The Cosmos as a Chronosphere.

By

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Abstract.

As shown by Larmor (1927a & b), Gödel (1949) and Kühne (2002), absolute time is indispensable at the cosmic scale, and is required by the General Theory of Relativity. Melia (2007; 2012) and Melia and Shevchuk (2012) have argued that FLRW-type metrics reduce to the Minkowski metric, and the Hubble horizon is a 'gravitational horizon', as defined by Melia (2018), as opposed to either a particle or an event horizon, as these are defined by Rindler (1956). Their argument depends on the mass of the Hubble sphere being variable, whereas, if it is constant, its radius becomes that of a black hole, and its horizon is an event horizon. In every direction we look, total cosmic distance is given by the present age of the Universe multiplied by the speed of light in vacuum. If we abandon the cosmological principle as defined by Milne (1933), we can see we are at the centre of a chronosphere, with the 'Big Bang' singularity at its circumference. Eddington (1939) would doubtless have seen the numerical 'coincidences' that arise in cosmology as proof of God's existence and creation of the Universe.

Keywords: General Theory of Relativity; absolute time; absolute speed (*c*); space; cosmology; cosmological models; cosmological parameters; cosmological principle; chronosphere; 'Big Bang'; numerical cosmological 'coincidences'; design (teleological) argument.

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[1]. Introduction and Literature Review.

In 1927, Joseph Larmor (Larmor, 1927a & b [1], [2]) argued that Newtonian, or absolute, time was essential to astronomy and cosmology, and – moreover – required by the General Theory of Relativity.

This was confirmed by Kurt Gödel in 1949 (Gödel, 1949 [3]), whose metric, presented in that paper, was intended to demonstrate the consequences of doing without an absolute cosmic time coordinate, which included the presence of 'closed timelike curves (CTCs)', and the ability to travel backwards in time – with all its attendant problems for causality, and violation of the Second Law of Thermodynamics.

More recently, Kühne (2002 [4]) has argued that the General Theory of Relativity requires absolute space, as well as absolute time, and it easy to see that this is the case, for – if there is absolute time, and an absolute speed, in the speed of light in vacuum, *c* – all cosmic spatial distances are expressible as the product of *c* and absolute cosmic time, or, conversely, reducible to absolute cosmic time. We may reject his notion that it includes, or consists of, a Universe that is anisotropic and rotates, permitting CTCs and backwards time travel. Kühne seems, strangely, to be unaware that Gödel's entire argument is based on demonstrating the need for an absolute time coordinate, and that CTCs and backwards time travel are the result of *dispensing* with that premise.

Melia (2007 [5]; 2012 [6]) and Melia and Shevchuk (2012 [7]) argue that the various FLRW-type metrics reduce to the Minkowski metric (Minkowski, 1909, 2012 [8]), given a suitable transformation of coordinates, and the assumption that we are in the interior of a space whose external metric is defined by the Schwarzschild metric (Schwarzschild, 1916, 1999 [9]), which would make the Hubble horizon (Hubble, 1929 [10]) an *event* horizon as opposed to a *particle* horizon, as these are defined by Rindler (1956 [11], p.663) if the mass of the Hubble sphere was a constant. Melia (2018 [12]), however, makes clear that, in his view, it is not. He claims, instead, the Hubble horizon is what he terms a 'gravitational horizon' (op.cit.). In other words, we are only inside a black hole, and our Universe is only a black hole (but not the usual sort, see p.6 below) *if* the mass of the Hubble sphere is a constant over time. According to Melia ([12], op.cit.), it is not, but see below. Melia ([5]; [6]) and Melia and Shevchuk ([7]) say it is not *space* that has been expanding, but the matter and energy *in* space. In this, they agree with Milne (1933 [13]).

