A Space-time Map of the Universe

http://www.johnagowan.org/spacetxt.html

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http://www.johnagowan.org/index.html

On a summer morning in 1981 I sat at my kitchen table in upstate New York and drew a space-time map of the cosmos, such as we see in Fig. 1. It has remained unchanged in all essential details since that time. (See: Space-time Map Fig. 1).

The map shows a universe that is 14 billion years old, with billion-year intervals represented by circles concentric on a central "Big Bang" (http://www.johnagowan.org/spacemapnew.pdf). Obviously, a map of this type will only work for a "Big Bang" universe, one which has a discreet, small, and sudden beginning. As we will see, the map works for our universe, which suggests that we do indeed live in a "Big Bang" cosmos (an origin similar to the Genesis story).

Notice first that only the upper left quadrant of this map is "real". If the universe contained only light, then the whole circular form would be appropriate; but when we add a material observer, the spherical symmetry of the light universe is broken due to the one-way character of time, the unique perspective of the observer, and the consequent need to avoid mapping "negative" space. Hence, we must arbitrarily choose a single quadrant of the circle to represent our observational position ("mapping artifact" – the map is not simply a scale model of the universe).

There are two critical features of the map which must claim our immediate attention: first, we have collapsed all three spatial dimensions into a single line, with increasing space running vertically from the central "Big Bang". This allows us to construct the time line horizontally, at right angles to all three spatial dimensions simultaneously, giving space and time equal importance as mapping parameters. The time dimension is one-way, increasing from the central Big Bang to the left-hand margin of the map, where it ends in earth's present position, our "here and now". Whereas the space line is marked off in units of billion light years, the time line is marked off in units of billion years. This correspondence between time and space is the essence of Einstein's and Minkowski's space-time metric; notice that both space and time are increasing in lockstep as metric equivalents. Both expansions are primordial expressions of entropy in free vs bound electromagnetic energy. The intrinsic motion of light drives the spatial expansion while the intrinsic motion of time drives the historical expansion, with gravity mediating between them, converting one into the other. (See: http://www.johnagowan.org/thermo.html "Entropy, Gravity, and Thermodynamics).

We connect the equivalent units of time and space via circles representing space-time volumes of equal age: since all points on a given circle are equidistant from the central Big Bang, all the space represented by that circle is of exactly the same age. Thus the spatial circles represent "3-spheres" of a specific age as indicated by their intersection with the time line. The first circle represents the spatial volume of the universe (and all material objects within it) when the cosmos was precisely one billion years old; and so on for each succeeding circle. The final circle represents the present spatial volume of the universe, including all the galaxies, as it exists now in the "universal present moment", about 14 billion years after the "Big Bang".

Secondly, because we are trying to understand how we see our universe, we must indicate the path of all light rays coming to planet earth from the cosmos. Any observer stands at the center of a nested, concentric set of observational shells –- two-dimensional spherical surfaces that get larger as they recede into spacetime. These 2-D spherical observational shells intersect the 3-D spatial circles of the map at some specific point on their arc, but how to identify this point? Since the map's spatial lines already represent 3 dimensions, a 2-dimensional intersection of their volumes would have to be represented as a point, and points on a circle can be designated by a tangent line -- in this case drawn from earth's location. We act upon this hunch and construct tangent lines from earth's position to all the spatial circles in the real quadrant of the map (I show only one), and then connect the tangent points. We discover that all such points lie on another circle which has earth's time line as its diameter.

If this (one-way) "light line" is a valid representation of the path of (all) light rays coming to earth from the cosmos, then we should be able to use the same principle of construction to indicate the position and "light line" of a second observer who is looking at earth while we are looking at him, and note if this reciprocal exchange of observer's perspectives maps properly. We have indicated this second observer at "B", 4 billion light years distant, and we have constructed B's time line from the Big Bang through the position where we see him (4 billion years in his past), extending the time line to his present position on the outermost spatial circle. We draw B's light line, which is a circle with B's time line as a diameter, finding that B's light line indeed intersects earth's time line 4 billion years in our past, validating our mapping procedure for these "light lines".

Consider next a demonstration of the map's validity. Because the cosmological "redshift" is caused (according to Steven Weinberg's *The First Three Minutes,* Basic Books, 1977) by the difference in the size between the observer's universe as compared to the size of the observed universe (since we look backward in time to always smaller and younger historical eras of our universe as we look outward in any direction in space), we can calculate directly from the map what we expect the redshift should be for any galaxy at a given distance: simply substitute the map's radius in years for the wavelength of light. The formula is: wavelength observed minus wavelength emitted (or age of our universe minus age of observed universe), divided by wavelength emitted (divided by age of observed universe). Thus the redshift of a galaxy seen at a distance of 7 billion light years is 14-7 divided by 7 = 1 (redshift 1 is therefore halfway to the Big Bang). These calculations are for a universe expanding uniformly at velocity c, as indicated by our flat map. We would like to know what this map would yield in terms of redshift calculations if gravity were added, bending the map. Accordingly, I made another (approximate) calculation from this same map, but with gravity sufficient to halt its expansion in 300 billion years. These two sets of numbers gave me an upper and a lower bound (expansion with gravity vs expansion without gravity) to compare with real-world observations (taken mostly from *Sky and Telescope* and *Science*). (See: Space-time Graph Fig. 2.)

