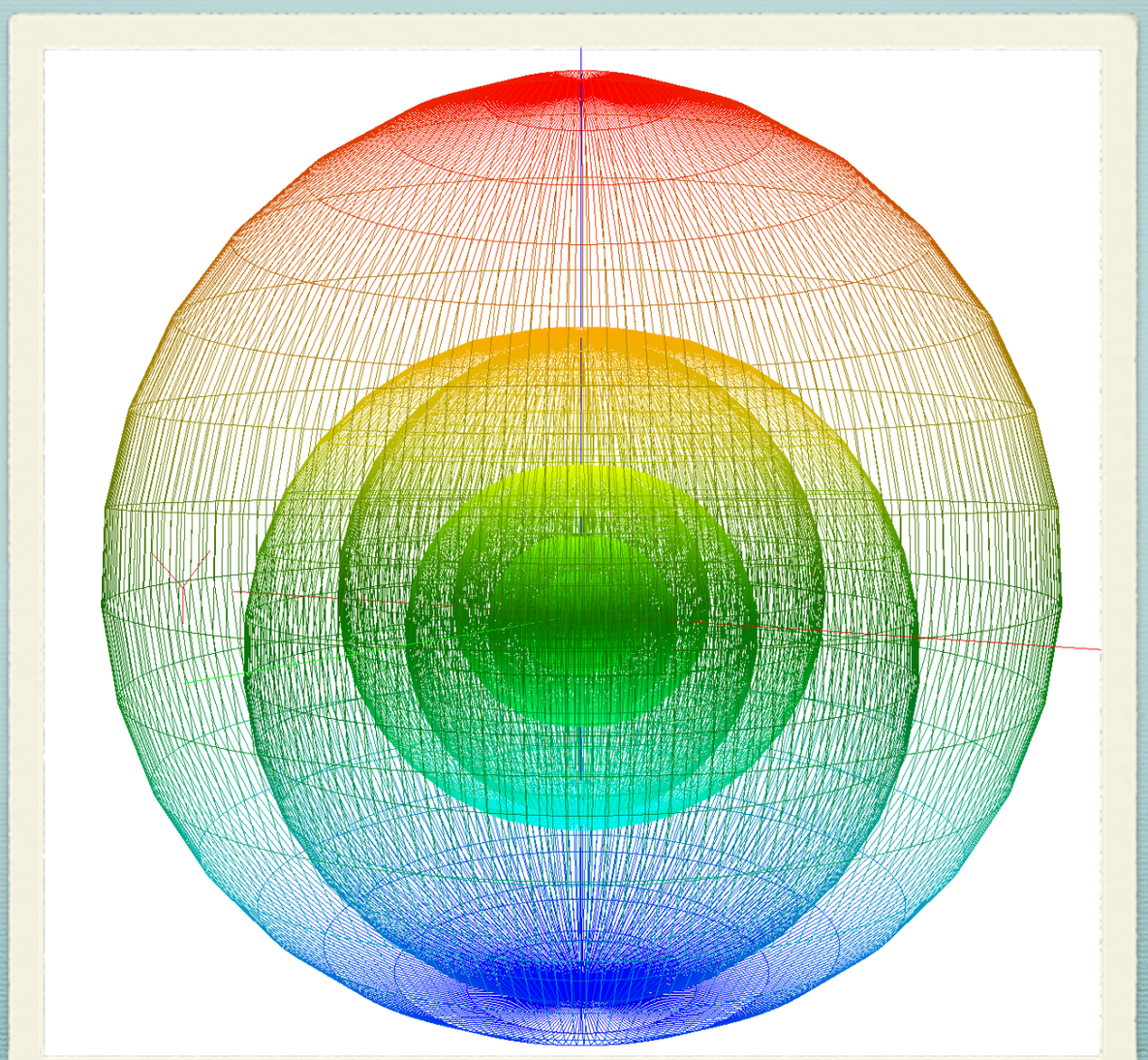
Spiral Cosmology?

A Speculation on the Large-scale Structure of the Cosmos in the Centenary of Einstein's General Relativity, 1915-2015

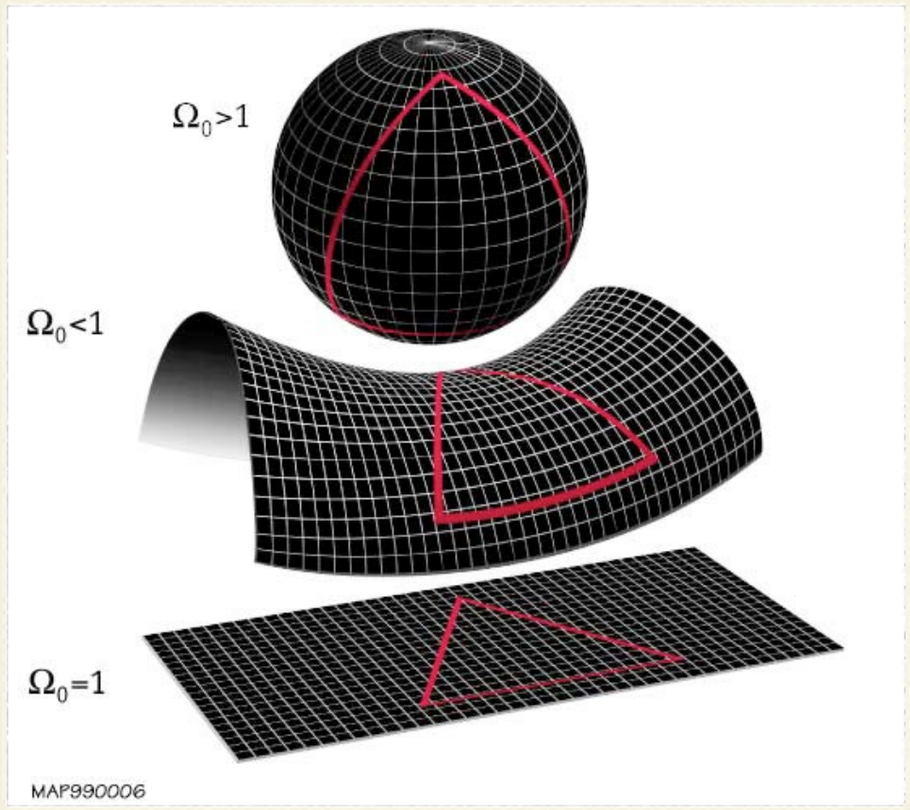


Dr Mike Evans, June 2015

Cosmology

Einstein's epoch-making theory of general relativity enabled in-principal calculations of the overall "shape" of space-time at the scale of the entire universe.

