A view on the universe without concoctions

Een blik op het heelal zonder verzinsels

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Proper Dutch pronunciation of my name

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Being a violin playing physicist myself, I can only have great respect for Albert Einstein.

If I were not a physicist, I would probably be a musician.
I often think in music. I live my daydreams in music.
I see my life in terms of music.

There is geometry in the humming of the strings,
there is music in the spacing of the spheres.

Πυθαγορας

The Πυθαγορας scale

Summary of my conclusions

1. Together with the *speed limit of light* the Hubble–Lemaître law implies the universe is finite, and the *homogeneity* and *isotropy* according to the Cosmological Principle imply it is unlimited. Especially the isotropy indicates spherical symmetry. Altogether, this leaves no other possible shape of the universe than a 3-sphere.
2. The SDF galaxy *count per magnitude* confirms this 3-spherical shape.
3. The quasar redshifts from the Sloan Digital Sky Survey reveal that the universe indeed is a 3-sphere according to the quasar *density* vs. the *time* since the big bang.

   Ex obſervatis phænomenis immediate deductum eſt.

   It has directly been deduced from observed phenomena.
4. As derived from the SDSS quasar database the extension of the universe is perfectly linear.
5. The type Ia supernovae data do not contradict the universe being a linearly expanding 3-sphere.
6. In a 3-spherical universe its centre of *mass* cannot reside within this very same universe.
7. I agree with Einstein that the *speed of light* can never ever be exceeded in any way, whatever the cause of an entity's *velocity*. Ex obſervatis phænomenis deductum eſt. *It has been deduced from observed phenomena.* However, conventional cosmology supports the non fact based delusion of *superluminality*.
8. Both the horizon problem and corresponding unobservable part of the universe or stars whose light did not yet have *time* to reach us, and the assumed *current proper size* of the universe far beyond the *Hubble distance*, presume *superluminality*, which contradicts fact-based arguments. Not even expansion of the metrics themselves can exceed the *speed of light*, since any *distance* change over *time* is a true *velocity*. The universe is not larger than the *Hubble distance*.
9. Conventional interpretation of the Hubble–Lemaître law contains an inconsistency that can be removed by applying correct mathematics, which implies the *lookback time* and *light travel distance* of distant objects cannot ever exceed **half** the *Hubble time* or *distance* as measured in our own local frame. The conventional (linear) Hubble–Lemaître law yields the *current proper distance* which is always less than the *Hubble distance*.
10. Cosmological or expansional *redshift* is a fiction that cannot exist.
11. The universe is not expanding but being extended symmetrically in all its four Minkowski dimensions, so the progress of *time*, i.e. the growth of the past, is this extension.
12. The CMB *redshift* approximates 10^9, which fully explains the complete absence of the hydrogen spectrum in the CMB.

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Introduction

Being a graduated physicist (Eindhoven University of Technology, 1984), I often wonder the fantasy and creativeness of people regarding theories about the universe that are obviously not based on observed phenomena. Sir Isaac Newton wrote in his Principia[1]:

> Rationem vero harum gravitatis proprietatum ex phænomenis nondum potui deducere, & hypotheſes non fingo. Quicquid enim ex phænomenis non deducitur, *hypotheſis* vocanda eſt; & hypotheſes seu metaphyſicæ, ſeu phyſicæ, ſeu qualitatum occultarum, ſeu mechanicæ, in *philoſophia experimentali* locum non habent.
>
> *But I have not yet been able to deduce the cause of these properties of gravitation from phenomena, & I do not feign hypotheses. For whatever has not been deduced from phenomena is called a hypothesis; & hypotheses, whether metaphysical or physical, whether of occult qualities or mechanical, have no place in experimental philosophy.*

In this text, *philosophy* should be interpreted as *science*. *Experimental* means: based on observed phenomena. To me it is clear that in this context the word *hypothesis* stands for *concoction*, *fabrication, brainchild* (Dutch: verzinsel, hersenspinsel), so I think the sentence: hypotheses non fingo (*I do not feign hypothesis*) should be read as: *I contrive no concoctions*. Newton did make hypotheses, based on observations that were insufficient to apply induction which would yield a law of nature. He didn't call gravitation a *law*. To me, the above citation simply says: *in science, there is no place for concoctions*.

