Local Superclusters

{Abstract *– In this segment of our "How far away is it" video book, we cover the superclusters closest to our supercluster, Virgo.*

First we discuss the overall structure of the nearest 20 superclusters and illustrate the galactic structures of galaxy filaments, walls and voids including: the Sculuptor void; the Perseus-Pegasus filament; the Fornax, Centaurus, and Sculptor walls as well as the Great Wall or Coma wall. Then we take a look at several of these superclusters and some of the galaxies in each one we examine.

We start with the Hydra Supercluster with the Hydra Galaxy Cluster at its center. We examine NGC 2314, a rare double aligned pair of galaxies. We then move to the Centaurus Supercluster with the Centaurus Galaxy Cluster at its center. We then take a look at some of the galaxies in this supercluster including NGC 4603, NGC 4622, the unusual NGC 4650A, and NGC 4696. We then move on to the Perseus-Pisces Supercluster and the Perseus galaxy cluster within it and the remarkable galaxy NGC 1275 within it. Then we cover the Coma Supercluster with the Coma galaxy cluster at its center. We then take a look at the beautiful and wispy galaxy NGC 4921 along with NGC 4911. Then we review the distances to some of the other local superclusters including Hercules, Leo, Shapely, Horologium, and the 1 billion light years distant Corona-Borealis Supercluster.

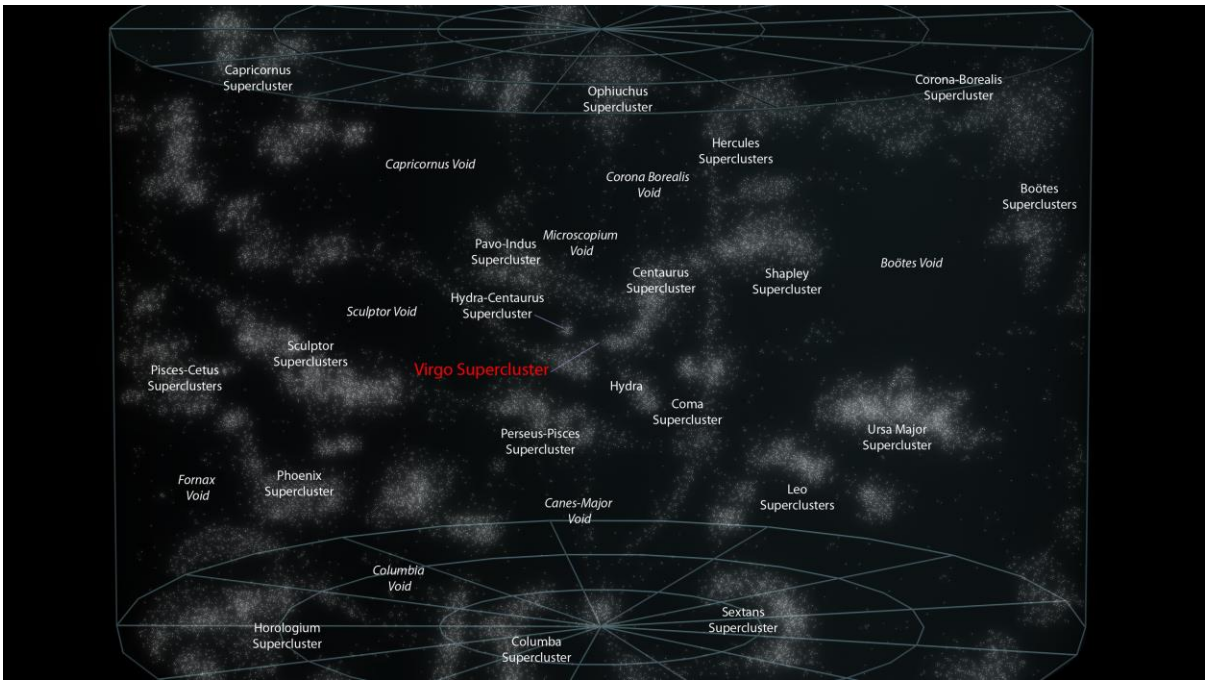
Next we cover a new way to identify superclusters with a focus on our own called Laniakea. We then take a look at additional galaxies within a billion light years of us including: ESO 510 – G13; NGC 6782; ESO 243-49 HLX-1 with a supermassive back hole in its disk; Stephan's Quintet; interacting galaxies NGC 1409 and NGC 1410; interacting galaxies ARP 127 and NGC 5679; galaxy cluster Abell S0740; ESO 325-G004 with its unique gravitational lens arcs called Einstein's rings; and finish with the very interesting Hoag's Object.

*Finally, we cover the unusual peculiar motion superimposed on the normal Hubble flow that all the galaxies within a billion light years have. It appears that they are all moving towards a Great Attractor in the Norma or Shapley Supercluster. We end with a map of all the local superclusters where we highlight the ones we've seen and list the number of objects that exist out to this distance.****}***

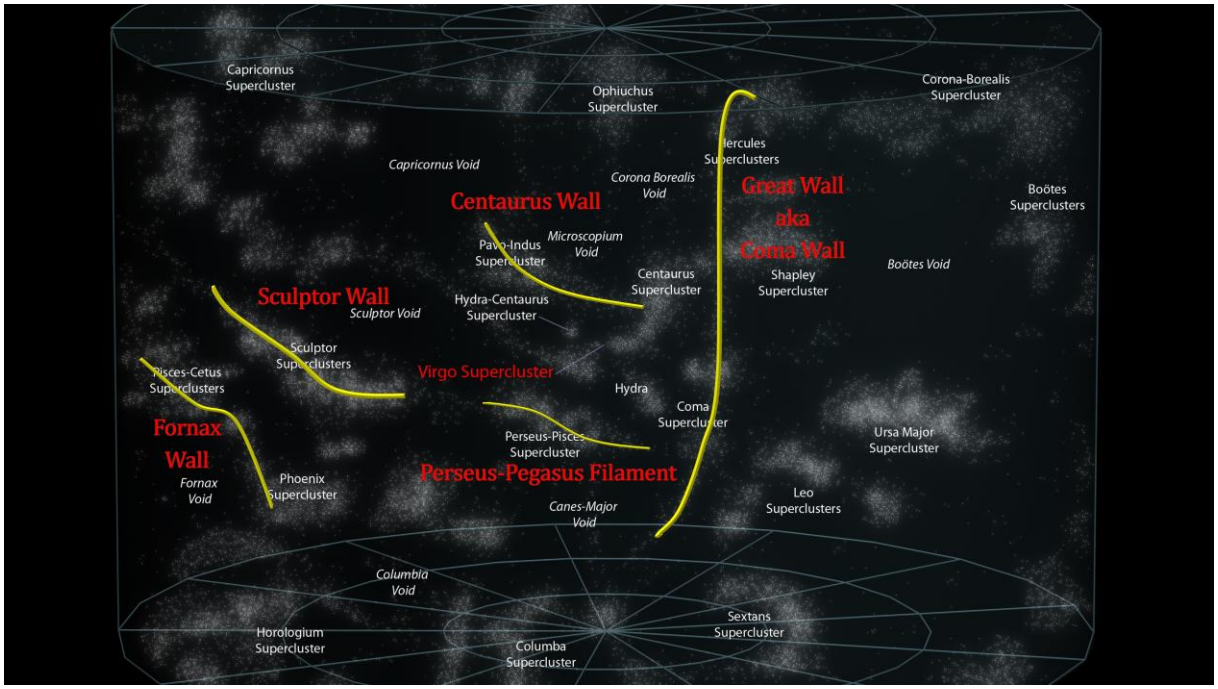
Introduction

> **[Music:** *@00:00 Ludwig van Beethoven – Piano Sonata No 14 in C sharp minor "Moonlight Sonata" –Dame Moura Lympany (piano) 1991- from the album "The most relaxing classical album in the world…ever!" 1997*

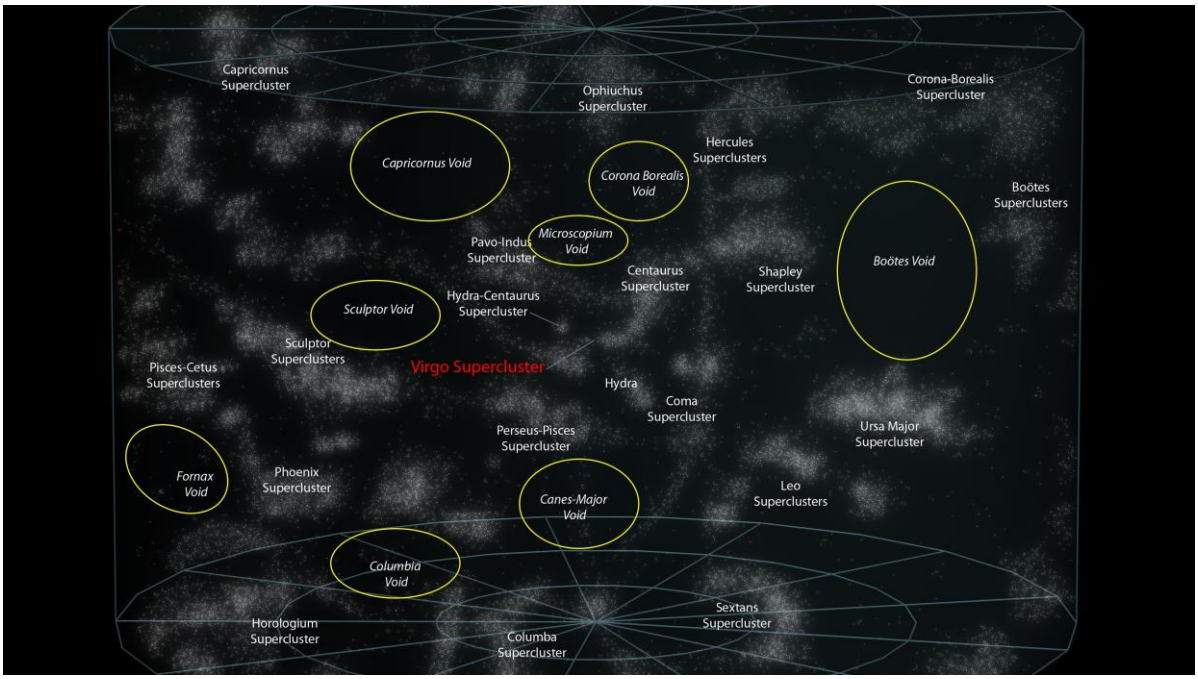
Here's a map of our local superclusters including the Virgo supercluster. As you can see, galaxies and clusters of galaxies are not uniformly distributed in the Universe. Instead they collect into vast clusters, filaments and walls of galaxies interspersed with large voids in which very few galaxies seem to exist.