A number of alternative shapes were possible, from flat to saddle-shaped to spherical in four dimensions:

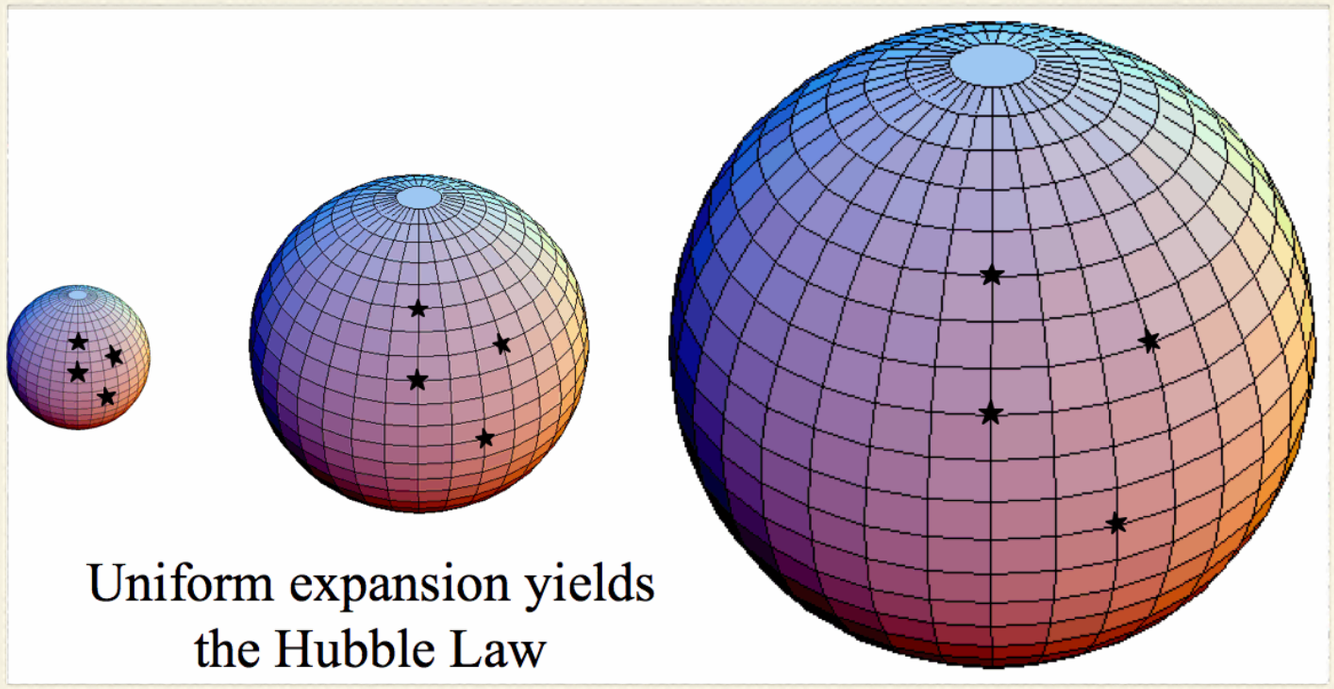


Given the assumption that the matter in the universe is homogeneous and isotropic (The Cosmological Principle) it can be shown that the corresponding distortion of space-time (due to the gravitational effects of this matter) can only have one of three forms, as shown schematically in the picture at left. It can be "positively" curved like the surface of a ball and finite in extent; it can be "negatively" curved like a saddle and infinite in extent; or it can be "flat" and infinite in extent - our "ordinary" conception of space. A key limitation of the picture shown here is that we can only portray the curvature of a 2-dimensional plane of an actual 3-dimensional space! Note that in a closed universe you could start a journey off in one direction and, if allowed enough time, ultimately return to your starting point; in an infinite universe, you would never return.

http://map.gsfc.nasa.gov/universe/bb_concepts.html

The Hubble Expansion: A Spherical Symmetry

In 1922, astronomer Edwin Hubble made a series of observations that confirmed the existence of galaxies as separate "island universes", and that the galaxies are all moving away from us, as if the universe is expanding. This appeared to confirm the closed spherical model of cosmology: a spherical symmetry is evident in the expansion.



https://www.astro.virginia.edu/class/whittle/astr553/Topic16/t16_Hubble_expansion.gif