I am convinced even conventional cosmology is making essential mistakes. For example, very distant objects cannot have reached that *distance* in the *time* available since the big bang without having exceeded the *speed of light*. But their *redshift* yields a subluminal *velocity*. Conventional cosmology seems to take this for granted and then starts philosophising about superluminality yielding a horizon problem and an unobservable part of the universe, as well as objects whose light did not yet have *time* to reach us. But as yet, there exists no observational evidence of anything unobservable... And in physics any theory of something unobservable is meaningless.

My intention is the very same as Newton's: deduce from observed phenomena without fantasising any excogitations, and to use proper logic and math. Evidently I rely on common sense too, and I do make some well-founded assumptions.

Truth is ever to be found in simplicity, and not in the multiplicity and confusion of things.
Sir Isaac Newton, *Rules for methodizing the Apocalypse*, Rule 9.

We are to admit no more causes of natural things than such
as are both true and sufficient to explain their appearances.
Sir Isaac Newton, *Philosophiæ Naturalis Principia Mathematica,*
Liber Tertius, Regulæ Philosphandi, Regula I.

All physical theories, their mathematical expressions apart, ought to lend
themselves to so simple a description that even a child could understand them.
Albert Einstein to Louis de Broglie at Gare du Nord, Paris, 1927.[2]

Wat niet kan is nog nooit gebeurd (the impossible has not yet ever happened).
Antje Reints-Kliphuis, my late mother.

Everyone said it was impossible, but somebody didn't know that, and he did it...

[1] Isaac Newton, Scholium Generale, Philosophiæ Naturalis Principia Mathematica, ed.2 (1714) p.484, ed.3 (1726) p.530
[2] Louis de Broglie, New Perspectives in Physics, p.184 (1962), "he told me that (...)", Basic Books, http://books.google.com/books?id=xY45AAAAMAAJ&q=%22mathematical+expression+apart%22#search_anchor

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The *speed of light*

Einstein's postulates[3] are based on observed phenomena (the fact of experience that you do everything the same way at any *velocity*, and the Michelson[4]-Morley experiment[5]). When taken together, they state that the *speed of light* is a *universal constant of nature* that has identically the very same value for all observers, independent of their mutual *velocity*. In footnote 2 of his next publication[6], he says the principle of the constancy of the *speed of light* is of course contained in Maxwell's equations[7], which yield:

$$c = \frac{1}{\sqrt{\varepsilon_0 \mu_0}} \quad [1]$$

where c equals the *speed of light* and ε_0 and μ_0 are the *electric* and *magnetic field constants*, respectively. Since both ε_0 and μ_0 are properties of empty space, [1] states that the *speed of light* also is a property of empty space and not a property of light itself. In more or less the same way the *speed of sound* is not a property of the sound itself but of the medium in which it propagates (for example in air or water of 20°C = 68°F it is 343 or 1484 m/s, respectively).

What is empty space? It is a collection of nothing at all and not even that. Since empty space contains nothing in which any difference can become apparent, it manifests identically to every observer. It has no reference points at all, making it completely meaningless to consider *distance* in truly empty space. Then the same applies to *velocity*, which is *distance* over *time*, so it is senseless to consider a *velocity* of empty space itself with respect to any observer. This implies empty space is identical to all observers independent of their mutual *velocity*. This identicalness of course applies to all properties of empty space, including the *speed of light* which then is identical to all observers independent of their mutual *velocity*. Q.E.D.

The *speed limit of light*

The fact that the *speed of light* is identical to all observers independant of their mutual *velocity* suffices to conclude that it cannot be exceeded by anything. Simple math (basically the Pythagorean theorem) yields the *Lorentz factor*, which applies to *time dilation* and *Lorentz contraction*:

$$\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} \quad [2]$$

With: $$\beta \equiv \frac{v}{c} \quad [3]$$

the *Lorentz factor* becomes: $$\gamma = \frac{1}{\sqrt{1-\beta^2}} \quad [4]$$

Since the square root has no real solution for negative numbers and division by zero is impossible, it immediately follows that: $$\beta < 1 \therefore v < c \quad [5]$$

