Hypersphere Cosmology

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Abstract. The author proposes that a reinterpretation of cosmological redshift as arising from the small positive spacetime curvature of a 4-rotating Hyperspherical Universe of constant size can eliminate the current requirement for spacetime singularities, cosmic inflation, dark matter, and dark energy from cosmological models.

Introduction. The estimated mass of ordinary baryonic matter in the observed universe equals ~ 10^{53}kg. This would prove sufficient to create a gravitationally closed Einsteinian hypersphere with an antipode length of about 13.8 billion light years. However a static hypersphere of this nature would implode under its own gravity. Gödel developed a non-imploding version of such a universe stabilised by rotation. However Gödel's solution depended on an ordinary rotation of a sphere (a 3-sphere or 2-ball), and in the absence of any evidence of an axis of rotation his solution became discarded. Since the discovery of cosmological redshift it has become the convention to attribute cosmological redshift to recession velocity in an expanding universe, and to attempt to interpret all subsequent observations and theories in terms of a universe expanding from some sort of a 'big bang' event.

However a hypersphere would more naturally undergo a 4-rotation in which all points within its 3d hypersurface 'rotate' back and forth to their antipode positions. Such a 4-rotation does not readily submit to visualisation and it does not have an obvious axis of rotation. Appendix 2 gives a method of approximate visualisation of such a rotation.

A 4-rotating hypersphere of constant size will have a positive spacetime curvature which will manifest as the acceleration 'A'. This acceleration A arises from the fundamental parameters of the cosmic hypersphere, it creates cosmological redshift, it creates the CMBR, the cosmic microwave background radiation, it flattens galactic rotation curves, it distorts the apparent magnitudes of distant supernovae, giving rise to the illusion of a universe with an accelerating expansion, and, nearer to home it decelerates our spacecraft as seen in the residual Anderson deceleration of the Pioneer Anomaly.

1) Redshift (Z) arises as the small positive curvature of the Universe resists the passage of light.

The alternative mechanism for redshift works as follows:

Redshift = Z = $\frac{\lambda_o}{\lambda_e}$ - 1

Where λ_o = observed wavelength, λ_e = expected wavelength, and the -1 simply starts the scale at zero rather than 1.

Now wavelength, λ , times frequency, f, still always equals lightspeed, c .

$$\lambda_e f_e = \lambda_o f_o = c$$

However

$\lambda_e f_o$ < c

$\lambda_e f_o$ = c - $\sqrt{dA}$

Where d = astronomical distance, A = Anderson acceleration. The Anderson acceleration (the small positive curvature of the hypersphere of the universe) works against the passage of light over the astronomical distance, d. It cannot actually decrease lightspeed but it acts on the frequency component.

So substituting $f_o = \frac{c}{\lambda_o}$

We obtain $\frac{c\lambda_e}{\lambda_o} = c - \sqrt{dA}$

Therefore Redshift, Z = $\frac{c}{c-\sqrt{dA}}$ - 1

Thus Z becomes just a function of d, astronomical distance, not recession velocity.

Redshift does not arise from a huge and inexplicable expansion of the underlying spacetime increasing the wavelength; it arises from the resistance of the small positive gravitational curvature of hyperspherical spacetime to the passage of light decreasing its frequency.

Thus the 'Hubble Constant' has a value of precisely zero kilometres per second per magaparsec, but the 'Hubble Time' does give a reasonably accurate indication of the temporal horizon and hence the spatial horizon/antipode distance of the hypersphere of the universe. **The Universe does not expand.**

2) The Universe consists of a Hypersphere (a 3-Sphere or 4-ball) where: -

$\frac{M}{L} = \frac{c^2}{G}$ also $r_h = \pi L$ also $r_h = \frac{GM}{\pi c^2}$

The Universe thus has an 'orbital' velocity of lightspeed and an escape velocity of $\sqrt{2}c$

Hyperspheres can never have a radius r_h of less than $r_h = \frac{Gm}{\pi c^2}$

The geometry and topology of spacetime becomes hyperspherical beyond this limit, preventing further collapse.

Hyperspheres may form inside black holes but singularities do not exist.