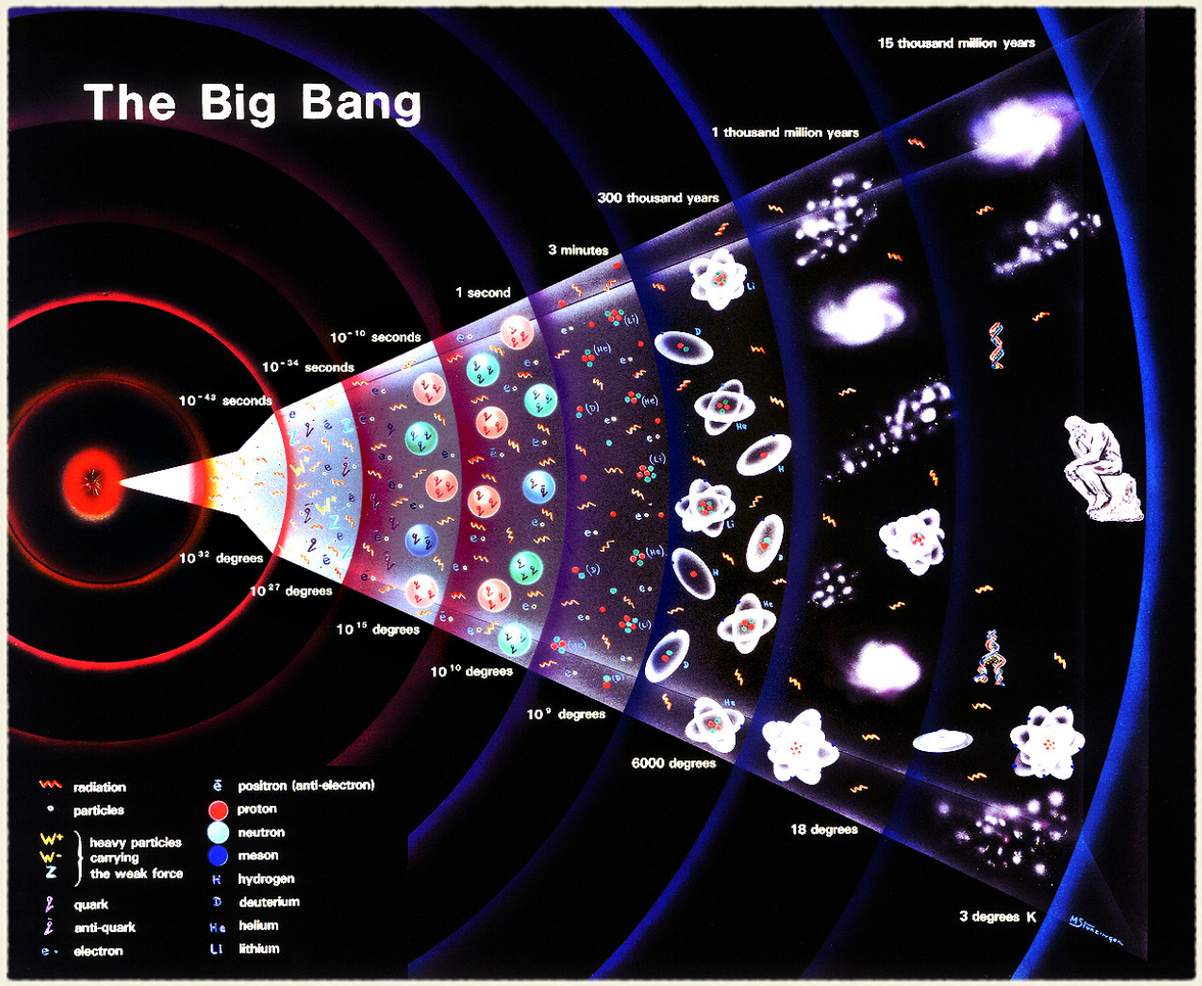
Big-Bang Cosmology

It is now accepted that the expansion of the universe can be explained in terms of its origins in the Big Bang. Direct physical evidence from a number of independent lines of investigation yield the same conclusion: that the universe "began" some 13.85 billion years ago. The spherical expansion is analogous to the shock wave from an explosion.

http://www.astronomy.com/videos/astronomy-101/2009/04/cosmology-101-big-bang

Space-Time: A Hyper-Spherical Domain

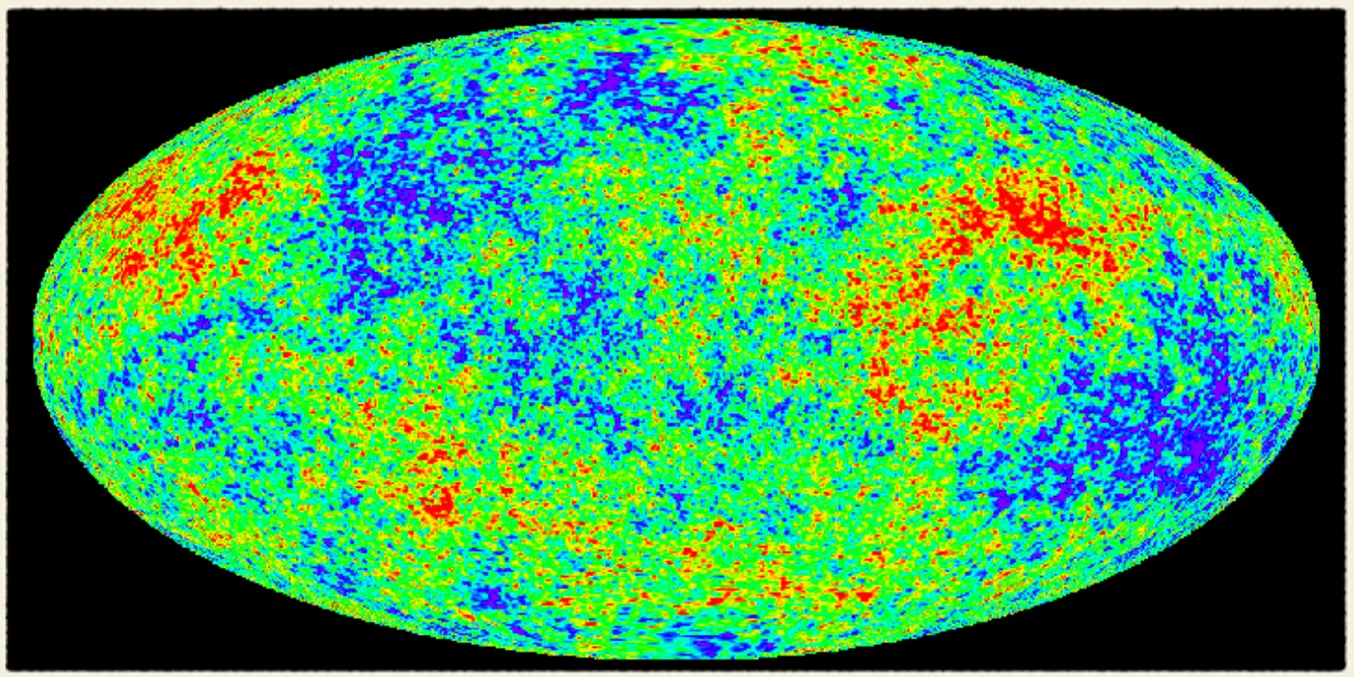
The visible universe is not just a large quantity of space, matter and energy, but includes time as well. When we look out into space, we are also seeing back in time, as light takes time to travel. Objects in the night sky reveal stellar evolution as it happened millions or billions of years ago. Our view of the spherical expanding universe is one of immense depth in space-time.



