Universe, as the ants on the ground are to us.

But the reality is that the creative capabilities of the human race not only represent a physical-biological force for the better on Earth—as we have manifested for at least 2 million years—but that through the extension of our senses with our telescopes and spacecraft, we can broaden our grasp to the farthest reaches of time and space.

And, eventually, humanity will discover the lawfulness behind these huge galactic structures; how they came to be, and how they're organized; we can be confident of a "Grand Design" in the formation and expansion of the Universe.

When a youngster first looks up at the night sky, and experiences the vision of the bejeweled Milky Way galaxy spanning the heavens, rather than teaching our youth "how small mankind is," ought we not to enlighten them: That although we are individually mortal, we as a species can not only perceive the vast universe around us, but can learn how to forge it for the better, through humanity's creativity, for our posterity?

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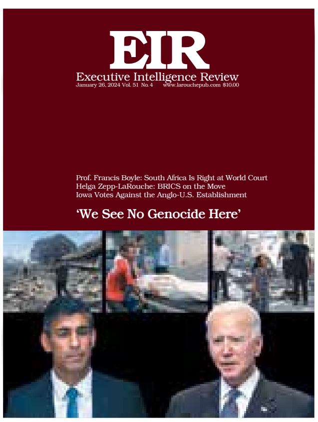

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