The inverse *Lorentz factor* function is: $$\beta = \sqrt{1-\frac{1}{\gamma^2}} \quad [6]$$

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[3] Albert Einstein, Zur Elektrodynamik bewegter Körper, Annalen der Physik 17, 891-921 (1905).
[4] Albert A. Michelson, The relative motion of the Earth and the Luminiferous ether, American Journal of Science 22, 120-129 (1881).
[5] Albert A. Michelson & Edward W. Morley, On the Relative Motion of the Earth and the Luminiferous Ether, American Journal of Science 34, 333-345 (1887).
[6] Albert Einstein, Ist die Trägheit eines Körpers von seinem Energieinhalt abhängig?, Annalen der Physik 18, 639-641 (1905).
[7] James Clerk Maxwell, A Dynamical Theory of the Electromagnetic Field, Philosophical Transactions of the Royal Society of London 155, 459–512 (1865).

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In Einstein's addition theorem of *velocities*[3]:

$$u = \frac{v+w}{1+\frac{v}{c}\cdot\frac{w}{c}} \text{ or } \beta_0 = \frac{\beta_1+\beta_2}{1+\beta_1\beta_2} \quad [7]$$

we can immediately see that the result is always subluminal if both v and w are subluminal (and even two superluminal *velocities* would yield a subluminal result), and that addition of anything to the *speed of light* (except $minus\ c$ which yields $\frac{0}{0}$) results in the very same *speed of light*. Einstein derived[3] formula [7] based on a point moving at *velocity* w in a frame named k which itselfs moves at *velocity* v in frame K. A moving point in a moving frame. Not an object in the universe. So [5] also applies to space itself, whatever that might mean, since empty space hasn't got any *velocity* at all (not even zero).

This means: THE *SPEED OF LIGHT* CANNOT EVER BE EXCEEDED BY WHATEVER. [8]
Stated otherwise: SUPERLUMINALITY IS A DELUSION. [9]
Stated otherwise: THERE EXISTS NO HORIZON PROBLEM. [10]

Light travel *distance* and *time*

Einstein formulated his second postulate as (he used V for the *speed of light*):

> Jeder Lichtstrahl bewegt sich im "ruhenden" Koordinatensystem mit der bestimmten Geschwindigkeit V, unabhängig davon, ob dieser Lichtstrahl von einem ruhenden oder bewegten Körper emittiert ist.
>
> *Every ray of light moves in the "stationary" system of co-ordinates with the determined velocity V, independent of whether the ray was emitted by a stationary or by a moving body.*

In fact it says the *speed of light* is only meaningful with respect to the observer, and that at any moment during *light travel time*, the "still to go" *distance* cannot decrease otherwise than at the *speed of light*. Even expansion of the universe cannot change that, since according to [7] any addition to the *speed of light* yields the very same *speed of light*. Of course the *light travel distance* equals the *proper distance* from the light source to the observer as it was at the moment of emission of the light, which I'll call the *emission distance* or *original proper distance*:

$$D_L = D_e \quad [11]$$

where D_L is the *light travel distance* and D_e is this *emission distance* or *original proper distance* of the light source. The *light travel time* (or *lookback time*) then equals this *distance* divided by the *speed of light*, so:

$$t_L = \frac{D_L}{c} = \frac{D_e}{c} \quad [12]$$

where t_L is the *light travel time* and c the *speed of light*.

As a matter of fact, a photon already belongs to the ultimate observer as soon as it has been emitted and from then on it has nothing more to do with the light source whatsoever. This follows from Einstein's second postulate. And this postulate is not really a postulate since it can be derived from Maxwell's equations according to Einstein himself[6], as already mentioned. And during *light travel time* there effectively cannot exist any expansion of the universe between a photon and its ultimate observer. And if it can't, it doesn't.