http://www.quantumdiaries.org/2013/07/08/cosmology-and-dark-matter/

Cosmic Microwave Background Radiation

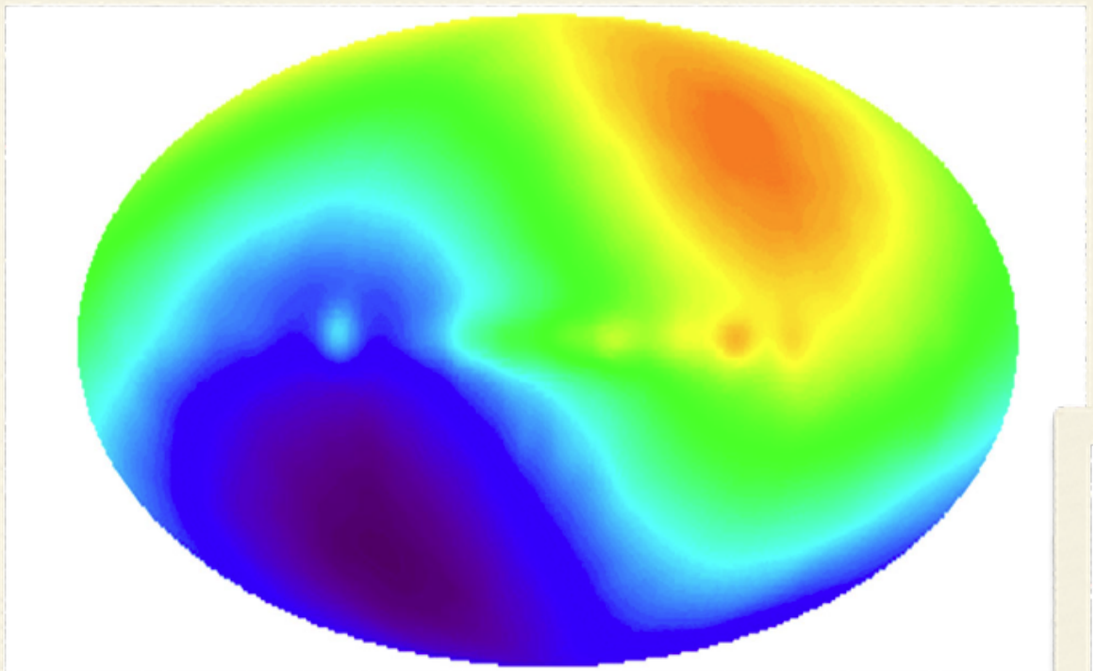
Since the 1960s one of the key evidences for the Big Bang theory has been the CMB, a visible low-frequency light source visible in all directions in the sky. In the 1980s the COBE satellite provided a detailed map of the CMB, revealing the beginnings of galactic and intergalactic matter distributions, the earliest cosmological structures.



http://www.psc.edu/science/Bertschinger/map-lg.GIF

Redshift of the CMB

The COBE satellite also provided evidence of the apparent motion of our own Milky Way galaxy, indicated by a very subtle gradation in the redshift of the CMB. Redshift is used in astronomy to indicate relative motion by a form of Doppler effect: like an ambulance siren, light has a higher frequency (blue colour) in the direction of our motion, lower frequency (red) in the opposite:

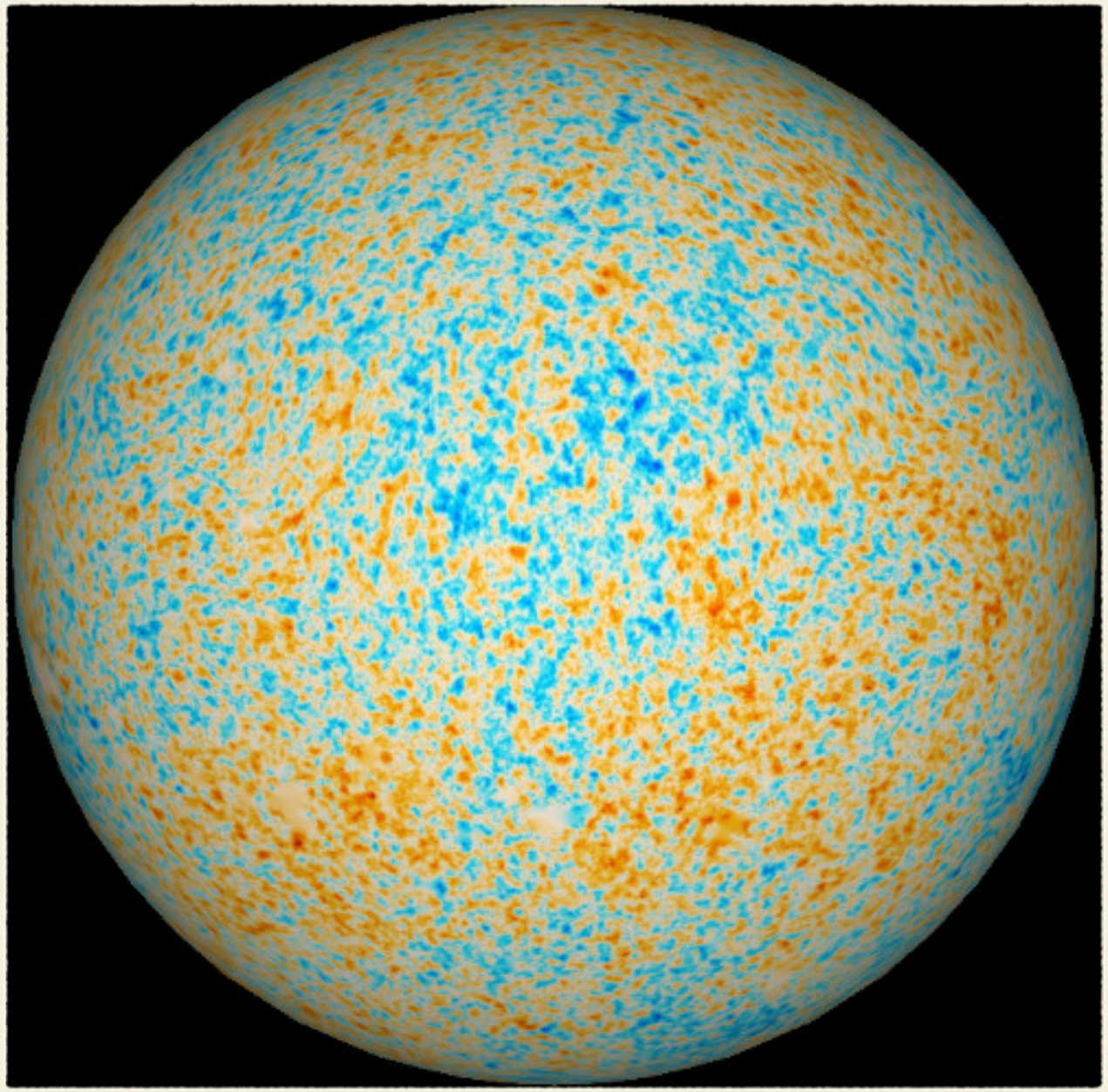


Astronomy Picture of the Day,
February 5 1996

Explanation: Our Earth is not at rest. The Earth moves around the Sun. The Sun orbits the center of the Milky Way Galaxy. The Milky Way Galaxy orbits in the Local Group of Galaxies. The Local Group falls toward the Virgo Cluster of Galaxies. But these speeds are less than the speed that all of these objects together move relative to the cosmic microwave background radiation (CMBR). In the above all-sky map from the COBE satellite, radiation in the Earth's direction of motion appears blueshifted and hence hotter, while radiation on the opposite side of the sky is redshifted and colder. The map indicates that the Local Group moves at about 600 kilometers per second relative to this primordial radiation. This high speed was initially unexpected and its magnitude is still unexplained. Why are we moving so fast? What is out there?¶

Is the CMB the Edge of Visible Space-Time?