3) The magnitudes of G and c arise from the structure of the entire universe as in Mach's principle: -

G = $\frac{Lc^2}{M}$ also c^2 = $\frac{GM}{L}$

4) The Anderson deceleration arises as a consequence of the gravity of the entire universe: -

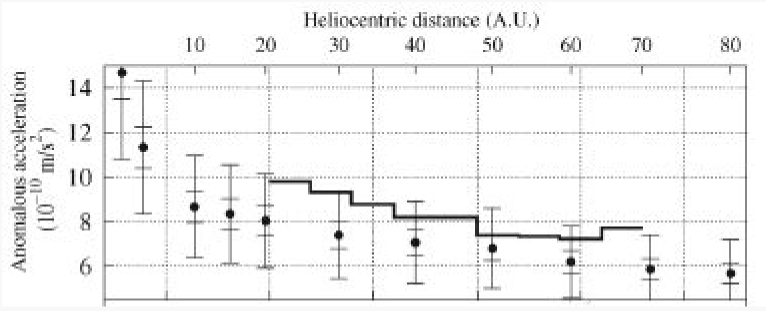
$\frac{GM}{L^2}$ = A also A = $\frac{c^2}{L}$

The Anderson deceleration actually represents the small positive curvature of the Universe.

Key.

M = Mass of the Universe. L = Antipode length. A = Anderson deceleration. r_h = radius of hypersphere.

Anderson deceleration = Pioneer deceleration –Thermal Recoil. This model predicts that it will bottom out at around 6.9 x 10^-10 m/s^-2. See below the Anomalous deceleration of the Pioneer spacecraft plotted against heliocentric distance.



5) The Universe undergoes a (fourth dimensional) 4-rotation or ‘vorticitation’ which gives it an angular velocity W, shown by: -

$$W^2 = \frac{2\pi GM}{V_H}$$

This equation derives from Gödel, but for a hypersphere rather than a sphere, where V_H the volume of the 3d ‘surface’ of the hypersphere equals

$V_H = 2\,\pi^2 r^2$ also $V_H = \frac{2L^3}{\pi}$

For a full derivation of this formula see appendix 1.

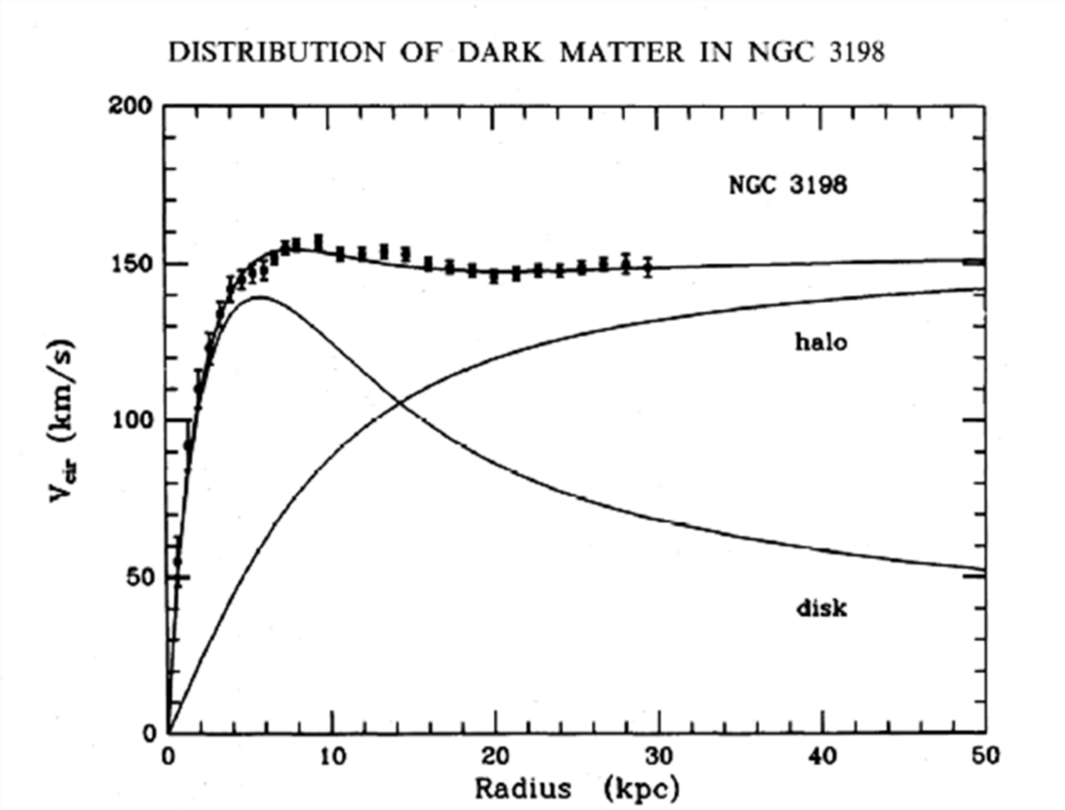
5b) The Universe thus has a ‘centrifugal’ acceleration of $\frac{c^2}{L}$ which exactly balances its ‘centripetal’ acceleration, the Anderson deceleration, thus imposing an omnidirectional resistance to linear motion.