Observable universe

https://en.wikipedia.org/wiki/Chronology_of_the_universe (as of 2018-08-01) states the following for the recombination, which would have lasted from ca. 380 ka until 480 ka:

> Electrons and atomic nuclei first become bound to form neutral atoms. Photons are no longer in thermal equilibrium with matter and the Universe first becomes transparent. Recombination lasts for about 100 ka, during which Universe is becoming more and more transparent to photons. The photons of the cosmic

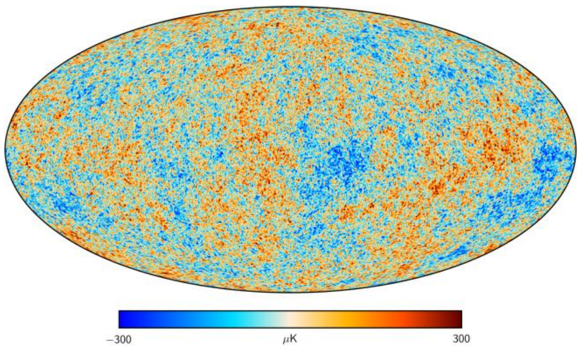
> microwave background radiation originate at this time. The spherical volume of space which will become the observable universe is 42 million light-years in radius at this time. The baryonic matter density at this time is about 500 million hydrogen and helium atoms per m3, approximately a billion times higher than today. This density corresponds to pressure on the order of 10−17 atm.

Please note the sentence: *The spherical volume of space which will become the observable universe is 42 million light-years in radius at this time*. That simply means a light source that was outside that sphere is currently still unobservable, doesn't it? Of course it does not matter how far it was outside that sphere, does it? Let's say 1 million light years. And we are at the exact centre of the part of the universe observable to us, aren't we? So the *light travel distance = emission distance = original proper distance* from this light source that was 1 million light years outside this sphere at the moment of emission was 43 million light years, wasn't it? Then the *light travel time* is 43 million years, isn't it? And the light was emitted at $t = 380$ ka, which is negligible with respect to the say 14 Ga since the big bang. And 14 billion years is of course far too short a time for a 43 million year journey... Who came up with that type of logic? There was plenty of time.

Only light from sources at an *original proper distance* greater than the current *Hubble distance* would not yet have had *time* to reach us. But they would have been at that *distance* at the moment of emission of the light, when the universe was far smaller than it is right now. They must then already have been there just after the recombination, for which a *velocity* of at least 14 Gly/480 ka = nearly 30 000 times the *speed of light* would have been necessary. Combining this with [8] and [9], which directly follow from Einstein's postulates which themselves are based on observed phenomena, I conclude:

THERE EXIST NO LIGHT SOURCES WHOSE LIGHT DID NOT HAVE *TIME* TO REACH US. [13]

Another way to come to this very same conclusion is: the light source must have been farther away than the source of the Cosmic Microwave Background radiation, which did have *time* to reach us. After all, we photographed it[8], see the image to the right.



And doesn't the CMB originate from the very beginning (well, ok, from the recombination)? Shouldn't its source reside at the "edge" of the universe? Would there be light sources farther away than the CMB source?

Conclusion: THERE EXISTS NO UNOBSERVABLE PART OF THE UNIVERSE. [14]

Stated otherwise: WHAT WE OBSERVE IS ALL THERE IS. [15]

An unobservable part of the universe would require objects to have exceeded the speed of light.

> I challenge anyone to provide an indisputable mathematical proof of the possibility of superluminality without getting into conflict with any single observed phenomenon and without any fabrication.

Thanks to Maxwell and Einstein, I already found the proof that it is not possible:

$$c = \frac{1}{\sqrt{\varepsilon_0 \mu_0}} \quad \therefore \quad v < c \quad \text{Q.E.D.} \qquad [16]$$

Galileo Galilei wrote[9]: due verità non posson mai contrariarsi, *two truths cannot ever contradict one another*. So either your "proof" or [16] will be wrong. But [16] is an application of Maxwell's equations,

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[8] image source: Max-Planck-Institut für Astrophysik, http://www.mpa-garching.mpg.de/

[9] Galileo Galilei, letter to Benedetto Castelli in Pisa, 21st December 1613.

which are fully based on observed phenomena, i.e. experiments with electricity and magnetism by Michael Faraday and many others. You doubt Maxwell's equations? Anything that uses electricity and/or magnetism works, doesn't it?

Local frame

An often used argument for *superluminality* is that in general relativity, you must use a local frame. But a local frame is only local because you are near its origin and the directions of the axes are determined by nearby objects or even your own body parts. Your arm length is a usable *length* unit and your heart rate gives you some measure of *time*. That is a local frame. But it is infinitely large and it spans the entire universe. And also in a local frame, *superluminality* is in contradiction with the observed phenomena that lead to Maxwell's equations.