For reasons we shall make clear shortly, we must dispense with the cosmological (or 'Copernican') principle as defined by Milne (op.cit., pp.3-4), namely, that:

> **'not only the laws of nature, but also the events occurring in nature, the world itself, must appear the same to all observers, wherever they may be, provided their space-frames and time-scales are similarly oriented with respect to the events [under] observation'**

in favour of the one defended by Schwarz (2009 [14], p.7), namely that:

> **'All physical quantities measured by a comoving observer are spatially homogeneous and isotropic.'**

Even this is inadequate, however, as the reference to 'a comoving observer' needs to be removed, and replaced with the phrase 'astronomical observers on Earth or in the Solar System'.

The fundamental question not asked is "*What* other observers elsewhere in the Universe?" It is simply *assumed* these hypothetical observers exist, and what they would, or would not, see is also *assumed*. We have absolutely no evidence that any such extraterrestrial observers exist, and even if they do, they may be too far away to contact for many thousands of years, and long after we humans become extinct ourselves (Westby and Conselice, 2020 [15]).

The fact is, we *are* special – unique, indeed – for we are the only observers in the Universe that we know of, so Ptolemy was right, after all, even though Galileo was correct in his insistence on the Copernican view of the Solar System (see Boas, 1962 [16], pp.309-321).

The view taken here is more consistent with the weak anthropic principle outlined by Carter (in Longair, ed., 1974 [17], pp.292-293), and our location in the cosmos is '*necessarily* privileged to the extent of being compatible with our existence as observers' (ibid., his emphasis). It is not necessary to invoke the strong version (op.cit., p.294).

Davies (1982 [18]), in discussing the number and average mass of the galaxies in the Universe (p.76), tells us that the number, N_g is approximately α^{-5}, where α is the electromagnetic fine-structure constant = $7.2973525693 \times 10^{-3}$, and $N_g = 4.8325 \times 10^{10}$. Davies' estimate of $\sim 10^{10}$ galaxies in the Universe is likely to be a gross underestimate, however, as Harvey and Howell (2022 [19]) point out, because the true value of N_g may be nearer to 200-300 billion, which is more like $2\pi\alpha^{-5}$ = 303.636 billion. The mass of a typical star, Davies informs us (ibid.), is given by:

$$M_* \sim \alpha_G^{-3/2} m_p = 3.685 \times 10^{30} \text{ kg} . \tag{1}$$

Here, α_G is the gravitational fine-structure constant, given by $Gm_p^2/\hbar c = 5.906 \times 10^{-39}$. Davies then gives an approximation for the mass of a typical galaxy (ibid.):

$$M_g \sim \alpha^5 \alpha_G^{-1/2} (m_p/m_e)^{1/2} M_* . \tag{2}$$

Multiplying M_g by N_g gives:

$$\alpha_G^{-2} (m_p/m_e)^{1/2} m_p .$$

This, however, is dimensionally inconsistent, and would only give a very crude approximation to the mass of the Universe in any event. We shall obtain a more accurate figure in the next section.

[2] The Universe as a Black Hole.

If the Universe is, indeed, a black hole, then one would expect it to have a Schwarzschild radius (Schwarzschild, op.cit.), given by:

$$R_S = 2GM/c^2 = c\tau_0 = ct_0 \,, \tag{3}$$

where τ_0 is the present Hubble time and t_0 is the present age of the Universe. G is the Newtonian gravitational constant, and M is the mass of the Universe. Melia ([5]; [6]; [12]) and Melia and Shevchuk ([7]) are able to make R_h (better, R_H), the Hubble radius, equal to $2GM/c^2$ at *any* time, t, because, for them, M is a variable. We are arguing here that, on the contrary, M is a constant, and at earlier times, $R_H < R_S$.

