Hypersphere Cosmology. (5)   P J Carroll 1/4/20

Abstract. Hypersphere Cosmology presents an alternative to the expanding universe of the standard LCDM-Big Bang model. In Hypersphere Cosmology, a universe finite and unbounded in both space and time has a small positive spacetime curvature and a form of rotation. This positive spacetime curvature appears as an acceleration A that accounts for the cosmological redshift of distant galaxies and a stereographic projection of radiant flux from distant sources that makes them appear dimmer and hence more distant.

Hypersphere Cosmology.

'Hypersphere' in this model corresponds to the mathematical object known as a 3-Sphere or a Glome. Such a hypersphere has an antipode length and a volume as shown in the zeroth equation.

0) $L = \pi r \quad vol = \frac{2L^3}{\pi} = 2\pi^2 r^3$ L = Antipode length of a hypersphere.

1) $\frac{2GM}{L} = c^2 \quad \frac{GM}{L^2} = \frac{c^2}{2L} = \frac{A}{2} \quad \frac{c^2}{L} = A$ Schwarzschild metric. Centripetal acceleration. M = mass of universe.

2) $\omega = 2\sqrt{\pi G p} \quad \omega^2 = \frac{4\pi^2 GM}{2L^3} \quad \omega = \frac{\pi c}{L}$

$f = \frac{c}{2L} \quad \frac{c^2}{2L} = \frac{A}{2} \quad \frac{c^2}{L} = A$ Gödel metric. Centrifugal acceleration.

A/2 = 7.32 x 10^{-10} m/s, the Pioneer Anomaly corrected for thermal recoil.

L = 1.23 x 10^{26} metres or 13 billion light years, see 7) for an exact determination of L.

M = 1.66 x 10^{53} kg.

1&2 yield a stable hypersphere, finite and unbounded in space and time. Galaxies rotate/vorticitate around the randomly aligned Hopf circles of the hyperspherical universe. The universe does not have an axis of rotation.

3) $\frac{2GMm_g}{Lc^2} = m_i$ Mach's Principle. This can only work in a non-expanding hypersphere.

4) $v_2 = v_1 - \frac{At}{2} \quad v^2 = 2da \quad v^2 = \frac{2dA}{2} \quad v^2 = dA$ A/2 Observed as the Pioneer Anomaly.

5) $\frac{\lambda_e}{\lambda_o} = \frac{E_o}{E_e} = \frac{m(c^2 - dA)}{mc^2} = 1 - \frac{dA}{c^2} = 1 - \frac{d}{L} = \frac{1}{Z+1}$ Redshift arising from distance d. The universe does not expand.

The small positive spacetime curvature of the hypersphere appears as an omnidirectional deceleration A, which increases the wavelength and decreases frequency of light over long distances, giving rise to both redshift and time dilation.

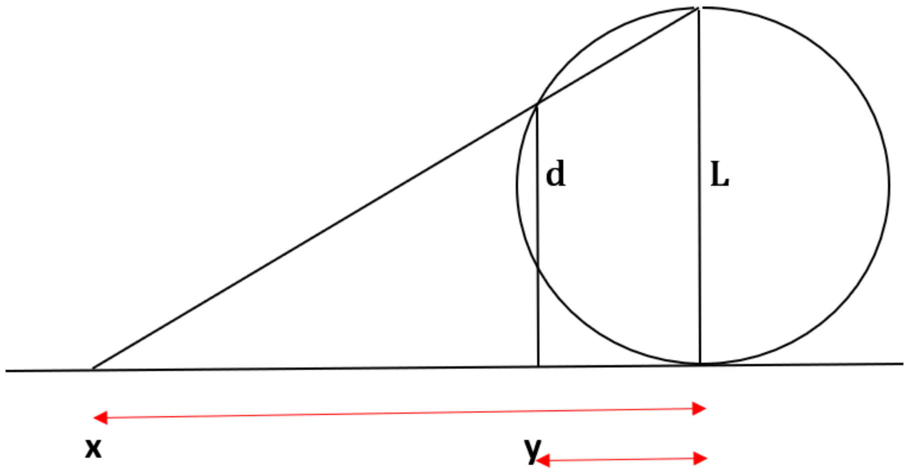
$$6)\ f = ma - \frac{mA}{2} \quad ma = \frac{Gmm}{r} + \frac{mA}{2} \quad a = \frac{Gm}{r} + \frac{A}{2}$$