Large scale gravitation

Let's consider an extragalactic object at the *distance* of the Andromeda Nebula (M31), which starts a free fall towards our Milky Way by the gravitation of only that, at an initial *velocity* towards us equalling zero. Any relativistic effects would be small, so I use Newtonian gravitation. The free fall then starts at a *distance*[10]: $D_A = 2.54 \times 10^6$ light years [17]

Newton's law of gravitation (which he never called a *law* himself) is:

$$F_G = G\frac{mM}{r^2} \quad [18]$$

where m is the object's *mass* and M that of our Milky Way. Assuming $m \ll M$, we derive Kepler's third law as follows. If the object were orbiting the Milky Way at a distance r, the *centripetal force* would be:

$$F_c = m \cdot \omega^2 r \quad [19]$$

Putting [18] equal to [19] yields: $\omega^2 a^3 \equiv \omega^2 r^3 = GM$ [20]

which is Kepler's third law. According to his first law, the orbits are ellipses and instead of r, we must then use a, the semi-major axis. The free fall trajectory (which is a straight line segment) can be seen as a degenerated ellipse, so: $a = \frac{D_A}{2}$ [21]

The *angular velocity*, ω, equals: $\omega = \frac{2\pi}{t_o}$ [22]

with t_o being the *orbit time*. Insertion of [21] and [22] into [20] yields:

$$\left(\frac{2\pi}{t_o}\right)^2 \left(\frac{D_A}{2}\right)^3 = GM \quad [23]$$

yielding: $t_o^2 = \frac{4\pi^2 D_A^3}{8GM} = \frac{\pi^2 D_A^3}{2GM} \therefore t_o = \sqrt{\frac{\pi^2 D_A^3}{2GM}} = \pi \cdot \sqrt{\frac{D_A^3}{2GM}}$ [24]

Of course the *free fall time* equals half the *orbit time* of this degenerated elliptic trajectory, and by bringing this factor of $\frac{1}{2}$ as $\left(\frac{1}{2}\right)^2 = \frac{1}{4}$ inside the square root, we obtain:

$$t_{ff} = \pi \cdot \sqrt{\frac{D_A^3}{8GM}} \quad [25]$$

The Milky Way's *mass*[11] is: $M = 1^{+0.5}_{-0.2} \times 10^{12} \odot \approx 2 \times 10^{42}$ kg [26]

The result is that a free fall towards the Milky Way from a *distance* equal to that of the Andromeda Nebula, with $v_0 = 0$, takes: $t_{ff} = 11.35$ Ga, so more than 11 billion years [27]

which is close to 0.8 times the estimated age of the universe. [28]

[10] https://en.wikipedia.org/wiki/Andromeda_Galaxy
[11] https://en.wikipedia.org/wiki/Milky_Way

Please note that, on a cosmic scale, the *distance* to the Andromeda Nebula is very very very small. It is the nearest spiral galaxy at less than 0.2‰ (nought point two promille) of the so called *Hubble distance* (see below), so, based on this calculation, the overall gravitational attraction on a cosmic scale and on the *time* scale of the current *age* of the universe, can be considered negligible. It did not significantly affect:

The Hubble–Lemaître law

As predicted by Georges Lemaître[12] and discovered by Edwin Hubble[13], nearly all galaxies move away from us with a *velocity* proportional to their *distance*:

$$v_H = H_0 \cdot D \qquad [29]$$

where H_0 is the *Hubble constant*, v_H the *velocity* in the Hubble flow (which I will call *Hubble velocity*), and D is the *distance* to the object.

This law implies that all objects in te universe once must have been all together at the same location, as a very dense thing containing all matter in the universe. In accordance with the Dutch word for the universe: *heelal* ("whole all"), I call this inital blob of primitive matter (Dutch: klodder oermaterie) the *IniAll*. And since there exists no observational evidence whatsoever, I do not look further back in *time* than this *IniAll* and I do not ask the question of how it came into being. In other words: I do not look back towards the singularity[14] that would have been the true start of the universe. I don't even know if the universe indeed "came into being". As cited in the introduction, Isaac Newton wrote: hypotheses non fingo, *I feign no hypotheses, I contrive no concoctions.* Neither do I. No assumptions unless supported by observed phenomena. In Dutch: ik zuig niks uit mijn duim, ik pluk niks uit de lucht.