A filament is constructed of galaxies and galaxy clusters. The Perseus-Pegasus Filament is an example. Walls are much wider and thicker than filaments. Here we see the Fornax, Centaurus, Sculptor and the Great Wall or Coma wall. The Great Wall is one of the longest known super-structures in the Universe. It is approximately 200 million light-years away and measures over 500 million light-years long, 300 million light-years wide and 16 million light-years thick.



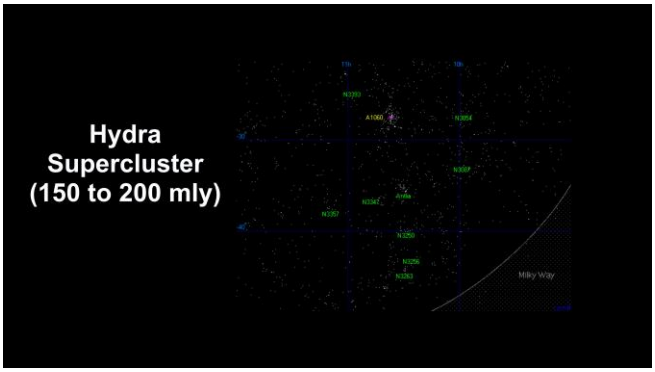
Voids are the vast empty spaces between filaments which contain very few, or no, galaxies at all. There are 25 major voids in our local superclusters. Only a few are marked here. The Sculuptor void is the largest in the nearby universe.



Let's take a look at some of these superclusters and some of the galaxies photographed by Hubble that are contained in these superclusters.

Hydra Supercluster

The Hydra Supercluster is close to the Virgo Supercluster and similar in size and shape to it. It's about 100 million light years long and contains the large Hydra galaxy cluster. This map plots every bright galaxy in the Supercluster. The galaxies in the supercluster range from 150 to 200 million light years away.



Hydra Galaxy Cluster

Here is a picture of the Hydra Cluster. Two stars within our own Milky Way galaxy can be seen in the foreground. There are three large galaxies near the cluster center, two yellow ellipticals [NGC 3311, NGC 3309] and one prominent blue spiral [NGC 3312]. These are the dominant galaxies, each

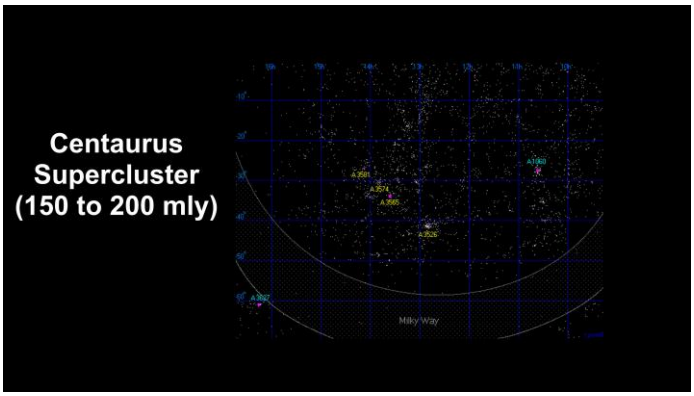
about 150,000 light-years in diameter. And here's an interesting overlapping galaxy pair cataloged as NGC 3314. We'll take a closer look at this one.

NGC 3314 A & B – 140 mly

Through an extraordinary chance alignment, a face-on spiral galaxy lies precisely in front of another larger spiral. This line-up provides us with the rare chance to visualize dark material within the front galaxy, seen only because it is silhouetted against the object behind it. The bright blue stars forming a pinwheel shape near the center of the front galaxy have formed recently from interstellar gas and dust. A small, red patch near the center of the image is the bright nucleus of the background galaxy. [NGC 3314b**]**

Centaurus Supercluster

The Centaurus Supercluster is the closest neighbor of our Virgo Supercluster. It contains a number of large galaxy clusters including the Centaurus Cluster. The galaxies in the supercluster range from 150 to 200 million light years away. This map plots the brightest galaxies in this area of the sky. The supercluster structure is fairly obvious in the middle of the map.



Centaurus Cluster

The Centaurus Cluster is a swarm of hundreds of galaxies 170 million light-years away. The cluster is filled with gas at temperatures of 10 million degrees or more, making it a luminous source for cosmic x-rays.

NGC 4603 – 108 mly

Here's a magnificent view of the spiral galaxy NGC 4603 in the Centaurus cluster. It is the most distant galaxy in which Cepheid variables have been found. Clusters of young bright blue stars highlight the galaxy's spiral arms. In contrast, red giant stars in the process of dying are also found.

Only the very brightest stars in NGC 4603 can be seen individually. Much of the diffuse glow comes from fainter stars that cannot be individually distinguished. **[**The reddish filaments are regions where clouds of dust obscure blue light from the stars behind them.**]**

NGC 4622 – 111 mly

Here is another galaxy in the Centaurus Cluster. The image shows NGC 4622 and its outer pair of winding arms full of new stars, shown in blue. Astronomers are puzzled by its clockwise rotation because of the direction the outer spiral arms are pointing. Most spiral galaxies have arms of gas and stars that trail behind as they turn. But this galaxy has two "leading" outer arms that point toward the direction of the galaxy's clockwise rotation.

NGC 4650A – 130 mly

Located about 130 million light-years away in the Centaurus cluster, NGC 4650A is one of only 100 known polar-ring galaxies. Their unusual disk-ring structure is not yet well understood. One possibility is that polar rings are the remnants of colossal collisions between two galaxies sometime in the distant past, probably at least a billion years ago.

NGC 4696 Black Hole – 150 mly

NGC 4696 is an elliptical galaxy in the Centaurus Cluster. In fact, it is the brightest galaxy in the cluster. This composite image was taken in a study of the galaxy's central black hole. It shows a vast cloud of hot gas (in red), surrounding high-energy bubbles 10,000 light years across (in blue). The green dots in the image show infrared radiation from star clusters on the outer edges of the galaxy.

New observations from Hubble have revealed the intricate structure of the galaxy in greater detail than ever before. Astronomers have found that each of the dusty filaments has a width of about 200 light-years, and a density some 10 times greater than the surrounding gas. These filaments knit together and spiral inwards towards the centers supermassive black hole that's flooding the galaxy's inner regions with energy, heating the gas, and creating streams of heated material. It appears that these hot streams of gas bubble outwards, dragging the filamentary material with them as they go. The galaxy's magnetic field is also swept out with this bubbling motion, constraining and sculpting the material within the filaments.

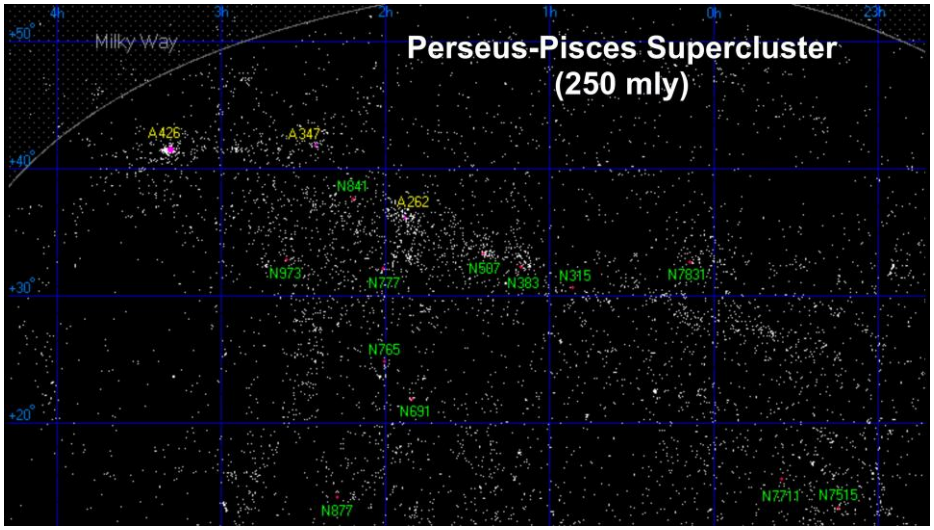
[Additional info: Understanding more about filamentary galaxies such as NGC 4696 may help us to better understand why so many massive galaxies near to us in the Universe appear to be dead; rather than forming newborn stars from their vast reserves of gas and dust, they instead sit quietly, and are mostly populated with old and aging stars. This is the case with NGC 4696. It may be that the magnetic structure flowing throughout the galaxy stops the gas from creating new stars.**]**

[Music: *Antonín Leopold Dvořák – "String Serenade" moderato – London Chamber Orchestra, Christopher Warren-Green 1990 – from the album "The most relaxing classical album in the world…ever!" 1997*

Perseus-Pisces Supercluster

The Perseus-Pisces Supercluster is a long, dense wall of galaxies with a length of almost 300 million light-years that is around 250 million light-years away. It is one of the largest known structures in the universe. This plot of the brightest galaxies in the supercluster show how prominent it is. At the left

end of the supercluster is the massive Perseus cluster – one of the most massive clusters of galaxies within 500 million light-years.