5c) The universe has a frequency f_v of vorticitation where: -

$$f_v = \frac{c}{2L}$$

This equates to the time taken for complete 4-rotation, during which the Universe rotates into an antimatter phase and back again. This implies an angular ‘rotation’ of only 0.0056 Arcseconds per century only. We have not noticed this yet.

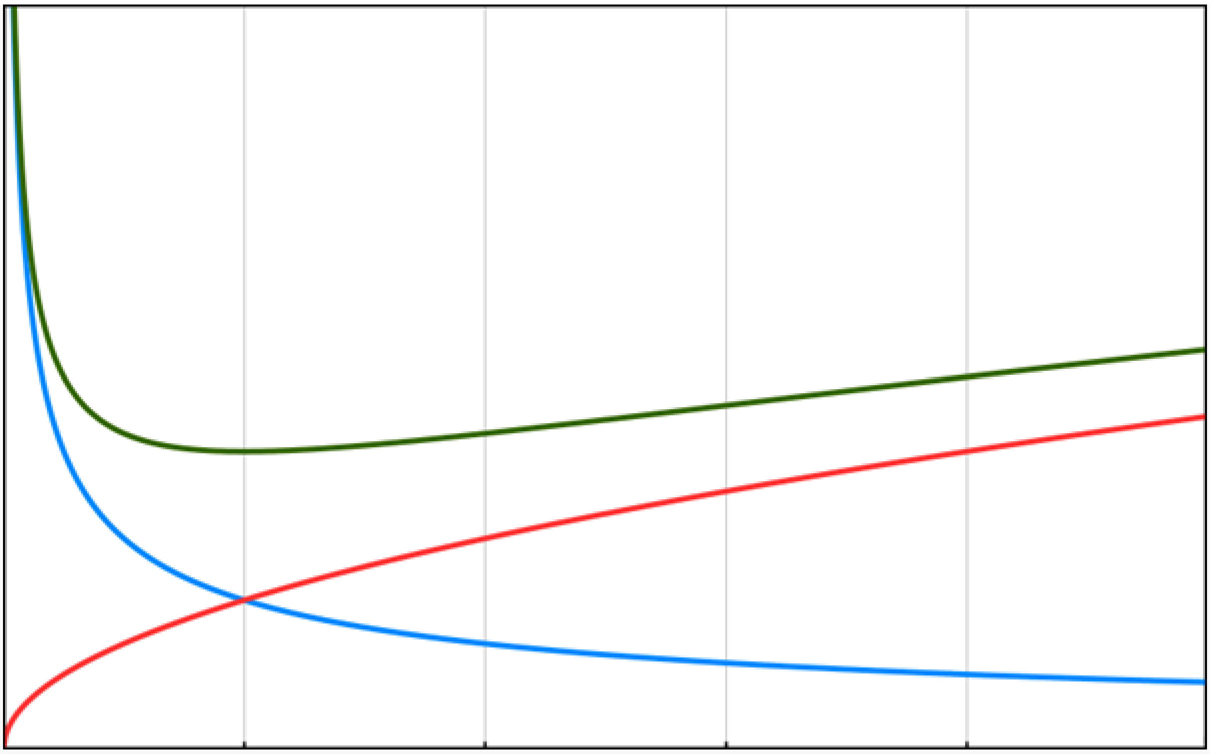
6) The positive spacetime curvature the Universe increases orbital velocity: -



By some form of the equation

$$V_o = \sqrt{\frac{Gm}{r}} + \sqrt{frA}$$ where some factor f applies.

As the general form of disc galaxy rotation curves beyond the central bulge takes the form of v = sqrt(1/r) + sqrt(r) as below:



The positive spacetime curvature increases centripetal acceleration which increases orbital velocity flattening galactic rotation curves, this repays the energy that the curvature takes from linear motions.