The *time* passed since the *IniAll* is called the *Hubble time*, which equals the reciprocal of the *Hubble constant*:

$$t_H = 1/H_0 \qquad [30]$$

which is to be considered the age of the universe. This *time* multiplied by the *speed of light* yields the *Hubble distance*:

$$D_H = c \cdot t_H \qquad [31]$$

Since no object can ever have travelled faster than light, the *Hubble distance* yields the size of the universe.

THE HUBBLE–LEMAÎTRE LAW IMPLIES THE UNIVERSE IS FINITE. [32]

Note: Olbers' paradox[15] (if the universe were infinitely and homogeneously filled with light sources, it could not be dark at night) also implies the universe is finite, which was already recognised by Johannes Kepler in 1610 (in a letter to Galileo Galilei[16]).

From the above we can easily see:

$$\beta_H \equiv \frac{v_H}{c} = \frac{D}{D_H} \equiv \rho_H \qquad [33]$$

which is the dimensionless form of the Hubble–Lemaître law. Note: right here, ρ is used for dimensionless *distance*, but further below also for *density*. The context should then clarify what is meant.

On https://en.wikipedia.org/wiki/Hubble%27s_law various values of the *Hubble constant* are given, even recent measurements with non-overlapping tolerances... I choose a value of:

$$H_0 = 69.84 \text{ km/s/Mpc} \qquad [34]$$

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[12] G. Lemaître, Discussion sur l'évolution de l'univers, 1927

[13] Edwin P. Hubble, "A relation between distance and radial velocity among extra-galactic nebulae", *Proc. Natl. Acad. Sci. USA* 15, 168–173 (1929).

[14] S.W. Hawking & R.Penrose, The singularities of gravitational collapse and cosmology, Proceedings of the Royal Society, (1970-01-27), DOI: 10.1098/rspa.1970.0021

[15] https://en.wikipedia.org/wiki/Olbers%27_paradox

[16] https://www.huffingtonpost.com/mario-livio/who-first-wondered-why-is_b_3676160.html

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which yields a *Hubble time* of almost exactly:

$$t_H = 14.00 \text{ Ga} \quad [35]$$

This is just a choice within the rather wide range of plausible values, made for the ease of calculations.

A big mistake

Consider an object at say 10 Gly from here. Then, according to [33], its *velocity* equals: $v = \frac{10}{14}c$. Its light needed 10 Ga to reach us, so it was emitted when the object was $14 - 10 = 4$ Ga old. But how did the object arrive at a *distance* of 10 Gly during a *time* of 4 Ga at a *velocity* of $v = \frac{10}{14}c$? Newton's law of inertia, together with the neglection of gravitational slowdown according to [28], tells this velocity must have been practically constant all *time*. Any contradictory statement must alway be rejected because of the principle of explosion, but common cosmology seems to take this inconsistency for granted, which I consider a big mistake. [36]

Ex falso sequitur quod libet = *from falsehood follows anything you like*.

I think this mistake is the root cause of the (to my opinion wrong) idea of the unobservable part of the universe and the horizon problem, which ultimately lead to the *inflationary universe* theory by Alan Guth[17]. This is an "*if <brainchild> then it would ...*" theory in which he feigned a hypothesis, a fiction, to tackle the non-realistic horizon problem that arises from [36] and the also not existing flatness of the universe (see page 35 and further). It assumes *velocities* very heavily tresspassing the *speed limit of light* by stating that it was the metric itself that expanded and then it would not have to obey the *speed limit of light*. But Einstein never ever mentions any cause of a *velocity*, and any *distance change over time* is a *velocity*, whatever caused it, be it the metric itself or whatever. Based on observed phenomena, the only plausible statement is that not any *velocity* can exceed the *speed of light*.