Perseus Cluster and NGC 1277 - 240 mly

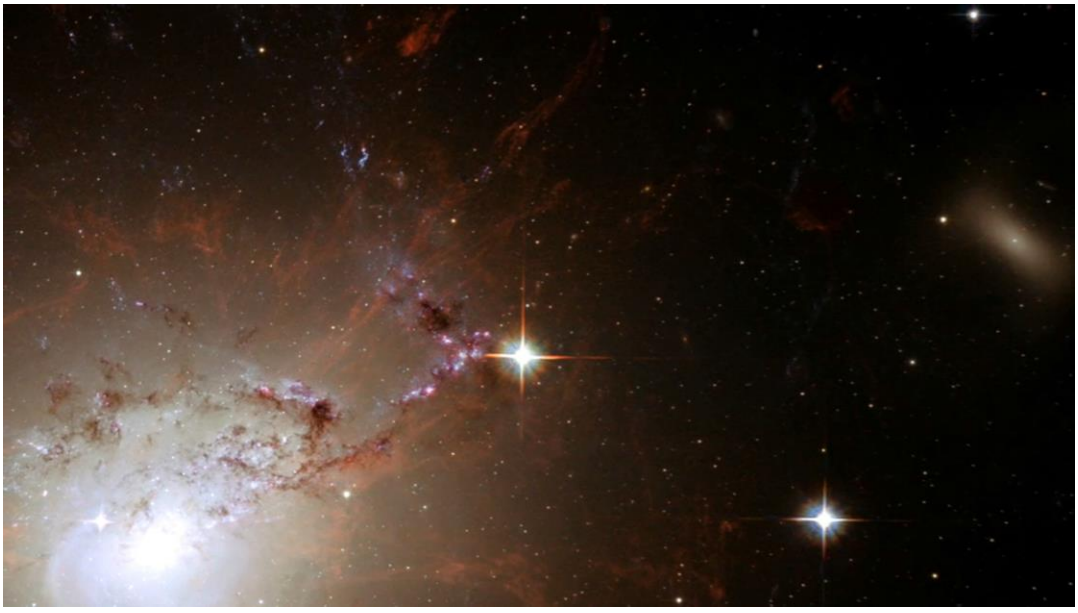
Here we have the Perseus Galaxy Cluster containing thousands of galaxies immersed in a vast cloud of hot gas. It's moving away from us at over 5,000 km/s m (that's almost 2,000 miles/s).

Inside this galaxy cluster, Hubble discovered a very old and rare galaxy moving through the cluster at 3.2 million km per hour (that's 2 million miles per hour). It is though that NGC 1277 has remained essentially unchanged for the past 10 billion years. The evidence that this is the case lies in the ancient globular star clusters that swarm around it. Massive galaxies like this one tend to have both newer blue and older red globular clusters. Red ones are believed to have formed as their

galaxies are formed. Blue ones are brought in later as the galaxy merges with others. However, NGC 1277 is almost entirely lacking in blue globular clusters. One explanation is that, because, that it cannot merge with other galaxies to collect stars or pull in gas to fuel star formation.

NGC 1275 – 230 mly

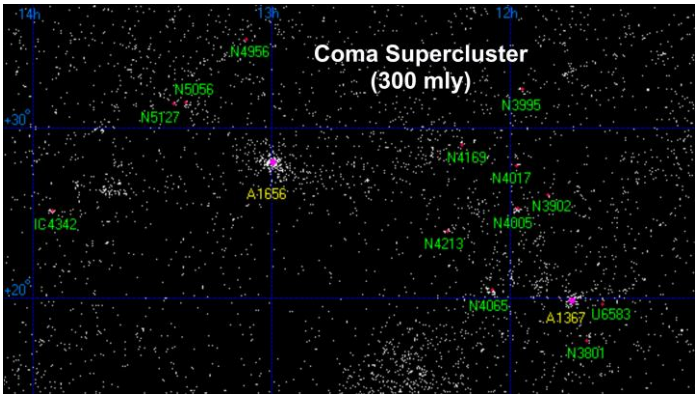
Here we are zooming into the giant elliptical galaxy NGC 1275 in the Perseus cluster. We see fine, thread-like filamentary structures in the gas surrounding the galaxy. The red filaments are composed of cool gas being suspended by a magnetic field, and are surrounded by the 100-million-degree hot gas in the center of the Perseus galaxy cluster.



The filaments are dramatic markers of the feedback process through which energy is transferred from the central massive black hole to the surrounding gas. The filaments originate when cool gas is transported from the center of the galaxy by radio bubbles that rise in the hot interstellar gas.

Coma Supercluster

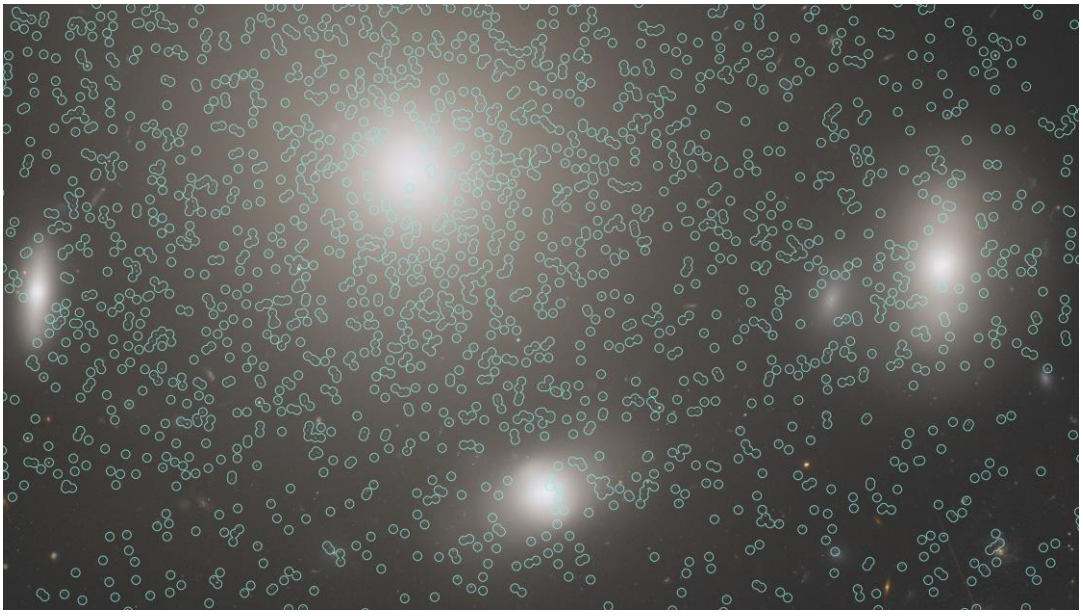
The Coma Supercluster is a nearby supercluster of galaxies that includes the famous Coma Cluster (Abell 1656). The Supercluster is located 300 million light-years from Earth, it is roughly spherical, about 20 million light-years in diameter and contains more than 3,000 galaxies. Being one of the first superclusters to be discovered, Coma Supercluster helped astronomers understand the large scale structure of the universe. This map plots the brightest galaxies in Coma Supercluster's region of the sky.



Here we are zooming into the immense Coma Cluster of over 1,000 galaxies, located 300 million light-years from Earth. The Coma cluster has received a huge amount of scientific research. This is partly because it lays a long way from the plane of our Galaxy and it is largely unobscured by any gas, dust or foreground stars.

Hubble was used to do a comprehensive survey of the Coma's globular star clusters. They found over 22,000 of them (circled in green). They found globular clusters scattered in space between the

galaxies - ripped from their home galaxies by near-collisions with other galaxies. Astronomers will use the globular cluster field for mapping the distribution of matter and dark matter in the Coma galaxy cluster.



NGC 4921 – 320 mly

Here we are zooming into NGC 4921. It is one of the rare spirals in the Coma cluster, and a rather unusual one — it is an example of an "anemic spiral" where the normal vigorous star formation that creates a spiral galaxy's familiar bright arms is much less intense. As a result, there is just a delicate swirl of dust in a ring around the galaxy, accompanied by some bright young blue stars.