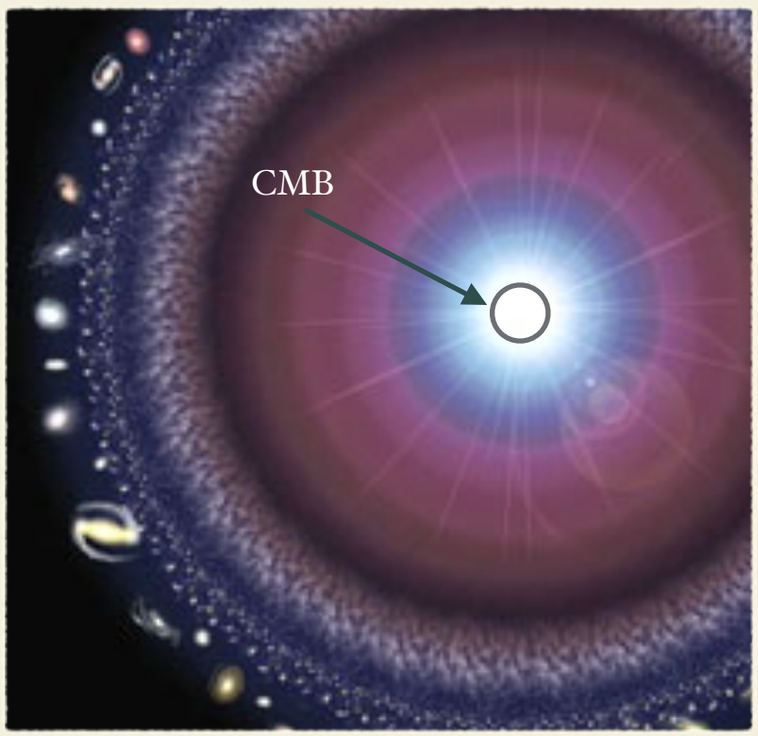
The CMB represents an epoch of the distant past when light first emerged. Before that, quantum theory predicts a high-energy soup of particles and fundamental forces, and before that there is the Big Bang. In observing the CMB, we are seeing to within 400,000 years of the point in Space-time when the universe began.



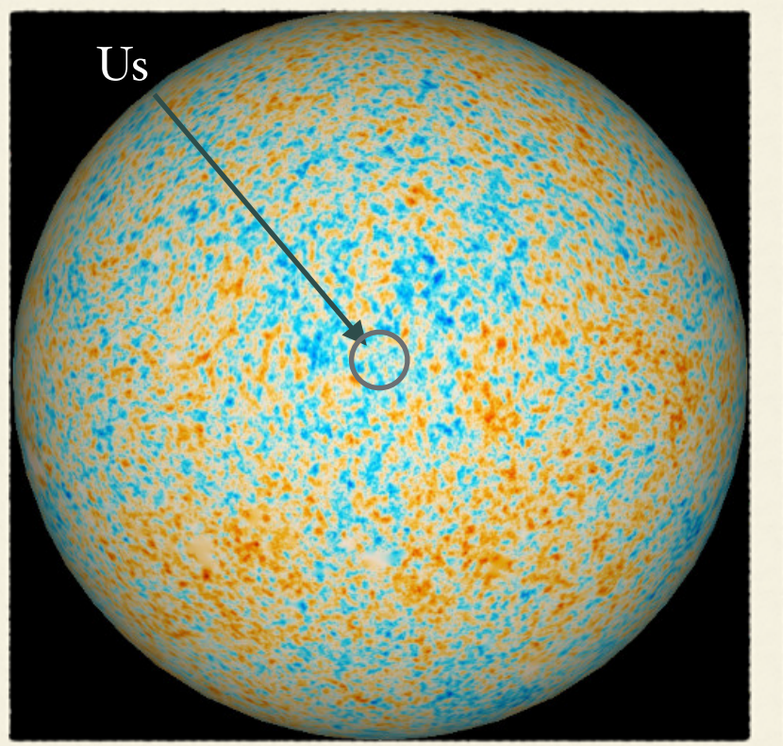
http://thecmb.org/

Is the Visible Universe Inside-Out?

The CMB is visible in every direction. But if the universe began as a primordial single point in space-time (ie a singularity in general relativity), and then expanded, surely the CMB is not "out there" but is in some sense located towards the centre of the universe:



How do we reconcile these inverse perspectives of the universe?



Is the CMB a Universal Reference Frame?

* 600 km/s is pretty fast, but it was the observation itself that surprised me, that we could detect this velocity at all. We're talking about radiation from the entire universe at its earliest stage of evolution. It is so smooth and uniform that the structures it reveals can be regarded as almost perfectly homogenous, at a time when the gravitational process had only just started forming the clumpy gaseous regions that later became galaxies, well before the first stars were born. It is a lasting image of the entire universe before its differentiation into the relative motion of objects such as planets and satellites. To a very high precision it is flat, empty and on the large scale almost motionless overall.

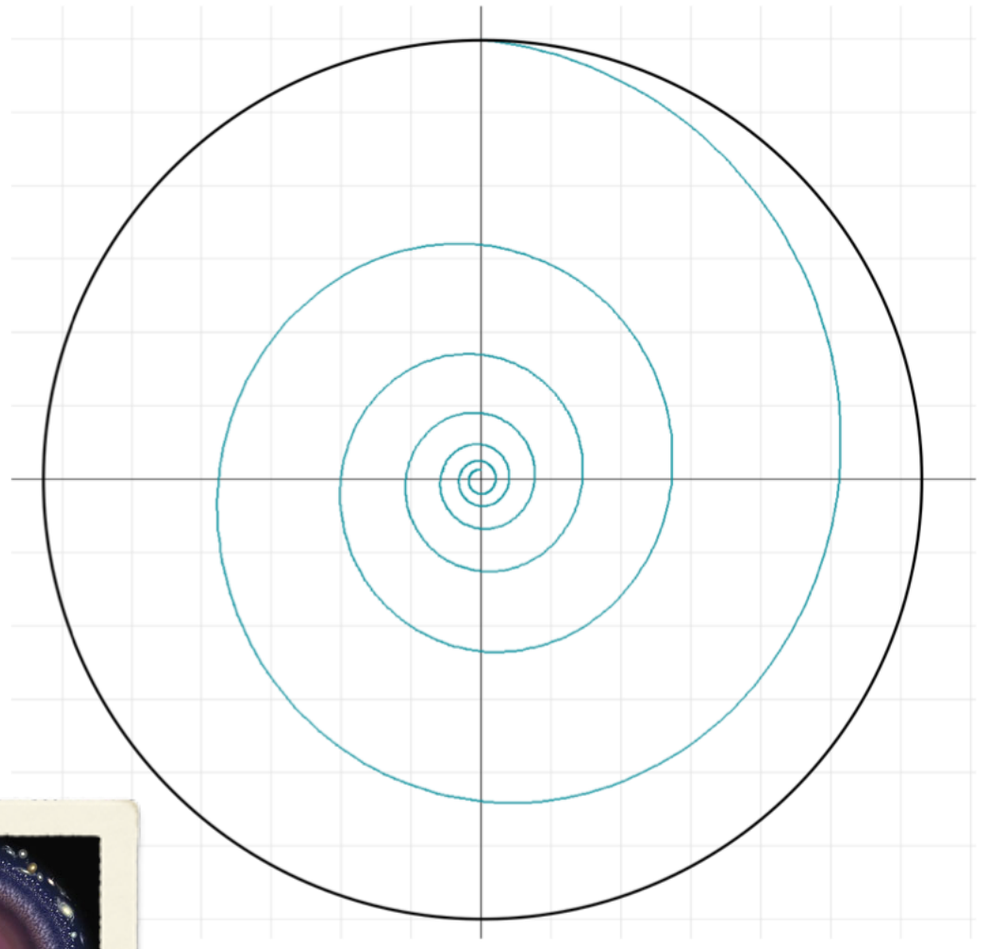
* With a figure of 600 km/s of the Earth relative to the COBE blueshift, we no longer had to talk in relative terms of our motion compared to the Earth, or the Sun, or the galaxy: we now had a near-motionless reference frame that included the entire universe at its earliest stage. Like the old schoolboy game of writing a street address to include the Country, the Earth, the Solar System, the Galaxy, the Universe, suddenly the ultimate location had a valid postcode, 600 km/s, and it seemed strange.