Corrected form of the Hubble–Lemaître law

Let's do some straight forward proper math. I define the *time* since the big bang ("BB")

as:	t_{bb}	[37]
Assume a light source at an *emission distance*:	D_e	[38]
The *light travel time* from that *distance* is:	$t_L = \frac{D_e}{c}$	[39]
Net *object travel time* since BB to that place is:	t_{obj}	[40]
The light is observed right now, so it must be that:	$t_{obj} + t_L = t_{bb}$	[41]
so:	$t_{obj} = t_{bb} - t_L = t_{bb} - \frac{D_e}{c}$	[42]
which yields an *object velocity* of:	$v_H = \frac{D_e}{t_{obj}} = \frac{D_e}{t_{bb} - \frac{D_e}{c}} = \frac{c \cdot D_e}{ct_{bb} - D_e}$	[43]
or, with [33]:	$\beta_H = \frac{D_e}{ct_{bb} - D_e}$	[44]
This has a Taylor series expansion of:	$\beta_H = \frac{D_e}{ct_{bb}} + \left(\frac{D_e}{ct_{bb}}\right)^2 + \left(\frac{D_e}{ct_{bb}}\right)^3 + \cdots$	[45]
Comparison with [33] yields that in first order:	$\frac{D_e}{ct_{bb}} = \rho_e$	[46]
so:	$ct_{bb} = D_H$	[47]
and:	$t_{bb} = t_H$	[48]
This means [44] becomes:	$\beta_H = \frac{D_e}{D_H - D_e} = \frac{\rho_e}{1 - \rho_e}$	[49]

[17] Alan H. Guth, Inflationary universe: A possible solution to the horizon and flatness problems, Phys.Rev.D 23, 347, published 1981-01-15

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or: $\rho_e = \frac{\beta_H}{1+\beta_H}$ [50]

According to [11], this (dimensionless) *emission distance* equals the *light travel distance*, so:

$\rho_L = \rho_e$ [51]

and using dimensionless *time*: $\tau = \frac{t}{t_H}$ [52]

we can easily see that: $\tau_L = \rho_L = \frac{\beta_H}{1+\beta_H}$ [53]

It is of course obvious that the dimensionless *light travel time* equals the dimensionless *light travel distance*, since $c = 1$ in dimensionless quantities. During this *light travel time*, the object has kept moving in the Hubble flow, which implies that

its *current proper distance* equals: $\rho_P = \beta_H$ [54]

The *speed limit of light* says: $\beta < 1$ [55]

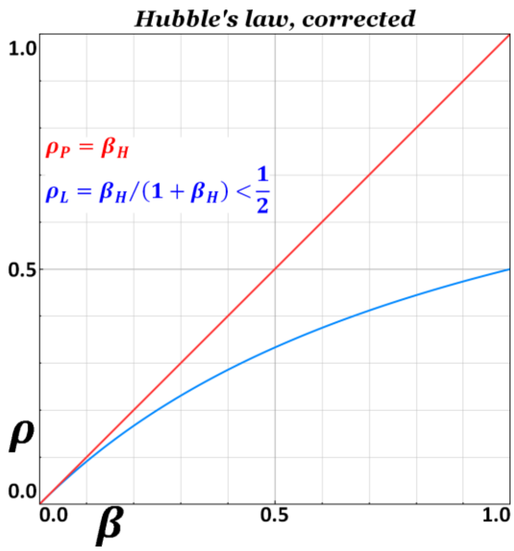
which implies: $\tau_L < \frac{1}{2}$ [56]

as well as: $\rho_L < \frac{1}{2}$ [57]

Altogether, the corrected form of the Hubble–Lemaître law is:

- *Light travel time*: $\tau_L = \frac{\beta_H}{1+\beta_H} < \frac{1}{2}$ [58]
- *Light travel distance*: $\rho_L = \frac{\beta_H}{1+\beta_H} < \frac{1}{2}$ [59]
- *Current proper distance*: $\rho_P = \beta_H$ [60]

The value of β_H can for each object be derived from its *redshift*, see further below. Both [58] and [59] apply to a currently observed photon and [60] applies to the light source from which it originates.