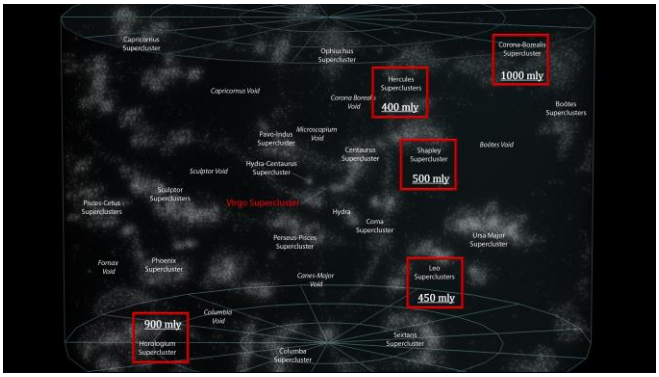
NGC 4911 – 320 mly

NGC 4911 contains rich lanes of dust and gas near its center. These are silhouetted against glowing newborn star clusters and iridescent pink clouds of hydrogen, the existence of which indicates ongoing star formation. 4911 and other spirals near the center of the cluster are being transformed by the gravitational tug of their neighbors. In the case of 4911, wispy arcs of the galaxy's outer spiral arms are being pulled and distorted by forces from a companion galaxy (NGC 4911A) to the upper right. The resultant stripped material will eventually be dispersed throughout the core of the Coma Cluster, where it will fuel the intergalactic populations of stars and star clusters.

Some Local Supercluster Distances

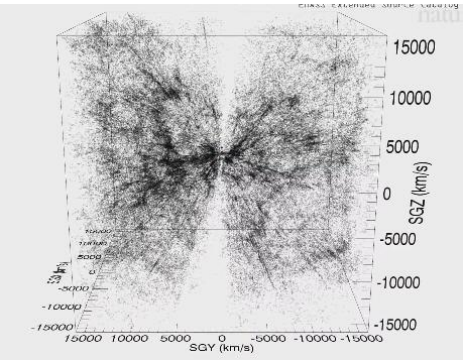
Here are the distances to a few additional superclusters in our local group:

Hercules is 400 million light years away.
Leo is 450 million light years away.
Shapley is 500 million light years away.
Horologium is 900 million light years.
Corona Borealis is 1 billion light years away

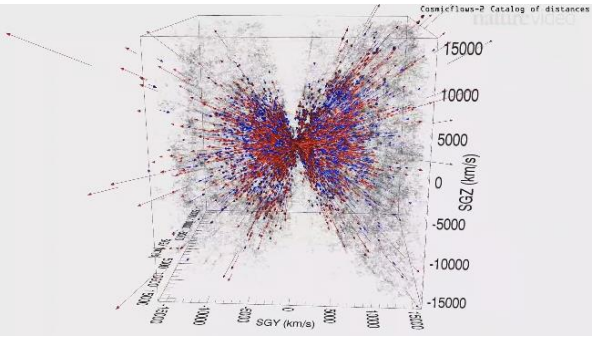


Laniakea: Our home supercluster

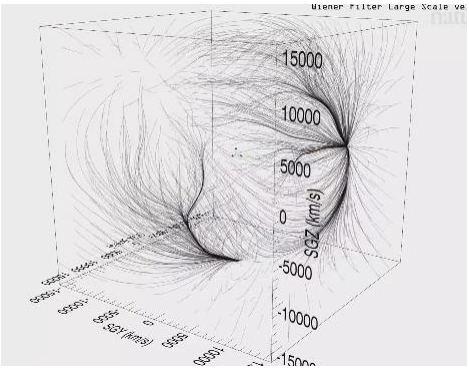
It has always been difficult for astronomers to determine where one supercluster ends and another begins. But now a team of astronomers have collected data on thousands of galaxies around us to understand their peculiar motion. the peculiar motion of an object is its motion less that part of its motion associated with the Hubble flow due to the expanding universe.



They used this data to identify which galaxies are moving towards us (shown in blue) and which galaxies are moving away from us (shown in red).



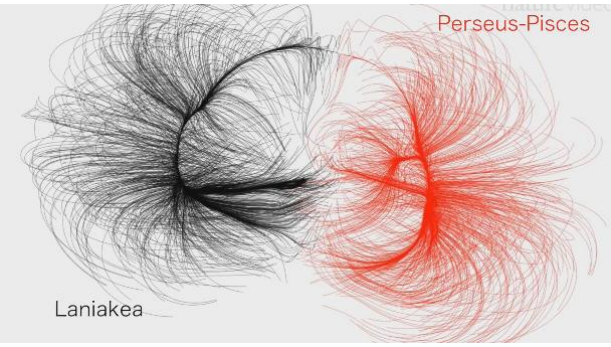
With this data, they were able to create a map of the paths galaxies are migrating along. These paths are called cosmic flows. Using this motion, they came up with a new way to map the distribution of matter in the universe.



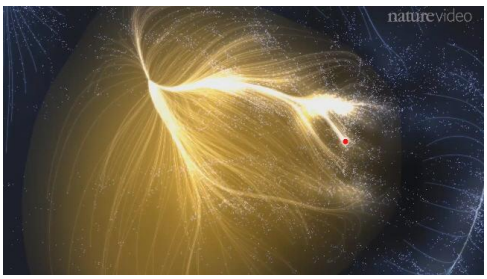
In our segment on the Virgo Supercluster, we counted the Virgo Galaxy cluster and a few hundred others as our local supercluster. But using this new technique we see that the Virgo Supercluster is

part of a much larger structure that is 100 time larger and more massive. The astronomers who made this discovery have named this new supercluster "Laniakea" – Hawaiian for 'immeasurable heaven'.

For example, here is an illustration of Laniakea and Perseus-Pisces an adjacent supercluster. The boundary is where the supercluster objects are sharing apart like the North American Great Divide separates water flowing to the Atlantic Ocean from water flowing to the Pacific Ocean.



In this view, the red dot shows our Milky Way's location in Laniakea.



[Music: *@16:35 Edvard Grieg – "Peer Gynt – Morning" – Academy of St Martin in the Fields / Sir Neville Marriner 1991- from the album "The most relaxing classical album in the world…ever!" 1997***]**

Let's take a look at a few more galaxies found in our local superclusters.

ESO 510-G13 150 mly

This is an image of an unusual edge-on galaxy, revealing remarkable details of its warped dusty disk. The strong warping of the disk indicates that this galaxy has recently undergone a collision with a nearby galaxy and is in the process of swallowing it. In the outer regions, especially on the right-hand side of the image, we see that the twisted disk contains not only dark dust, but also bright clouds of blue stars. This shows that hot, young stars are being formed in the disk. Astronomers

believe that the formation of new stars may be triggered by collisions between galaxies, as their interstellar clouds smash together and are compressed.

NGC 6984 – 180 mly

This spiral galaxy played host to a supernova explosion back in 2012, known as SN 2012im. Now, another star has exploded, forming supernova SN 2013ek — visible in this image as the prominent, star-like bright object just slightly above and to the right of the galaxy's center.

The observations that make up this new image were taken on 19 August 2013, and aimed to pinpoint the location of this new explosion more precisely. It is so close to where SN 2012im was spotted that the two events are thought to be linked; the chance of two completely independent supernovae so close together and of the same class exploding within one year of one another is a very unlikely event.

[Note: Neither of these were Type 1a like those covered in our video book. SN 2012im is known as a Type Ic supernova, while the more recent SN 2013ek is a Type Ib. Both of these types are caused by the core collapse of massive stars that have shed their outer layers of hydrogen. Type Ic supernovae are thought to have lost more of their outer envelope than Type Ib, including a layer of helium.**]**

NGC 6782 – 183 mly

The appearance of a galaxy can depend strongly on the color of the light with which it is viewed. This galaxy, when seen in visible light, exhibits tightly wound spiral arms that give it a pinwheel shape similar to that of many other spirals. However, when the galaxy is viewed in ultraviolet light, its shape is startlingly different.

Ultraviolet light has a shorter wavelength than ordinary visible light, and is emitted from stars that are much hotter than the Sun. At ultraviolet wavelengths, which are rendered as blue in this Hubble

image, we see a spectacular, nearly circular bright ring surrounding its nucleus. The ring marks the presence of many recently formed hot stars.