$$ar = \frac{Gm}{r^2} + \frac{rA}{2} \quad v_o = \sqrt{\frac{Gm}{r^2} + \frac{rA}{2}}$$

The omnidirectional deceleration A also slightly modifies all accelerations, and this results in a general very small boost to all orbital velocities. Thus, large hyperspheres cannot form within the hypersphere of the universe as their orbital velocities would tend to exceed lightspeed. Singularities cannot form. Black holes become unstable as hyperspheres form inside them.

$$7)\ d_a = d_o 1 - \sqrt{1 - \frac{1}{Z+1}}$$

Hyperspherical lensing from distance observed to actual distance, arising from stereographic projection of flux in a hypersphere. In this diagram the circle represents the Glome. In a Glome, the antipode distance L equals half the ‘circumference’.



$$\frac{x-y}{x} = \frac{Apparent\ flux}{Apparent\ flux - Actual\ flux} = \left(\frac{Apparent\ dist. - Actual\ dist.}{Apparent\ distance}\right)^2 = \frac{d}{L}$$

$$Actual\ distance = Apparent\ distance\ 1 - \sqrt{\frac{d}{L}}$$ **No Dark Energy.**

$$Actual\ distance = Apparent\ distance\ 1 - \sqrt{1 - \frac{1}{Z+1}}$$

Here we calculate the apparent distances of Type 1A supernovae from the flux given by their apparent magnitudes in Perlmutter et all, https://arxiv.org/pdf/astro-ph/9812133.pdf

See the calculations here https://www.specularium.org/hypersphere-cosmology/item/270-type-1a-supernovae-and-hypersphere-cosmology

When combined with the redshift-distance relationship these results show an antipode distance of $L = 1.23 \times 10^{26}$ metres, 13 billion light years.

No accelerating expansion exists. Dark energy does not exist.

8) $v(r) = v_i(r) + 2\sqrt{\pi G p}\, r$

Galactic rotation curve increases over that expected from Newtonian expectations, re Gomel & Zimmerman. Dark matter does not exist.

See an example calculation here: https://www.specularium.org/component/k2/item/290-rotation-of-the-triangulum-m33-galaxy

9) $\frac{M}{m_p} = \frac{L}{l_p} = \frac{T}{t_p} = \frac{a_p}{A} = U{\sim}10^{60}$ The Ubiquity Constant.

10) $\Delta E \Delta t = \hbar\sqrt[3]{U} \quad m_n = \frac{m_p}{\sqrt[3]{U}} \quad N_n = U^{\frac{4}{3}}$

$lack\ of\ observable\ phenomena\ below\ l_p\sqrt[3]{U}\ and\ t_p\sqrt[3]{U}$

The application of the Bekenstein-Hawking Conjecture that 'the information content of a spatially closed volume depends on its surface area in Planck units' yields something of the order of 10^{-20} units of information per Planck length within the hypersphere.

This raises the effective level of the Uncertainty Principle and suggests a reason for the mass and number of nucleons in the universe.

11) Commentary. The Hypersphere Cosmology model seeks to replace the standard LCDM Big Bang cosmological model with something approaching its exact opposite.

In HC the universe does not expand, it remains as a finite but unbounded structure in both space and time with spatial and temporal horizons of about 13bn light years and 13bn years. The HC universe does not collapse because its major gravitationally bound structures all rotate back and forth to their antipode positions over a 26bnyr period about randomly aligned axes, giving the universe no overall angular momentum and no observable axis of rotation.