* I had just gotten used to the idea that there is no absolute state of rest or motion in the universe, so you can't say that we have some specific velocity relative to empty space: according to Einstein's relativity, there is no such thing as empty space of absolute zero velocity, because there is no universal reference frame, only our individual relative ones.

* Through the COBE data it seemed we now had a reference frame whereby we could compare our motion to the motion of any other object (a distant galaxy say) and so determine its motion relative to the background as well. You can do this with anything you choose as a reference frame and it's always supposed to be just purely relative, but the COBE blueshift, for the reasons of its uniformity and stationarity, as well as its profound originality at the beginning of time, *could* easily be regarded as a universal reference frame. It's just that this is not supposed to be possible.

A Spiral Cosmology?

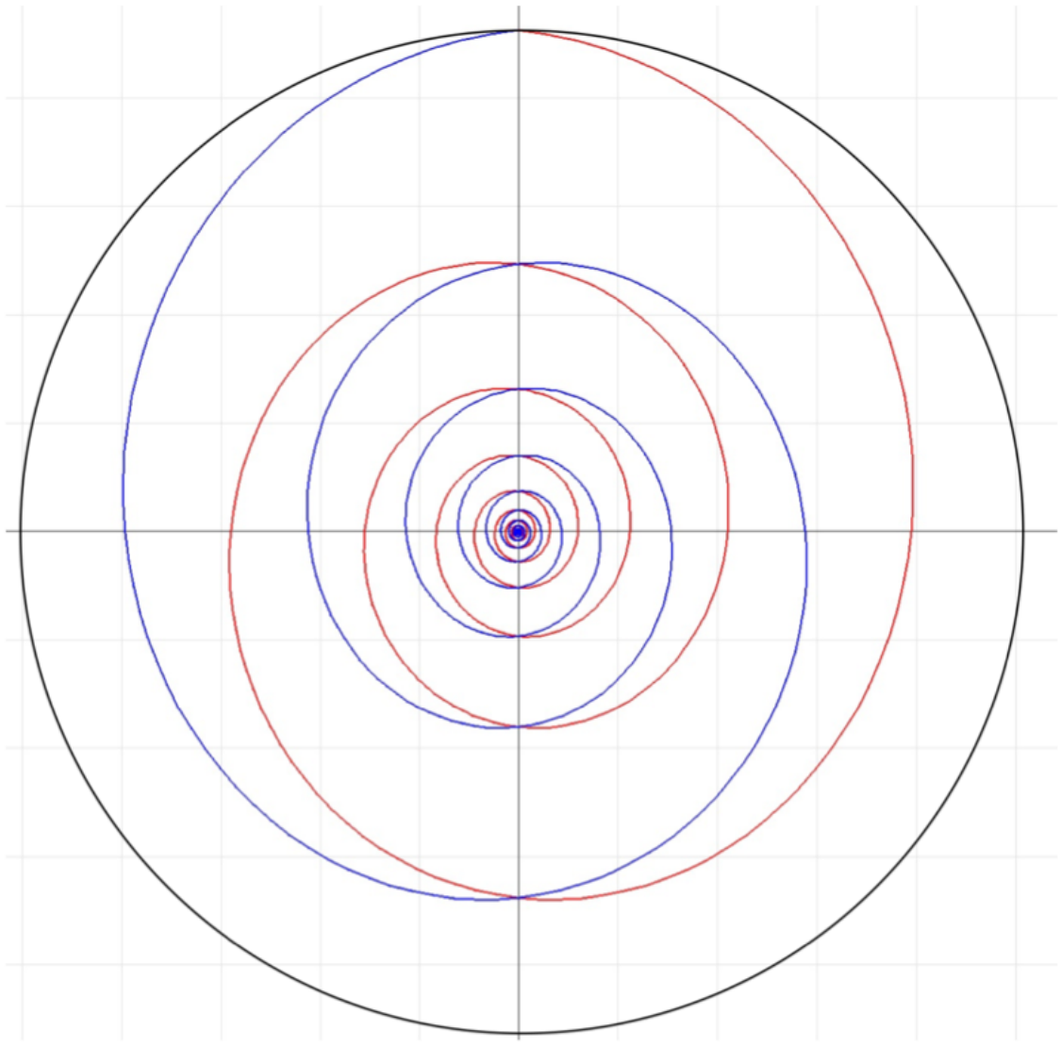
As light travels circumferentially around an expanding hyperspherical universe the world line traced by each photon would be an unwinding logarithmic spiral that traces across the universal radius as the universe expands:



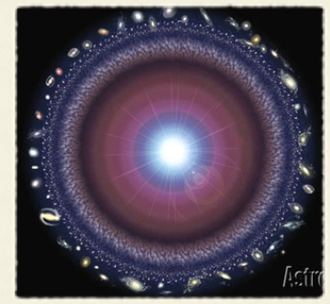
Spiral worldlines of photons traveling on an expanding hyperspherical domain represented by a circle. The observer is at the top of the graph.