The inverse of the gravitational fine-structure constant, α_G^{-1}, is related to R_S, and thus to τ_0 and t_0, by the equation:

$$(\hbar c/Gm_p^2) = (R_S m_e c^3/2\hbar) \,; \tag{4a}$$

so that:

$$R_S = 2GM/c^2 = 2\hbar/Gm_p^2 m_e c^2 \simeq 13.8 \text{ billion light-years} \,. \tag{4b}$$

The age of the Universe is thus ~13.8 billion years, which is correct. This, then, enables us to obtain an equation for the mass of the Universe:

$$M = M_P^4/m_p^2 m_e = 8.804353 \times 10^{52} \text{ kg} \,. \tag{5}$$

Here, M_P is the Planck mass, given by $(\hbar c/G)^{½} = 2.176434 \times 10^{-8}$ kg (see Wutke, 2023 [20]; NIST[2]). Values for the volume of the Hubble sphere, or rather, of the Universe itself, V, of its surface area, A, of its density, $\rho = M/V$, and rest-energy density, $\rho_E = Mc^2/V$, are all then easily obtained, as is that of the Hubble parameter at the present epoch, $H_0 = \tau_0^{-1} = t_0^{-1}$, see Blaber (2023 [21])[3]. Given Equation (1) above,

[2] See: https://physics.nist.gov/cuu/Constants/.

[3] In this earlier work, the present author conceded the Universe might be anisotropic, having been misled, in this respect, by other advocates of black hole cosmology (see references in that paper). He is now more convinced than ever that this is not the case, but that our Universe is spherically symmetric, homogeneous and isotropic on the broadest scale.

$$\mathrm{M}/M_{*} = \alpha_G^{1/2}(M_P^2/m_p m_e) = 2.3892 \times 10^{22} \,. \tag{6}$$

This is the equivalent of 23.892 sextillion stars, although obviously not all of the mass of the Universe will take the form of stars; some of it will be in the form of their attendant planets – and even of the inhabitants of those planets, such as ourselves.

[3]. The Cosmos as a Chronosphere.

If we view the Universe, then, as an enormous sphere, with ourselves as Earth-bound observers at its centre, and the 'Big Bang' singularity at its circumference (which is what makes *this* black hole different from all others we know of, because it is, in effect, 'inside out')[4] – bearing in mind, of course, that the term 'Big Bang' is completely inaccurate, because it was, in fact, extremely small – then its most accurate metric representation is:

$$ds^2 = c^2(dt_x^2 + dt_y^2 + dt_z^2) \,, \tag{7}$$

where $t_x = t_y = t_z = t_0 = \tau_0$ *in extremis*.

When we look outwards, or upwards, at the night sky, we are not seeing the planets, stars, nebulae and galaxies as they *are*, but as they *were*, when the light they are transmitting or reflecting to us left them, and it is only too easy to forget that.

Perlmutter (2003 [22], p.57) referring to the (alleged) acceleration of the cosmic expansion, speaks of it as something taking place *now*, when the Type 1a supernovae on which he bases his evidence for the acceleration are in galaxies he admits are over a billion light-years away, and from which the light has taken over a billion years to reach us, by definition (op.cit., p.56).

[4] If the Hubble horizon is the event horizon of the chronosphere, that is its *inner* surface; its *outer* surface is the 'Big Bang' singularity, which would be invisible to us even if it were not for the opacity prior to the 'Recombination Era', see below. It is **not** a 'white hole', see: https://en.wikipedia.org/wiki/White_hole.

Consequently, any such acceleration, if it *took* place, did so in the past, and we cannot say it *is* taking place *now*. All our telescopes, of whatever kind, be they optical, infra-red, ultra-violet, or whatever, are chronoscopes, and what they see is in the past. The further away an object is in space, the further back it is in time. This should hardly need saying, but when a co-winner of the 2011 Nobel Prize for Physics[5] can make such an elementary error, one does wonder.

It would be simpler, in fact, to eliminate the concept of space altogether, and replace equation (7) with the following:

$$d\tau^2 = dt_x^2 + dt_y^2 + dt_z^2 \ . \tag{8}$$

If we use spherical coordinates, bearing in mind that we are measuring cosmic (and therefore absolute) *time*, rather than *space*, this becomes much clearer:

$$d\tau^2 = dt_r^2 + dt_r^2 d\theta^2 + t_r^2 \sin^2 d\varphi^2 \ . \tag{9}$$

Clearly, to be of use as a coordinate system, $t_r \leq t_0$. The 'angles' θ and φ are, in this case, of course, pseudo-angles, but that is unimportant. What *is* important is that the chronosphere is an accurate means of conceptualising the 'inside out' black hole cosmology we are actually living in, if its advocates are correct (see Blaber, op.cit., for references).