The small positive spacetime curvature of the Glome type Hypersphere of the universe has many effects, it redshifts light traveling across it, it lenses distant objects making them look further away, it prevents smaller hyperspheres or singularities forming within black holes and it gradually causes black holes to eject mass and energy.

In HC the CMBR simply represents the temperature of the universe, and it consists of redshifted radiation that has reached thermodynamic equilibrium with the thin intergalactic medium***

The universe will appear to observers as having the flux from distant sources in stereographic projection due to the geometry of the small positive spacetime curvature.

In terms of the enormously dimmed flux from very distant sources the antipode will appear to lie an infinite distance away, and beyond direct observation, even though the antipode of any point in the universe lies about 13bnlyr distant.

The antipode thus in a sense plays the anti-role of the Big Bang Singularity in LCDM cosmology. We can never observe either, but instead of an apparently infinitely dense and infinitely hot singularity a finite distance away in universe undergoing an accelerating expansion in space and time, Hypersphere Cosmology posits an Antipode that will appear infinitely distant in space and time and infinitely diffuse and cold, even though actual conditions at the antipode of any point will appear broadly similar on the large scale for any observer anywhere in space and time within the hypersphere.

Both HC and LCDM-BB can both model many of the important cosmological observations but in radically different ways. HC has more economical concepts, as a small positive spacetime curvature alone can account for redshift without expansion, the dimming of distant sources of light without an accelerating expansion driven by dark energy, and it also offers a singularity free universe.

Neither model really explains where the universe 'came from', but we have no reason to regard non-existence as somehow more fundamental than existence.

The evidence for one-way cosmological evolution remains mixed. The entropy of a vast Glome Hypersphere may remain constant as a function of its hypersurface area. On the very large scale the universe needs only the ability to break neutrons to maintain constant entropy. Very distant parts of the universe appear to contain structures far too large to have evolved in the BB timescale.

Hypersphere addenda. Notes and Further Speculations

2) Gödel derived an exact solution of General Relativity in which 'Matter everywhere rotates relative to the compass of inertia with an angular velocity of twice the square root of pi times the gravitational constant times the density'. This solution became largely ignored because of the apparent lack of observational evidence for an axis of rotation. However, in a hypersphere the galaxies can rotate back and forth to their antipode positions about randomly aligned axes (most probably around the circles of a Hopf Fibration of the hypersphere, thus resulting in a universe with no net overall angular momentum. Such a 'Vorticitation' would stabilise a hypersphere against implosion under its own gravity and result in the universe rotating at a mere fraction of an arcsecond per century – well below levels that we can currently observe.

3) Mach's Principle can only work in a universe of constant size and density. Strong evidence exists to show that the gravitational constant and inertial masses have remained constant for billions of years.

***The Cosmic Microwave Background Radiation (CMB/CMBR) may consist of redshifted trans-antipodal light that has reached thermodynamic equilibrium with the thin intergalactic medium, but Hyperspherical Lensing raises another possibility: -

Widely spatially separated observers within the universe may see a quite different CMBR or perhaps none at all, because the CMBR originates from near their antipodes.

Consider that a galaxy like our own lies near to our antipode point. Such a galaxy will have a spherical Hot Gas Halo extending for several hundred thousand light years around it, accounting for about half of its mass, and at a temperature of about I million Kelvin.

The angular size of such a distant galaxy in Euclidean space would come out at a paltry e^{21}/e^{26} radians, about 1/10,000th of a radian.

However, lensing at a redshift of 300,000 would give it an apparent angular size of about 6 radians (it would thus fill the whole sky) and reduce its temperature to around 3 Kelvin.

The lower temperature light from the starry part of the distant galaxy would become redshifted far beyond observability, but all the light from the Hot Gas Halo would end up here, coming in from every direction, providing a microwave background radiation that remains location dependent rather than cosmically uniform.

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