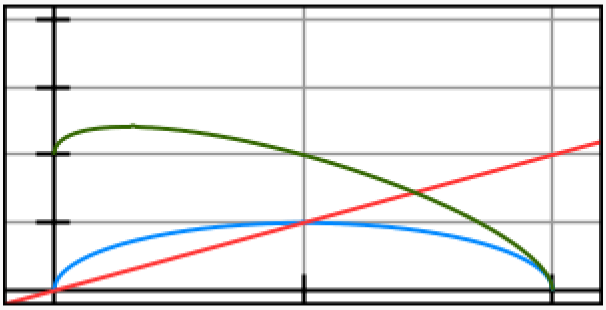
Dark matter does not exist.

7) The positive curvature of the Universe has a lensing effect on the passage of light across it: -

$L_h = 1 + \sqrt{d - d^2} - d$

Where L_h = hyperspherical lensing and d stands for the ratio a/L, astronomical distance over antipode distance. . The lensing distorts apparent magnitude and thus creates a mismatch with redshift leading to the incorrect assumption of an expanding acceleration.

Blue line – Hyperspherical geodesic, from observer to antipode.
Red line – Sight line assumed by observer.
Green line – The lensing, the amount by which the apparent magnitude of a point source becomes increased or decreased as a result of compression or expansion of the actual visual field. The green line begins at unity on the vertical scale.



Object’s apparent magnitudes at less than half antipode distance become slightly increased. Object’s apparent magnitudes beyond half antipode distance become progressively more diminished.

See Appendix 4, Hypersphere Visualisation and Lensing.

Dark energy does not exist.

Thus the Universe consists of a hypersphere, finite but unbounded in both space and time and constant in size, and vorticitating with a small positive spacetime curvature, despite the apparent temporal and spatial horizons.

Inflation did not occur.

8) The Cosmic Microwave Background Radiation. The CMBR consists of trans-antipodal starlight which has gone right round the universe, perhaps many times, until it has become redshifted till it achieves thermodynamic equilibrium with the thin intergalactic medium. It simply represents the overall average temperature of the universe.

9) Hydrogen Helium Ratio. This could not have arisen from the activities of stars alone beginning at a Big Bang some ~13.8 billion years ago. However as the universe has effectively unlimited age it may simply represent the natural ratio that evolves over unlimited time. The mechanism of Helium to Hydrogen conversion remains unknown but neutrons may (like neutrinos) act as Marjorama Fermions under extreme conditions.

10) Antimatter. The apparent absence of substantial quantities of antimatter in this universe arises because time rather than space separates matter from antimatter. Due to the 4d vorticitation of the Universe, all matter in the Universe will have an opposite sign to all matter about after a time corresponding to the temporal horizon of the universe. See Appendix 3.

9) Entropy. The entropy/information of the universe remains constant and proportional to its surface area in accordance with the Beckenstein-Hawking conjecture. The dimensions of the Universe all come out at the same multiple U, the ubiquity constant, of the Planck quantities: -

U = $\frac{M}{m_P} = \frac{L}{l_P} = \frac{T}{t_P} = \frac{E}{e_P} = \frac{a_P}{A} \sim 10^{60}$

The Universe thus has an information deficit leading to an effective quantisation of space and time at about: -

$l_P\sqrt[3]{U}$ and at $t_P\sqrt[3]{U}$

If we take T, the temporal horizon, as equivalent to the time elapsed since the big bang in conventional cosmology then the predicted quantisation of spacetime comes out at:-

Planck length and Planck time x 5.4 x 10^20.

Holometry experiments in progress may show this.

10) Evidence for the non-expansion of the Universe. The average frequency of quasars at around 6bn light years matches that of quasars at around 10bn light years. If the universe had actually expanded then one would expect some time dilation.
See http://phys.org/news190027752.html

http://iopscience.iop.org/1538-4357/553/2/L97/fulltext/

http://uk.arxiv.org/pdf/1004.1824

- 'There is however surprisingly little direct evidence that the universe is expanding'

Appendix 1. The 4-rotation of a Hypersphere.

The Gödel 3d rotating universe has this solution derived from General Relativity: -

$W = 2\sqrt{\pi \mathrm{Gd}}$

"Matter everywhere rotates relative to the compass of inertia with an angular velocity equal to twice the square root of pi times the gravitational constant times the density." – Gödel.