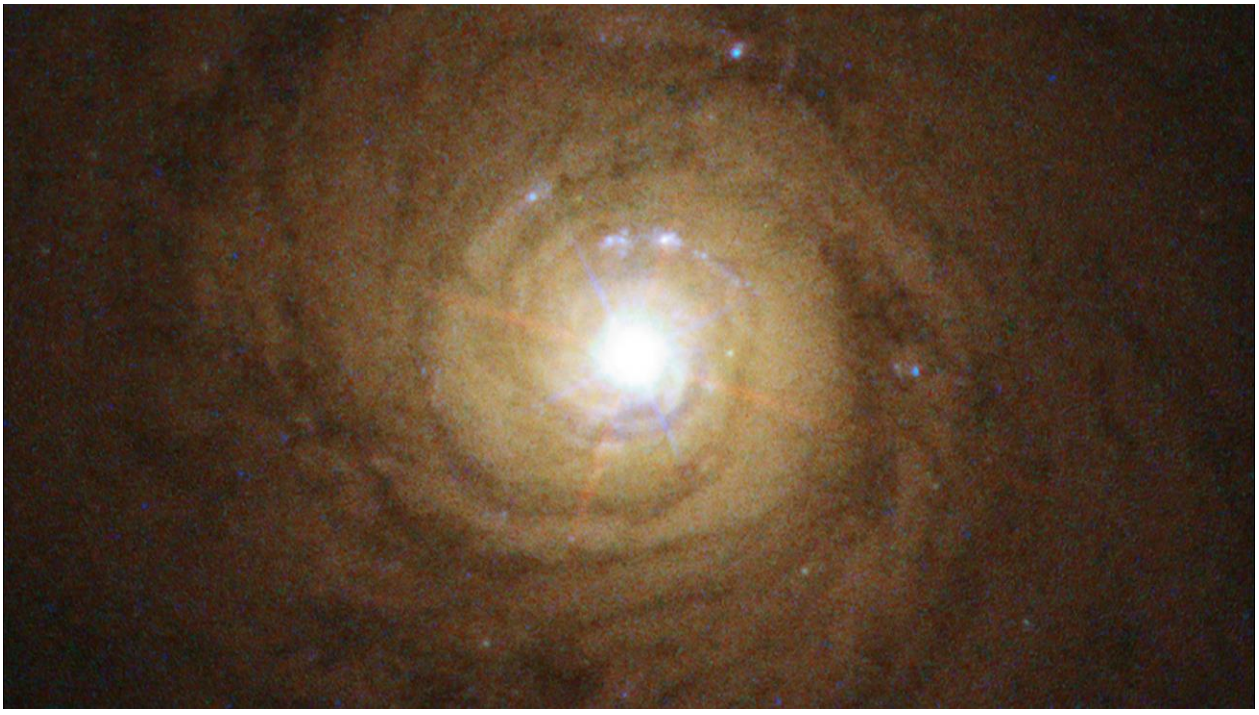
ESO 137-01 - 200 mly

This is ESO 137-001, a part of the Norma Galaxy Cluster near the Great Attractor. This image not only captures the galaxy and its backdrop in stunning detail, but also includes intense blue streaks streaming outwards from the galaxy, seen shining brightly in ultraviolet light. These streaks are actually hot young stars, encased in wispy streams of gas that are being torn away from the galaxy by its surroundings as it moves through the Norma cluster. This violent galactic star extraction is due to a process known as ram pressure stripping — a drag force felt by an object moving through a fluid. The fluid in question here is superheated gas that exists at the centers of galaxy clusters.

[Note: Studying ram pressure stripping helps us to understand the mechanisms that drive the evolution of galaxies. For example, it will leave this galaxy with very little of the cold gas that is essential for star formation. This will effectively end new star formation in the galaxy.**]**

NGC 5548 Black Hole - 244.6 mly

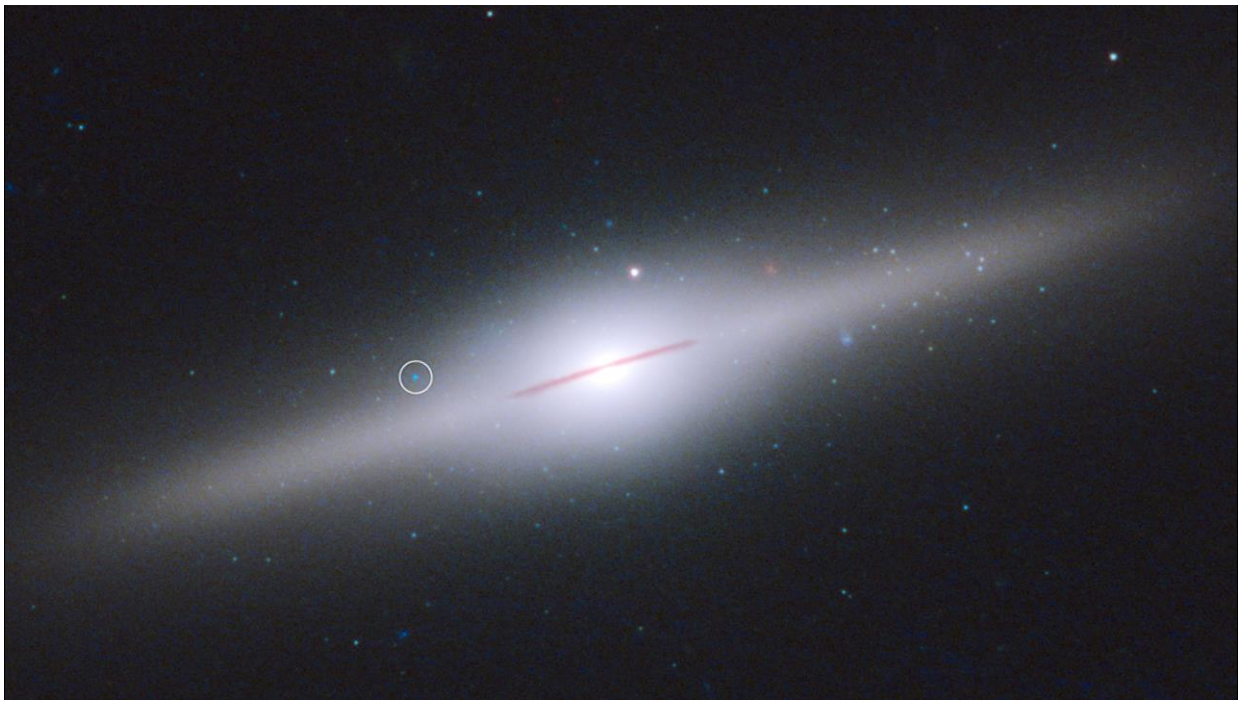
NGC 5548 is a well-studied Seyfert galaxy with a bright, active nucleus. This activity is caused by matter flowing onto a 65 million solar mass supermassive black hole at the core. As matter spirals down into a black hole it forms an accretion disc. The disc is heated so much that it emits X-rays, near to the black hole, and less energetic ultraviolet radiation further out. The ultraviolet radiation can create persistent winds strong enough to blow gas away from the black hole. NGC 5548's persistent wind, which has been known about for two decades, reaches velocities exceeding 3.5 million kilometers per hour (that's 2.1 million mi/hr). But a new wind has arisen which is much stronger and faster than the persistent wind. The new wind reaches speeds of up to 18 million kilometers per hour (that's 11 million mi/hr), but is much closer to the nucleus. This activity could provide insights into how supermassive black holes interact with their host galaxies.



***[Music:** @21:45 Claude Debussy – "Clair De Lune" – Dane Moura Lympany, 1988 - from the album "The most relaxing classical album in the world…ever!" 1997*]

ESO 243-49 HLX-1 – 290 mly

This spectacular edge-on galaxy is believed to be home to an intermediate-mass black hole that may have been stripped off of a cannibalized dwarf galaxy. The estimated 20,000-solar-mass black hole lies above the galactic plane. This is an unlikely place for such a massive back hole to exist, unless it belonged to a small galaxy that was gravitationally torn apart by this one. The circle identifies a unique X-ray source that pinpoints the black hole.



Stephan's Quintet – 290 mly

Here we are zooming into the Stephan's Quintet. As the name implies, it is a group of five galaxies. The name, however, is a bit of a misnomer. Studies have shown that group member NGC 7320 is actually a foreground galaxy. At 40 million light years, it is about seven times closer to Earth than the rest of the group.

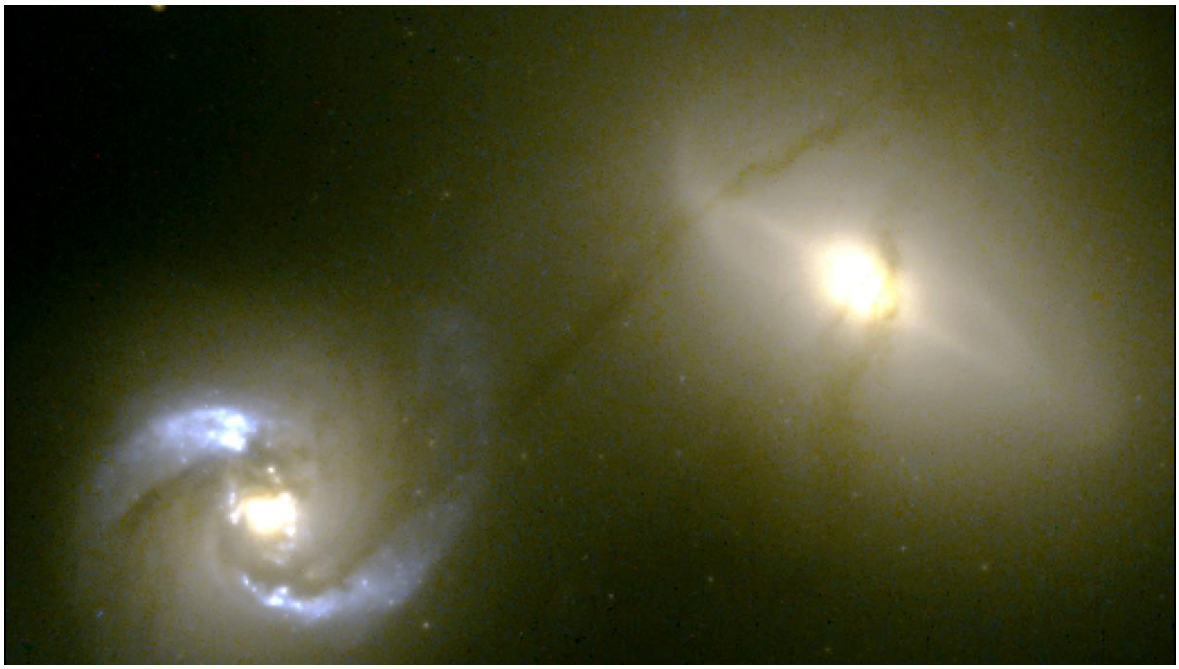
Three of the galaxies have distorted shapes, elongated spiral arms, and long, gaseous tidal tails containing myriad star clusters, proof of their close encounters. These interactions have sparked a frenzy of star birth in the central pair of galaxies.