[4]. Conclusion.

Melia (2022 [23]) supports the case the present author has been making here that the General Theory of Relativity requires the concept of an absolute cosmic reference frame, and thus of absolute space and time. Melia notes (p.2, pdf.) that:

> **'the present interpretation of an accelerating Universe as due to the influence of dark energy may be misdirected. Instead, a relativity theory with a preferred frame may "correct" the**

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[5] See: https://www.nobelprize.org/prizes/physics/2011/perlmutter/facts/.

> **redshift-distance relation in such a way that it modifies the deceleration parameter, possibly explaining why we infer an acceleration when in fact there is none.'**

He reiterates that space itself is *not* expanding (p.4, pdf.). Melia is still making the unwarranted assumption of the existence of other observers elsewhere in the Universe, however – of observers which *may* exist, but we do not *know* to exist.

We do not even know for a fact if the laws of physics apply as they do on Earth and in the Solar System everywhere in the Universe – *that* is an assumption. All we can say is that they do as far as we know, and we know of no cases where they do not (see Carroll, 2020 [24] on the issue of natural laws).

If, rather than Eddington's number, N_{Edd} (see Eddington, 1939 [25]), the number of protons or electrons in the Universe, we speak of N_{Part}, the total number of *particles* in it, given by:

$$N_{\mathrm{Part}} = (\pi)^{-1}(\alpha\alpha_{\mathrm{G}})^{-2} = 1.71369 \times 10^{80} \,, \tag{10}$$

we find that $\mathrm{M}/N_{\mathrm{Part}} = 5.13766 \times 10^{-28}$ kg per particle, whereas the average of the masses of the proton and electron is $8.3676643 \times 10^{-28}$ kg, the mass of the proton, $m_p = 1.67262192369 \times 10^{-27}$ kg and that of the neutron, $m_n = 1.67492749804 \times 10^{-27}$ kg (NIST values).

Given a value for V, the volume of the Universe (the Hubble sphere, or 'inside out' black hole), of 9.3662×10^{78} m^3, $N_{\mathrm{Part}}/\mathrm{V}$ = 18.2965 particles per cubic metre. Its current mass density is $\rho = 9.4 \times 10^{-27}$ kg m^{-3}, but at the time of the 'Big Bang', it was infinite.

There is no known physical process whereby a space-time singularity can be turned into the Universe we have now, because space-time singularities are not actually *in* space-time, as Senovilla (2022 [26]) points out. This is conceptually arguable: a Euclidean point, which has no size or dimension, occupies Euclidean space, which is composed of an infinite number of them. The same cannot be said of space-time singularities, however, because they differ from Euclidean points in having mass and infinite mass- and energy-density, and thus an infinitely powerful gravitational field.

Most cosmogonies do not even try to account for this mystery; they begin at the Planck time (5.391247×10^{-44} s, NIST value) *after* the 'Big Bang', when the Hubble radius would have been given by the Planck length (1.616255×10^{-35} m, NIST value), the Hubble volume, V, would have been equal to $1.105346 \times 10^{-105}$ m^3, and the mass density, 7.965246×10^{157} kg m^{-3}. See, e.g., Penrose (2018 [27]) who questions the existence of the initial singularity altogether, substituting a picture of an eternally expanding, contracting and re-expanding – or 'bouncing' – Universe. However, time, which Shakespeare's Harry Hotspur tells us '"Must have a stop"' (Henry IV, Part 1, Act V, Sc.IV, l.83) must have a definite *beginning*, as well (see: Erasmus and Luna, 2020 [28]).