However this solution applies to an ordinary sphere (a 3-ball or a 2-sphere). We can find the solution for a hypersphere (a 4-ball or 3-sphere) as follows: -

Squaring and substituting mass over volume for d yields:

W^2 = 4πGm/v

Substituting 4/3 πr^3 for the volume of a sphere yields:

$$W^2 = 3\pi^2 Gm / r^3$$

Substituting $r = \frac{3Gm}{c^2}$ the formula for a photon sphere (where orbital velocity equals lightspeed) yields:

$$W^2 = \frac{\pi^2 c^2}{r^2}$$

Taking the square root:

W = $\frac{\pi c}{r}$

Substituting L for r as we wish to find the solution for a hypersphere:

W = $\frac{\pi c}{L}$

Squaring yields:

$W^2 = \frac{\pi^2 c^2}{L^2}$

Substituting GM/L = c^2 the formula for a hypersphere yields:

$W^2 = \frac{2\pi \mathrm{Gm}}{\mathrm{V_h}}$

Which we can also express as:

W= $\sqrt{\frac{2\pi \mathrm{Gm}}{\mathrm{V_h}}}$ or as W = $\sqrt{2\pi \mathrm{Gmd}}$

Substituting W = 2πf into W = $\frac{\pi c}{L}$ to turn radians into frequency we obtain:

f = $\frac{c}{2L}$ for a hypersphere.

Centripetal acceleration a, where a = $\frac{v2}{r}$ for a sphere and a $= \frac{v2}{L}$ for a hypersphere, yields:

a = $\frac{c2}{L}$ = for a hypersphere.

Now for a hypersphere where $\frac{\mathrm{Gm}}{\mathrm{L}} = \mathrm{c}^2$ a centrifugal acceleration a, of a = $\frac{\mathrm{Gm}}{\mathrm{L}^2}$ or more simply a = $\frac{c2}{L}$ will exist, to exactly balance the centrifugal effects of rotation.

In a hypersphere of about L = 13.8 billion light years, the rotation will correspond to about 0.0056 arcseconds per century. As this consists of a 4-rotation of the 3d ‘surface’, visualisation or measurement of its effects may prove problematical, the rotation should eventually cause every point within the 3d ‘surface’ to exchange its position with its antipode point, over a 13.8 billion year period, turning the universe into a mirror image of itself.

Appendix 2. 4-rotation does not submit to easy visualisation but consider this: -

A needle rotated in front of an observer and viewed in the plane of rotation will appear to shrink to a small point and then become restored to its original length with further rotation.

Likewise a sheet of card will appear to shrink to a line and then expand back into a plane if rotated in front of an observer.

In both cases the apparent shrinkage and expansion depends on the observer not seeing the needle or card in their full dimensionality..

A cube (or a sphere) rotated through a fourth dimension would appear to shrink to a point and then expand back to its original size to an observer viewing it in only three dimensions and ignoring the curvature.

Appendix 3. Note that if the universe does have the same number of dimensions of time as of space then it will rotate back and forth between matter and anti-matter as well, if fundamental particles also consist of hyperspheres whose properties depend on various types of 4-rotations. This hypothesis remains in development and the subject of a future paper.

Appendix 4.

This appendix provides a method of visualising the four dimensional hypersphere as a perspective construction in three dimensions, and it also shows how the curvature of hyperspherical space will distort images from distant galaxies and supernovae.