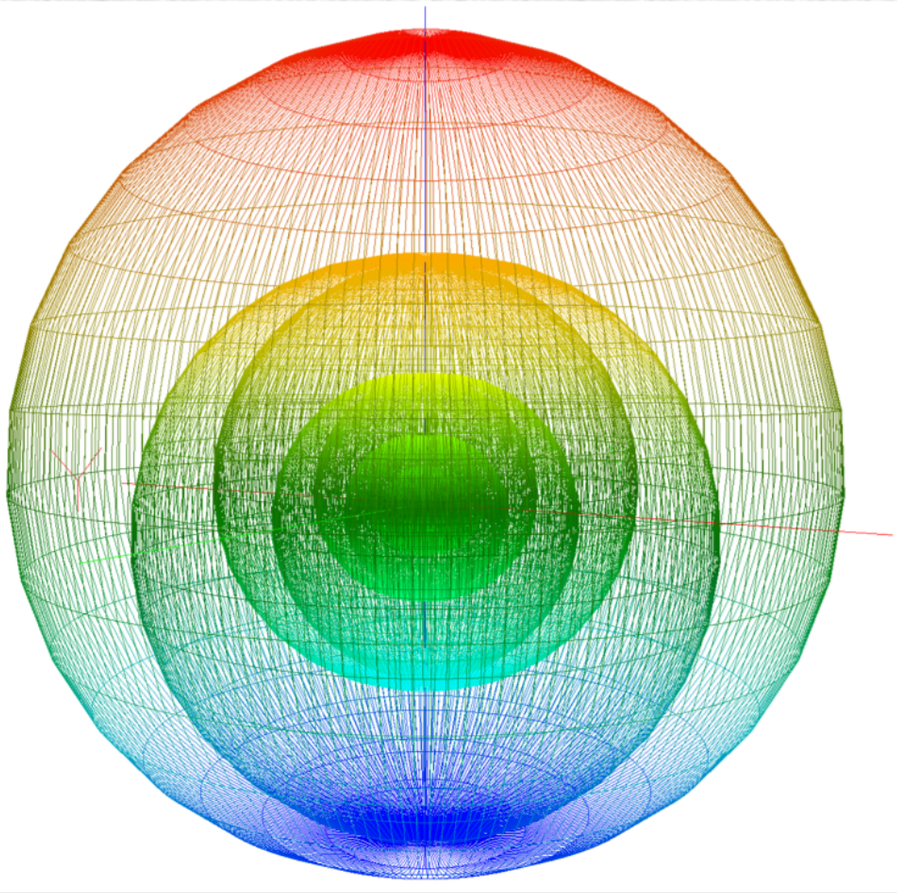
All points on the spiral curve are simultaneously visible to the observer at that instant. The spiral curve arises as photons in motion on the domain follow the expansion outwards. This represents a four-dimensional view of the expanding universe into the past.

The point of view can be extended into a forward (blue) and rear (red) view, with spiral worldlines extending in both directions along any axis:



The sum of all world lines reaching an observer at any moment, usually referred to as a *light cone*, is in fact only conical on the small scale, as at larger scales the cone follows the curvature of space. The large scale structure of the light cone would thus resemble a spiral volume of revolution leading back into the distant past:





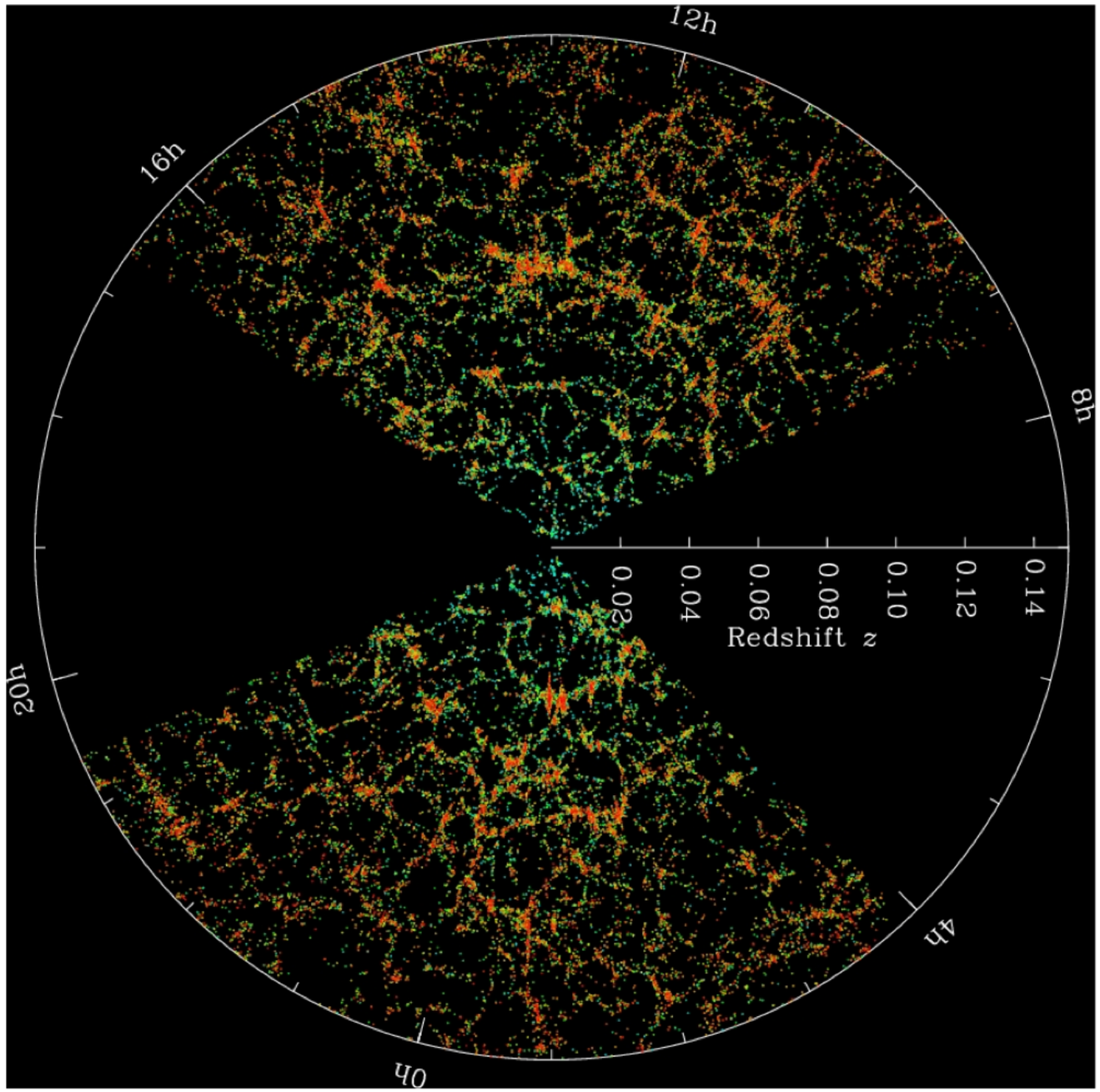
Spiral volume of visible space at any instant.