7319 is a barred spiral with distinct spiral arms that follow along 180 degrees back to the bar. Continuing clockwise, the next galaxy appears to have two cores, but it is actually two galaxies, 7318A and 7318B. NGC 7317 is a normal-looking elliptical galaxy that is less affected by the

interactions. These farther members are markedly redder than the foreground galaxy, suggesting that older stars reside in their cores.

NGC 1410, NGC 1409 – 300 mly

This visible-light Hubble picture reveals an intergalactic "pipeline" of material flowing between two battered galaxies that bumped into each other about 100 million years ago. The pipeline (the dark string of matter) begins in 1410 (the galaxy on the left), crosses over 20,000 light-years of intergalactic space, and wraps around 1409 (the companion galaxy on the right).

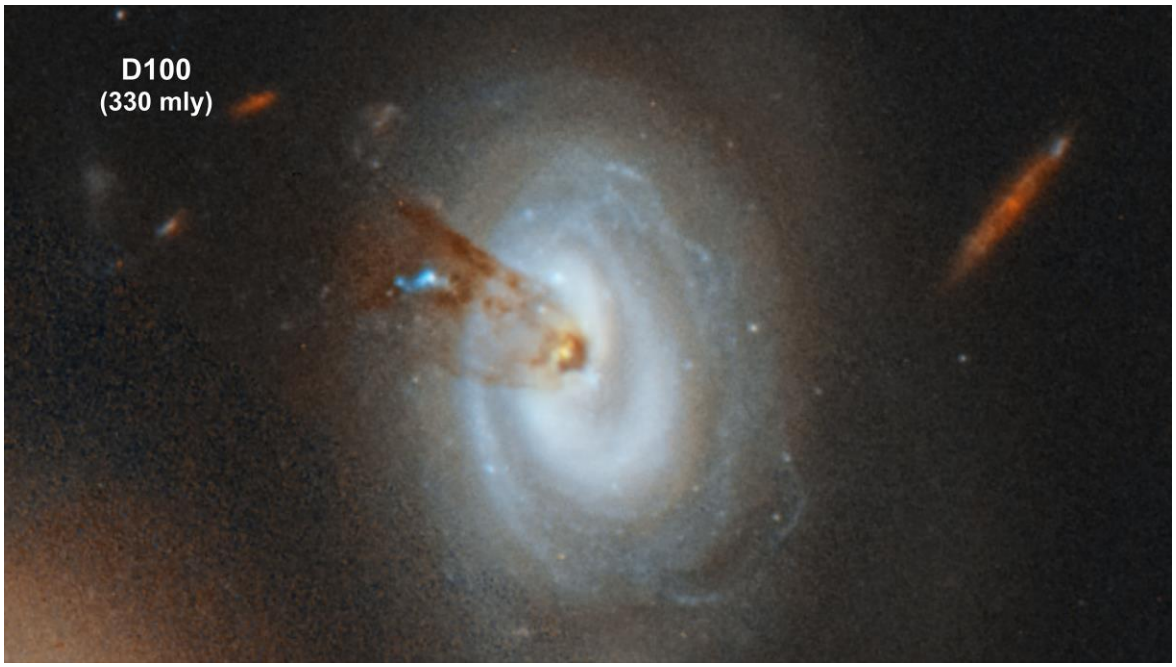


[Additional info: Scientists believe that the tussle between these compact galaxies somehow created the pipeline, but they're not certain why 1409 was the one to begin gravitationally siphoning material from its partner. And they don't know where the pipeline begins in 1410. More perplexing to astronomers is that NGC 1409 is seemingly unaware that it is gobbling up a steady flow of material. A stream of matter funneling into the galaxy should have fueled a spate of star birth. But astronomers don't see it. They speculate that perhaps the gas flowing into NGC 1409 is too hot to gravitationally collapse and form stars.**]**

D100 Loosing Gas – 330 mly

New images from NASA's Hubble Space Telescope show D100 a spiral galaxy being stripped of its gas as it plunges toward the cluster's center. A long, thin streamer of gas and dust stretches from the galaxy's core and on into space. The tail, a mixture of dust and hydrogen gas, extends nearly 200,000 light-years. But the structure is comparatively narrow, only 7,000 light-years wide. We saw this RAM Stripping earlier with ESO 137-01. Eventually, the galaxy will lose all of its gas. Without the material to create new stars, star formation in the galaxy will cease. It is estimated that the gas-stripping process in D100 began roughly 300 million years ago.

[The researchers' main goal was to study star formation along the tail. Hubble's sharp vision uncovered the blue glow of clumps of young stars. The brightest clump in the middle of the tail contains at least 200,000 stars, triggered by the ongoing gas loss from the galaxy. The Hubble data show that the gas-stripping process began on the outskirts of the galaxy and is moving in towards the center, which is typical in this type of mass loss. Based on the Hubble images, the gas has been cleared out all the way down to the central 6,400 light-years.**]**



Adding to this story is another galaxy in the image that foreshadows D100's fate. The object, named D99, began as a spiral galaxy similar in mass to D100. It underwent the same violent gas-loss process as D100 is now undergoing, and it can no longer form new stars.

Arp 274, NGC 5679 – 400 mly

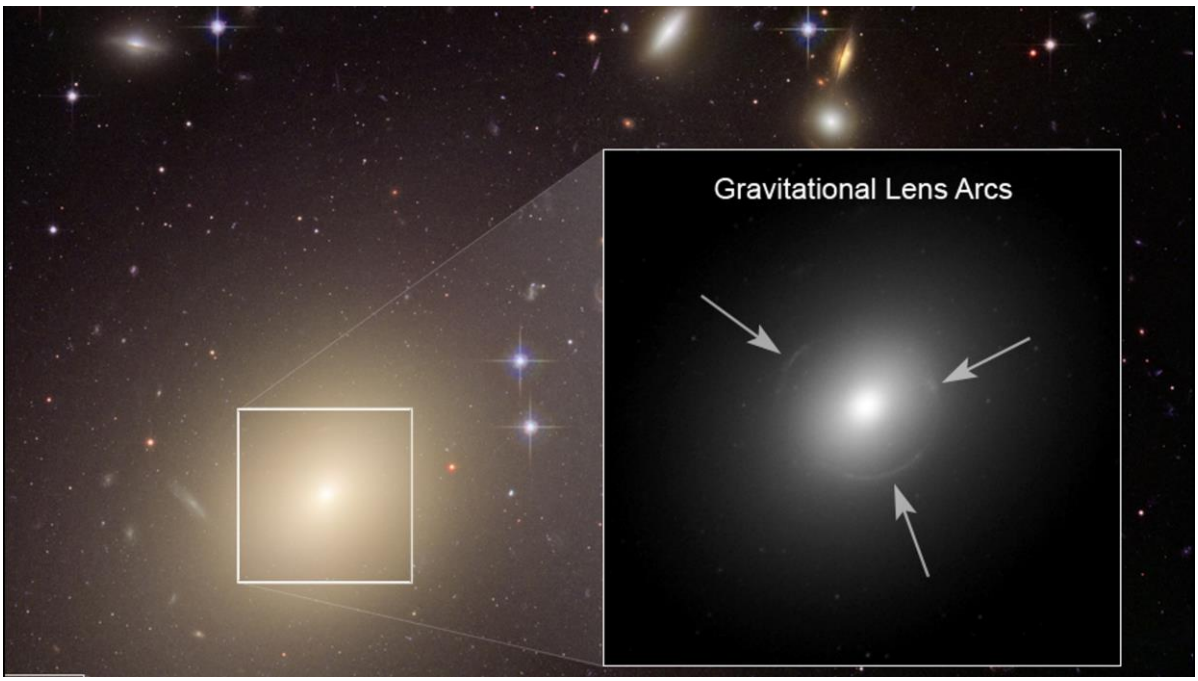
Here we are zooming into three galaxies that appear to be partially overlapping in the image, although they may be at somewhat different distances. The spiral shapes of two of these galaxies appear mostly intact. The third galaxy (on the far left) is more compact, but shows evidence of star formation.

[Additional info: Two of the three galaxies are forming new stars at a high rate. This is evident in the bright blue knots of star formation that are strung along the arms of the galaxy on the right and along the small galaxy on the left.**]**

Abell S0740 – 450 mly

This image shows the diverse collection of galaxies in the cluster Abell S0740. **[**Other fuzzy elliptical galaxies dot the image. Some have evidence of a disk or ring structure that gives them a bow-tie shape. Several spiral galaxies are also present.**]**

The giant elliptical ESO 325-G004 looms large at the cluster's center. In the course of analyzing this Hubble image, astronomers discovered that ESO325 is actually a "**gravitational lens**." This means that the focusing power of the enormous mass making up the galaxy caused the light from some background object, probably a distant "dwarf" galaxy, to be deflected and magnified. As a result, the more distant galaxy appears brighter, and distorted into the shape of an arc, or ring, known as an "**Einstein ring**" because the phenomenon was first predicted by Albert Einstein.