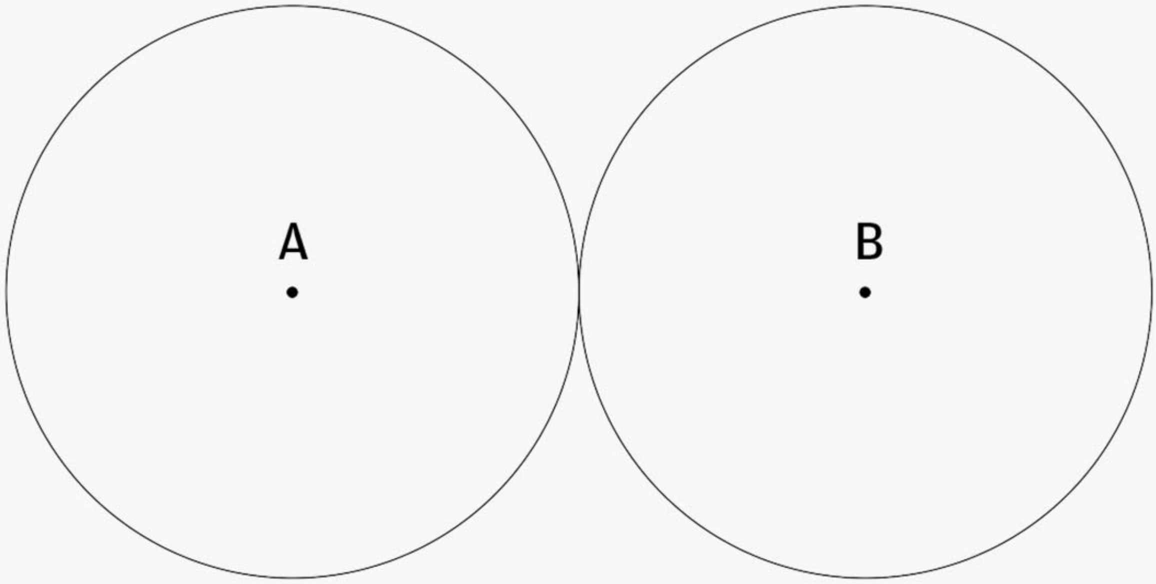


fig 1

Figure 1. Any attempt to project the surface of the Earth onto a flat surface necessarily leads to some kind of distortion. In addition to the usual Mercator projection that distorts distances towards the poles, we can also make a polar projection by cutting through the equator and then "photographing" each hemisphere from above the poles. Such a projection gives a good representation of distances near the poles but it leads to progressive distortions as we near the equator. Cartographers normally place the two halves of the polar projection in contact at some point, to remind us that all points around the equator of one hemisphere actually touch a corresponding point on the other hemisphere.
Similarly we can represent the 3-sphere or hypersphere as two spheres in which every point on the surface of one of the spheres corresponds to a point on the other sphere, despite that we can only represent them with a single point of contact. Now when we make a polar projection of the Earth's surface, convention dictates that we centre the projection on the poles, but we could choose any two opposite points and cut the sphere across a great circle other than the equator. An egomaniac might delight in a projection with his house at the very centre of the projection, but it would remain a valid projection.
Thus an observer A, in a hypersphere can define her map of it with herself at the centre of one of the spheres. This then defines a second point B, as her hyperspherical antipode,

analogous to the point furthest away from her on the surface of the world. In a hypersphere it represents the furthest point you can travel to without starting to come back to where you started from.

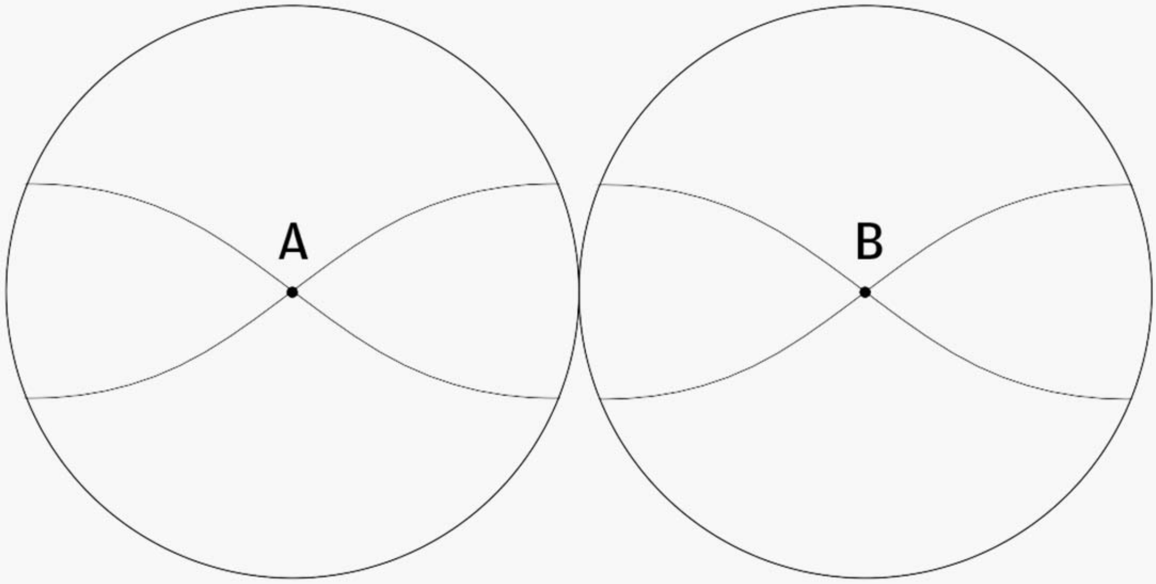


fig2

Figure 2 . An observer looking into the deep space of an hypersphere could in theory see an object at her antipode point B, by looking in any direction, analogous to the way in which all routes from the North Pole lead to the South Pole on the Earth. Note that lines of sight curve within a hypersphere, in a way analogous to the way in which meridians curve around the surface of the Earth. Light follows geodesics in space, so if space curves, light has to follow the curvature. Theoretically our observer could see right past her antipode and catch sight of the back of her own head. In practice light from near the antipode becomes so red-shifted by the time it gets to A, that A cannot even see quite as far as the antipode.