The world line returns on itself periodically, repeating the view of earlier epochs along any line of sight. This would be visible as a series of concentric shells of similar structure and the same galactic elements viewed at earlier stages of evolution. Current sky surveys may confirm this.

A stationary observer in an expanding spherical universe would have an opposite point, or *antipode* (blue base of figure), which is distant both in time and space. The antipode is symmetrical to the observer's location, such that all information reaching the observer from the distant past of the universe would have to pass through it. The antipode thus acts as a focal point which is visible in every direction at a specific large distance from the observer. Beyond that point our view of the universe would tend to repeat in a mirror image of a line of sight in the opposite direction, and then to repeat again as the world line extends beyond the next antipode, which is the observer's location at an earlier time.

If this is correct, telescopic data measured relative to the background radiation should show a strong pattern of similarity in all directions, repeating at about the distance of the antipodal point, and recurring in periodic shells at greater distances from any viewpoint. This can be examined visually from current astronomical data:

A map of the distribution of galaxies in one slice of the sky from the Sloan Digital Sky Survey.



There is even a chance that the Milky Way has already been imaged as a distant galaxy:

Hubble Telescope Spies Milky Way Galaxy's Twin

SPACE.com Staff | February 03, 2012 07:00am ET

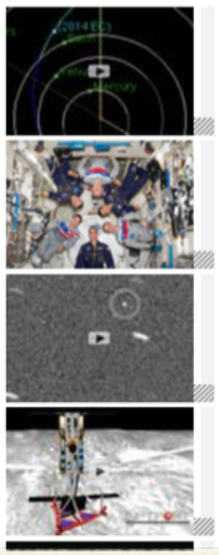
The barred spiral galaxy NGC 1073 is seen in this image from the Hubble Space Telescope. Pin it

Credit: NASA & ESA

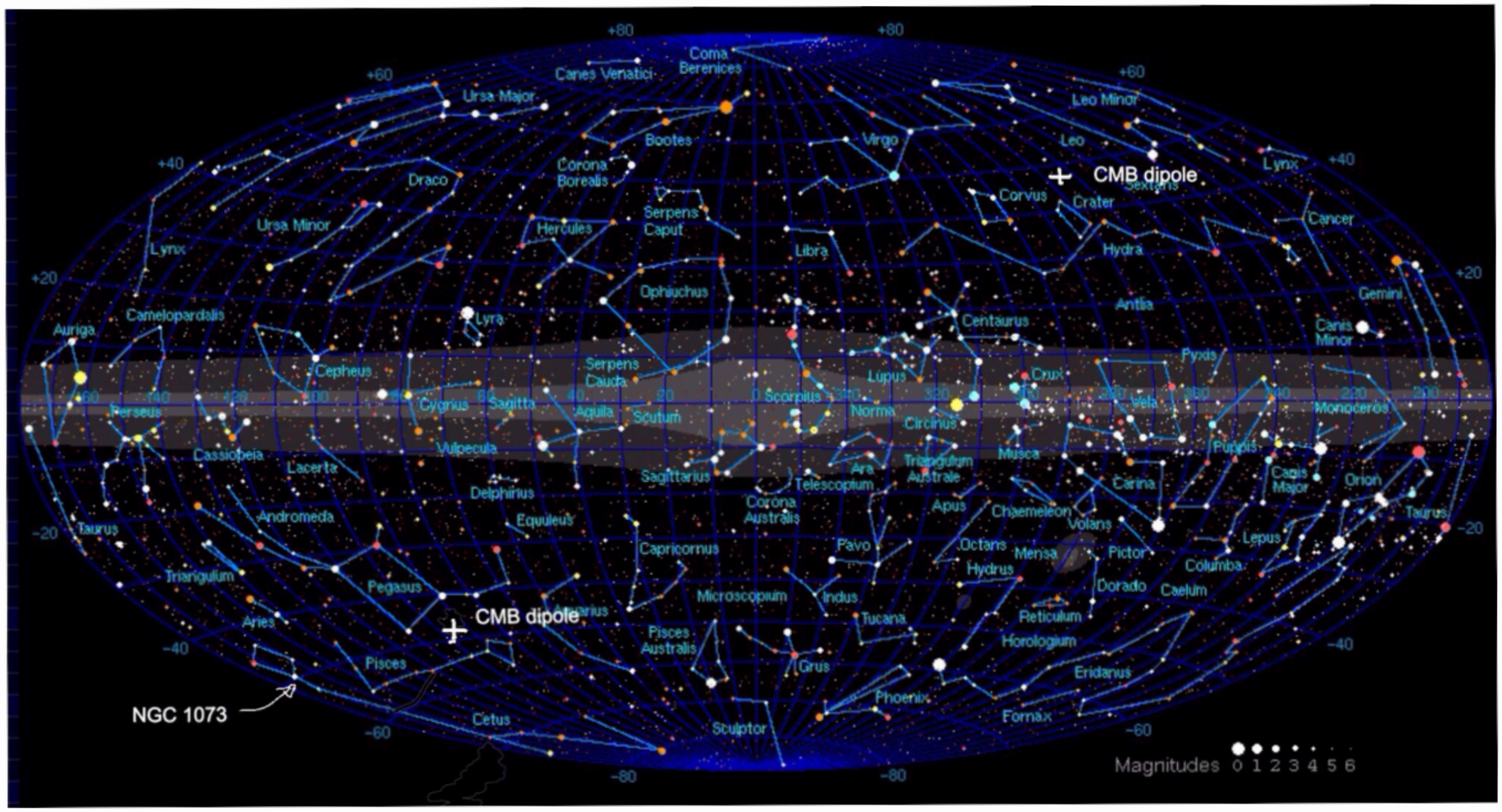
View full size image

An uncanny twin of our own Milky Way galaxy takes center stage in a new cosmic portrait by the Hubble Space Telescope unveiled today (Feb. 3).

The amazing photo shows the galaxy NGC 1073, a barred spiral like our own Milky Way. The galaxy is located 55 million light-years away in the constellation of Cetus (The Sea Monster).



The ultimate selfie?



In fact NGC 1073 is around 70 degrees off the COBE dipole axis so probably not. *The dipole axis is at G.C. l=264 b=48 between Pegasus and Pisces.*

MORE Questions...?