The graph shows three lines: the lower line is the "no gravity" curve, the upper line is the "with gravity" curve, both calculated from the raw parameters of the map, flat in one case and spherical in the other (http://www.johnagowan.org/14gyr.gif). Redshift values increase toward the right on the horizontal axis, distance increases toward the top on the vertical axis. The third line is the observational data line, which falls just between the top and bottom calculated lines, as we must expect if the map is a valid representation of space-time. This is the "hard" observational evidence that the map actually "works" as constructed.

Explaining the "horizon" paradox to myself was the original motivation for drawing the map, and we will turn to it now. Most people, apparently including some professional astronomers, think the "edge of the universe" is somewhere "out there" in deep space, whereas the map clearly shows that "here and now" is the true edge of the universe. What is "out there" in deep space is the Big Bang, the center of the universe in the sense of its beginning in space-time. We are poised on the edge of space-time, looking backward in time (along our lightline) toward ever-smaller and younger historical eras of our universe as we look outward in space – in every direction. The common failure to appreciate this point has led to the perceived paradox of the "horizon problem" (among others) –- in which hard data (from the cosmic microwave background radiation) shows the universe to be a causally unified whole, but that evidence is at odds with what we think we see in the sky.

An example of the "horizon problem" (as commonly misconceived) is found in an article in "*Scientific American*" in a special issue on cosmology and the theory of "inflation" (Jan 1999, pages 63-69). In this article, the authors claim that two galaxies, both seen at 12 billion light years distance, but 180 degrees apart as we see them in the sky (one east and the other west), must be separated by 24 billion light years of space and therefore cannot have exchanged light signals in the lifetime of our cosmos, which is only 14 billion years old (they are therefore beyond each other's visual "horizon"). A glance at the map reveals the fallacy of this argument: at 12 billion light years distance, both these galaxies occupy a universe which is only 2 billion light years in diameter. Their maximum separation in space-time is therefore 2 billion light years, not 24, and they have had ample time to exchange light signals. Similar arguments apply to the "smoothness" and "flatness" problems (the background radiation is too homogenous, and the overall geometry of space-time is not gravitationally warped). Because the theory of inflation was developed specifically to address such problems, we have to wonder about the motivational and theoretical foundations of "inflation". It seems it is our view of the universe that is "inflated" rather than the universe itself. The cosmic microwave background radiation, for example, is thought to be redshifted (or "inflated") by a factor of about 1100. (An "inflated" view comes about because as our observational shells increase in size with increasing distance, the historical universe we are observing grows always smaller and younger – and yet visually, continues to surround us completely.)

In summary, we look at several types of reality represented in the map. Almost the entire universe is invisible to us; we cannot see our historical past, which is fully ½ of the "bulk" universe, the area between our time line and our light line. Also, we cannot see the other half of the universe, the area above our light line, which is a sort of "manifest future" consisting of light signals from the universe which are "in the pipeline" but which have not yet reached us. Our light line is our only view of the cosmos, which neatly separates these two areas into equal halves of past and future (as required by the reciprocal perspectives of observers everywhere), both unseen (by us) but both perfectly real (insofar as light and space-time are real), and both currently visible to observers elsewhere in the cosmos. All the galaxies that occupy the "universal present moment" are likewise invisible to us, as they all lie in the outermost spatial circle, the "universal present moment" (which we contact only by touch). We don't see objects where they are, we see them where they were at various times in the past, depending on their distance from us. We see only as and what the space-time metric allows us to see (as the phenomenon of gravitational lensing demonstrates). The advantage of our map is that it shows us what we do see as well as what we don't see. The unseen universe represents an extra, large, spacetime dimension, encompassing past, present, and "manifest future", a vast dimension consisting of causal or "karmic" information, not only our own, but that of all other observers in the cosmos, real or potential.

The special significance of our "observer's position" is that it is the 4-way intersection of space, time, light, and matter, the only point in our personal universe where two-way interactions are possible. From "here and now" we receive and send light signals from and to the universe, and mould our future with a mixture of karmic influence from the past, physical contact with present matter, and free-will action embedded in the ever-moving entropic flow of time and space. Note finally that our light line directly connects our position, which represents the center of creative energy in our personal universe, with the "Big Bang", which represents the center of creative energy in the macro-universe.

This is the view from the flightdeck of "Spaceship Earth": looking out into space in every direction we see the galaxies receding into space and history, the more distant they are the faster they recede. This progressive recession is how we perceive the entropic expansion of historical spacetime. In front of us we see nothing but the blank void of the unformed future; and of the present, we actually perceive only what we touch. The vast bulk of the cosmos we do not see at all, including our own historical past, the universal present moment, and the “manifest future” of light “in the pipeline” which has not yet reached us.

Links

Cosmology

Section V: Introduction to Cosmology
A Spacetime Map of the Universe (text - updated copy)
A Spacetime Map of the Universe (updated pdf diagram)
The "Spacetime Map" as a Model of a 5-Dimensional Holographic Universe
Commentary on the Physical Parameters of the "Spacetime Map"
A Graph of the 14 Gyr Cosmos Expanding with and without Gravity
Table of Data Inputs to "13.7 Gyr Graph" of Cosmic Expansion
Dr. Richard D. Stafford's Spacetime Map (text)
Dr. Richard D. Stafford's Spacetime Map (diagram)