Hypersphere Cosmology argues that the curvature of the universe also causes the progressive red-shift of light travelling across it, and that conventional cosmology has mistaken this for recession velocity, an hypothesis which implies an expanding universe. This paper will attempt to show that the supposed acceleration of that expansion arises from the lensing effect of hyperspherical space.

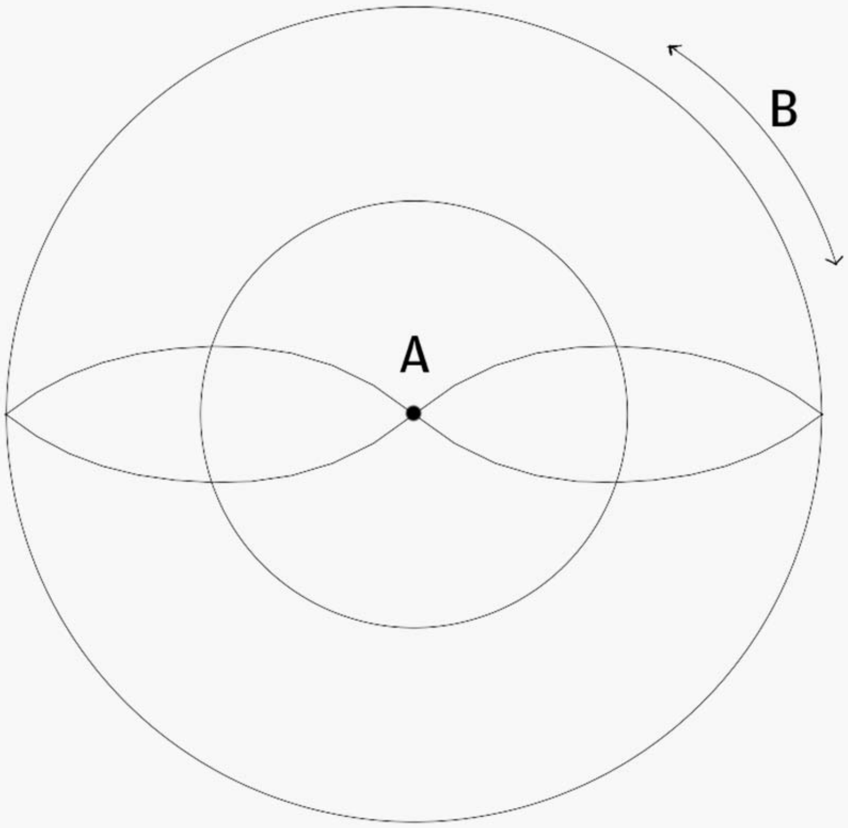


fig3

Figure 3. Imagine that we take the polar projection of the Earth and then roll the equator of the Southern Hemisphere around that of the Northern one. This will have the effect of stretching out Antarctica so that it goes all the way around the circumference of the whole map. We would then have a circular and highly topological map of the world with huge distance distortions towards the South Pole which itself now stretches around the entire edge. With a little effort at visualisation we can do something analogous with the two sphere map of the hypersphere, by rolling one sphere all over the entire surface of the other so that all corresponding points come into contact. This will result in the antipode point becoming spread out over the entire surface of the resulting sphere. Astronomers who assume a "flat" Euclidean universe will have effectively and unwittingly distorted their view of the universe in exactly this way if it does in fact have a hyperspherical geometry.