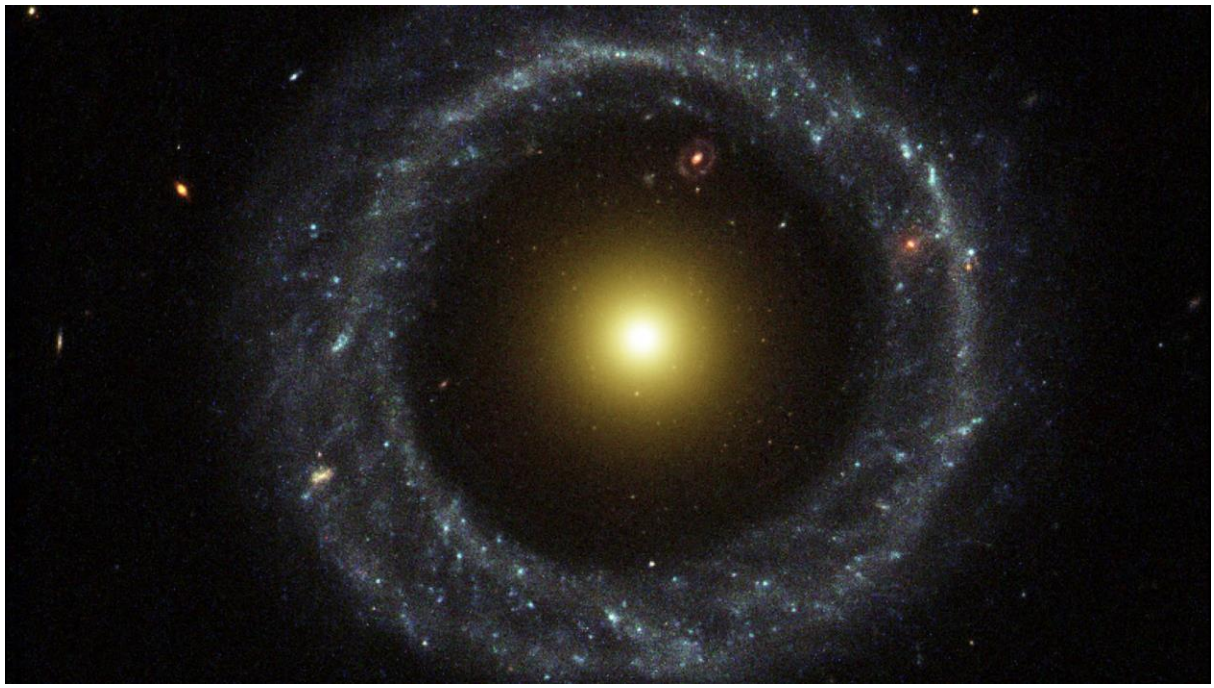
[Additional info: Although the universe is filled with galaxies, gravitational lensing is a rare occurrence because it requires an almost perfect alignment of a distant galaxy with an intervening one that has enough mass to gravitationally focus the light.

This particular system is unique because it is the closest known example of strong gravitational lensing. The galaxy is close enough that the dynamics of its stars can be studied in detail using spectrographs. The spectrographs reveal how fast the stars in the galaxy are moving, and this allows astronomers to estimate how much mass must be present in the center of the galaxy. This estimate can in turn be compared to the amount of mass needed to produce the observed gravitational lensing effect.

In this way, astronomers can build up a detailed, self-consistent picture of the matter distribution and dynamics of this unique nearby lensing system.**]**

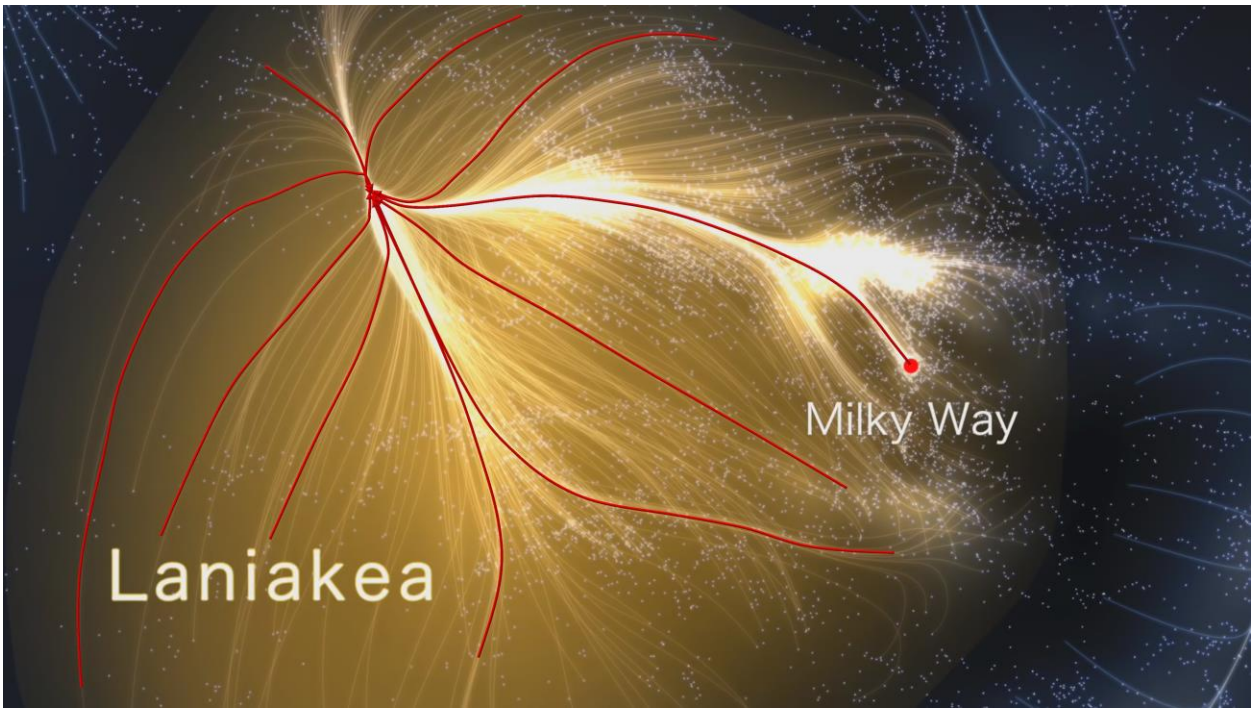
Hoag's Object – 600 mly

A nearly perfect ring of hot blue stars pinwheels about the yellow nucleus of an unusual galaxy known as Hoag's Object. A blue ring, which is dominated by clusters of young, massive stars, contrasts sharply with the yellow nucleus of mostly older stars. What appears to be a "gap" separating the two stellar populations may actually contain some star clusters that are just too faint to see. Curiously, an object that bears an uncanny resemblance to Hoag's Object can be seen in the gap at the one o'clock position. The object is probably a background ring galaxy.



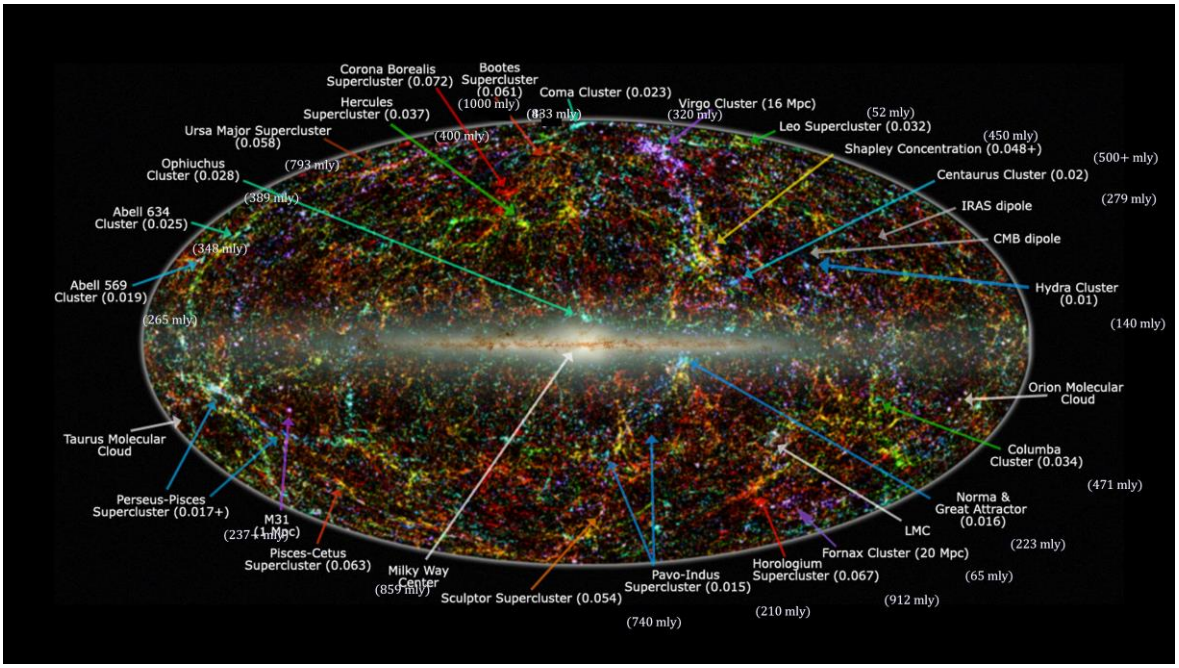
The Great Attractor

There's one more thing about the galaxies in our local Superclusters – They all have an unusual peculiar motion. Normally, galaxies are expected to have a motion consistent with the Hubble flow. That is, given the Hubble law, and the distance to a galaxy, its velocity is set. But in our local area – within 1 billion light years – there is an additional flow superimposed on the Hubble flow. It appears that our galaxy and a large number of the galaxy clusters in our area are flowing towards what is called 'the great attractor'. Our velocity is estimated to be around 700 km/s towards this point. That's 435 miles/s. Recent observations indicate that the point is the place all the galaxies in the Laniakea supercluster are moving. The mass at this theorized location is estimated to be thousands of times more than the mass of the entire Milky Way.