If N_g, the number of galaxies, is given by $2\pi\alpha^{-5}$, N_{Part}/N_g is given by:

$$\tfrac{1}{2}\alpha^3(\pi\alpha_G)^{-2} = 5.6439 \times 10^{68} \text{ particles per galaxy} . \tag{11}$$

The Universe, as we have already seen, contains enough mass to constitute 23.892 sextillion stars in 303.636 billion galaxies, with an average of 78.686 billion stars per galaxy[6], but not all of that matter and energy, in fact, consists of stars, or the photons, neutrinos and antineutrinos they are emitting (Wolschin in Castell and Ischebeck, eds., 2003 [29]). There is also interstellar dust and gas, asteroids and (as we have said) planets, and, here at least, life (Bergin *et al*, 2015 [30]).

The mean temperature, T, of the Universe at any given time is given by:

$$T = \hbar \mathrm{H}/k , \tag{12a}$$

where H is the Hubble parameter at any time and k is Boltzmann's constant. However, at the present opoch, it is given by:

[6] Our own contains 100 billion stars, see: https://imagine.gsfc.nasa.gov/science/objects/milkyway1.html.

$$T = \hbar H_0/k = \hbar c^3/2GMk = 1.75114384 \times 10^{-29}\ K\ . \tag{12b}$$

The temperature of the cosmic microwave background radiation (CMBR)[7] has been measured at 2.726 K. The CMBR dates from the 'recombination era' (see below), though, so there has been plenty of time for the Universe as a whole to cool down further since.

There is no dark matter, and no 'dark energy'; these are myths, and will go the way of phlogiston (see White, 1932 [31]). The lack of astronomical and laboratory evidence for dark matter, and the existence of more plausible explanations for the phenomena dark matter seeks to explain, are sufficient to refute it (Merritt, 2021 [32]).

Melia ([5]; [6]; [12]; [23]) and Melia and Shevchuk ([7]) have done enough to convince the present author, at any rate, that there is no such thing as 'dark energy', and no acceleration of the cosmic expansion, which has now – we can legitimately say 'now', given its age – reached its limit (it is thus 'closed'). He was already convinced there was an absolute cosmic space-time and that we were living inside an enormous black hole, whose radius is 13.8 billion light-years, and whose age is 13.8 billion years.

It should be pointed out (although it should be clear enough) that the black hole cosmology presented here bears no relation to that put forward by Gaztanaga (2022 [33]): he has got it the wrong-way round. The 'Big Bang' is not *inside* the black hole, but *outside* it, forming its exterior surface. How does a space-time singularity form a 'surface' of any kind? The present author does not pretend to know; he just believes that it does.

There is an obvious paradox entailed, but is it any worse than that entailed by the idea of a point of infinite density and pressure giving rise to the Universe we now live in? By itself, it could not do so, but if we permit ourselves, as Laplace did not (see Stent, 1998 [34], p.583), the hypothesis of God, then an explanation is forthcoming.

It is this 'inside out' black hole, at which we occupy the central position as observers, looking out towards the 'Big Bang' singularity

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7 See: https://www.esa.int/Science_Exploration/Space_Science/Planck/Planck_and_the_cosmic_microwave_background.

at its furthest possible extremity (we cannot, in fact see that, because it is hidden behind the veil of the so-called ‘recombination era’, i.e., before protons and electrons first became bound to form neutral hydrogen atoms, some 378,000 years after the ‘Big Bang’ (the Universe was too hot before then – see Peebles, 1968 [35]), which we represent here as a ‘chronosphere’, arguing that Claudius Ptolemaeus of Alexandria (*c.*100-*c.*170 CE) would have recognised this world-view as not unrelated to his own.

Eddington (op.cit.) would doubtless have found the numerous numerical ‘coincidences’ compelling evidence for the design (or ‘teleological’) argument for God (Kandler, 2009 [36]). The present author has already offered his own modal ontological argument for God, albeit a version of him lacking omnibenevolence (Blaber, 2023 [37]), which accounts for the existence of natural and moral evil in our world.

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