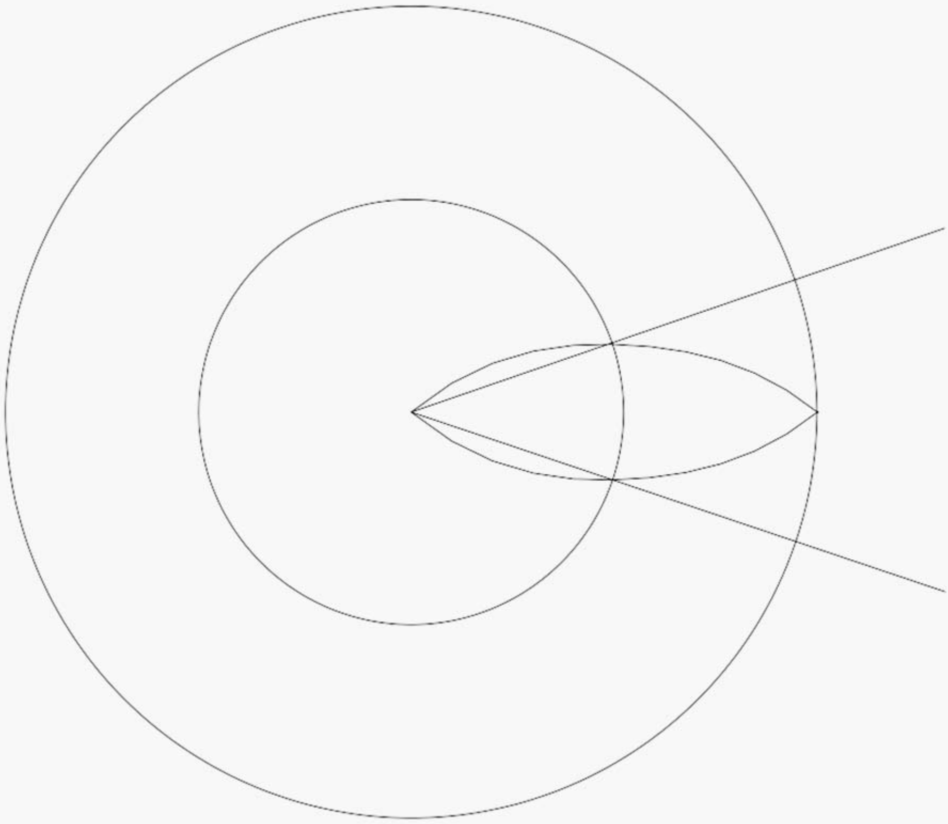


fig4

Figure 4. Astronomers who assume a flat universe with no curvature will assume that they can see in straight lines. If they look out into the apparent sphere of space that surrounds them, they will actually see along geodesics which curve relative to the assumed flat space of their maps.

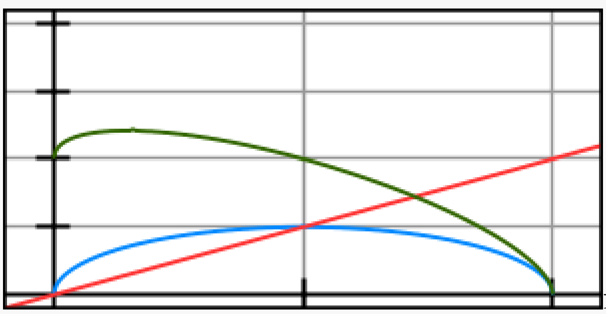


fig5

Figure 5. This shows the lensing effects of the hyperspherical curvature.

Blue line – Hyperspherical geodesic, observer to antipode.
Red line – Sight line of observer who assumes flat space.
Green line – The lensing, the amount by which the apparent magnitude of a point source

becomes increased or decreased as a result of compression or expansion of the actual visual field. The green line begins at unity on the vertical scale.

Objects less than halfway to antipode distance will appear magnified whilst objects well past the halfway to antipode point will appear diminished, for an observer located at the origin.

Now if hyperspherical lensing diminishes the apparent magnitude of very distant objects it explains why the red-shifts of type 1A supernovae do not match their apparent magnitudes. These supernovae which act as standard candles appear dimmer than they should for their measured red-shifts.

In the Hypersphere Cosmology model, red-shift still gives a fairly accurate measure of distance, (it does not mean recession velocity), and hyperspherical lensing means that far objects will appear dimmer than expected in flat space.

Thus the universe does not expand or have an accelerating expansion that implies dark energy; it just has a curved geometry and a topology that creates the optical illusion of such things.

Conclusion. The Hypersphere Cosmology model has the virtue of simplicity. It does not require an initial spacetime singularity, or cosmic inflation, or dark matter or dark energy as interpretations of existing observations. It does not provide a mechanism for reversing the expected increase of metallicity through nuclear fusion over time in the universe, although it implies that such a mechanism may exist. It does not explain why the universe does not appear to contain other hyperspheres of a significant fraction of its volume at this epoch. It does not explain how the universe attained its present condition, but the initial conditions of the big bang theory remain similarly inexplicable. Hypersphere Cosmology may not even require initial conditions. We have no good reason to consider non-existence as somehow more fundamental than existence.

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