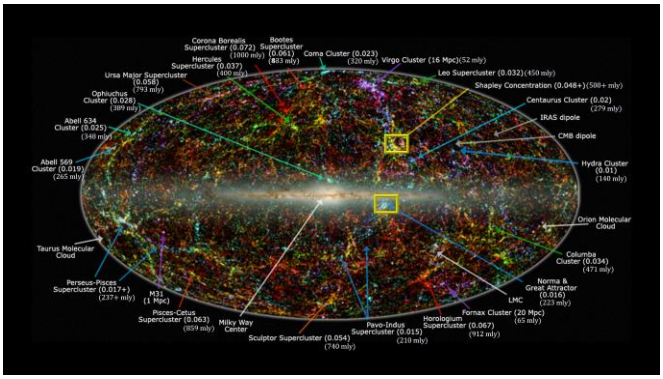


Here's a panoramic view of the entire sky as seen in near-infrared. It shows the distribution of galaxies beyond the Milky Way (at the center). **[**The image is derived from the 2MASS Extended Source Catalog (XSC)—more than 1.5 million galaxies, and the Point Source Catalog (PSC)--nearly 0.5 billion Milky Way stars.**]** The galaxies are color coded by redshift (numbers in parentheses) obtained from various sky surveys. **[**the UGC, CfA, Tully NBGC, LCRS, 2dF, 6dFGS, and SDSS surveys (and from various observations compiled by the NASA Extragalactic Database), or photo-metrically deduced from the K band (2.2 μm).**]** Blue/purple are the nearest sources eithing

140 million light years (z < 0.01); green are at moderate distances our to 600 mly (0.01 < z < 0.04) and red are the most distant sources out to a billion light years (0.04 < z < 0.1).



Initially, it looked like the great attractor was located close to the Norma Cluster. But Norma is so close to our galactic plane or 'area of avoidance' that we cannot see into it very well. More recently, updates to motion vectors indicate that the flow is not so much to the Norma Cluster, but to the much more massive Shapley Galaxy cluster behind it.

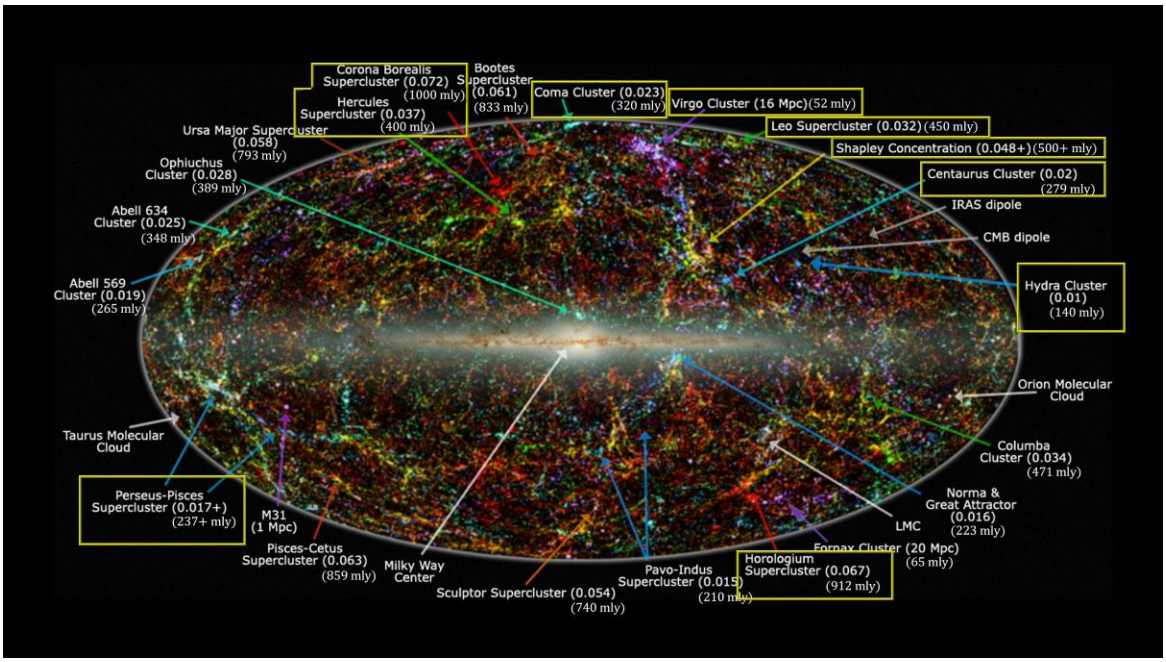


As you can imagine, understanding this peculiar flow is an area of active research.

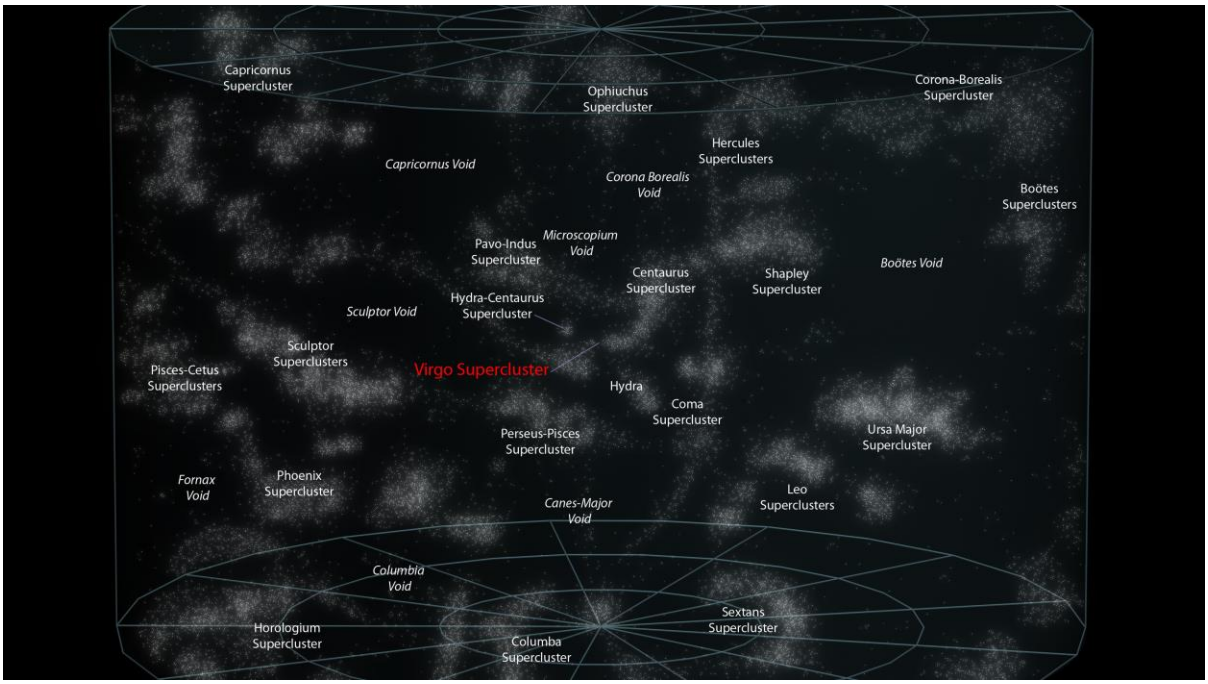
The Local Superclusters Big Picture

Here I have marked the galaxy clusters and local superclusters we covered in this segment. Within this 1 Billion light year radius from us, there are:

- 100 superclusters
- 240 thousand galaxy groups
- 3 million large galaxies
- 60 million dwarf galaxies
- 250,000 trillion stars



At this range, the Milky Way is too small to be seen, and our entire local volume is little more than a dot. But the entire map only represents about 7 percent of the entire visible Universe.



In this segment, we've seen several interacting galaxies. So, before we conclude the video book covering the cosmos as a whole, we'll take a closer look in our next segment at what it means for galaxies to collide.

Greek letters:
- α β γ δ ε ζ η θ ι κ λ μ ν ξ ο π ρ σ τ υ φ χ ψ ω
- Α Β Γ Δ Ε Ζ Η Θ Ι Κ Λ Μ Ν Ξ Ο Π Ρ Σ Τ Υ Φ Χ Ψ Ω

⇒ → ± ⊙ ∞ ↛ ∃ ∄ ∈ ∉ ∬ ∫ ≅ ≥ ≤ ≈ ≠ ≡ √ ∛ ~ ∝ ħ ÷