Conclusions:

1. both the *lookback time* and the *lookback distance* of any object are at most half the *Hubble time* or *distance* and at the moment of emission of the currently observed light their *age* since the big bang, as measured in our local frame, was at least half the *Hubble time*; [61]
2. what is called *light-travel distance* by conventional cosmology is in fact the *current proper distance*, which equals the *light-travel distance* for a now emitted photon, not a now observed one; [62]
3. no two objects in the universe can have a mutual *distance* greater than the *Hubble distance*; [63]
4. **conventional cosmology is making a BIG mistake!** [64]

Don't agree? Then please tell me were I made my own mistake. I draw my conclusions from observed phenomena without feigning hypotheses such as the mathematically impossible *superluminality* or taking inconsistencies like [36] for granted. And I am doing proper math. The Dutch word for mathematics is wiskunde, a term invented by Simon Stevin (1548-1620). The first syllable: wis, means: sure, certain, and kunde means: skill, knowledge.

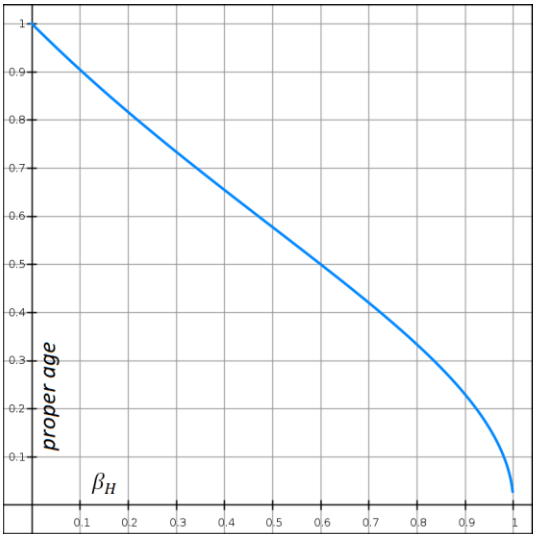
This *maximum lookback time* of half the *Hubble time* (which applies to distant objects) does of course not restrict the *age* of those objects, they can evidently already have existed for a long *time* before emission of the light we now observe. But the light that was emitted earlier than half the *Hubble time* ago already passed us, we've missed it, and we will never ever get another opportunity to observe that light.

For the moment of emission of a photon, we obtain:

Moment of emission: $$\tau_e = 1 - \tau_L = 1 - \frac{\beta_H}{1+\beta_H} = \frac{1}{1+\beta_H} \qquad [65]$$

which is in our local frame. But distant galaxies have a large *Hubble velocity*, causing *time dilation*. We see their *time* run slower, so in order to obtain their *proper age* (since the big bang) in their own *local frame* we must divide [65] by the *Lorentz factor*.

Object's *proper age*: $$\tau_e' = \tau_e \sqrt{1-\beta_H^2} = \frac{\sqrt{1-\beta_H^2}}{1+\beta_H} = \sqrt{\frac{1-\beta_H}{1+\beta_H}} = \frac{1}{\zeta} = \frac{1}{z+1} \qquad [66]$$



proper age vs. *Hubble velocity*

2020-03-30:

This is a is a big blunder of mine.
I applied *time dilation* to a *point in time* instead of to a *time span*.
The correct derivation is in
http://henk-reints.nl/astro/HR-distant-proper-age.pdf
on page 4.

I also use [66] in [184], but there *time* is counted from $t = 0$ onward, so it should be correct.

So in spite of this *maximum lookback time* of half the *Hubble time*, we can still observe very young objects and events, thanks to *time dilation*. In their own *time* they are far younger than the first half of the *Hubble time* as measured in our *time*. But very distant objects are not as young as what a linear lookback would yield.

Redshift

is a phenomenon that takes place in the *time* domain only, in different ways:

1. the *classical Doppler effect* is due to a difference in *signal-travel time* if two succeeding events take place at a different *distance* from the observer, which happens when the source is moving with respect to the observer;
2. according to *special relativity* there is *time dilation* due to mutual *velocity*, which causes a transition from the light source's time domain to that of the observer, and since a photon belongs to the

ultimate observer as soon as it has been emitted, this transition must take place at the very moment of emission; [67]

3. *gravitational redshift* due to *gravitational time dilation*. This applies mainly to light which originates from very heavy light sources. Light that is passing a heavy object is first *blueshifted* during approach, which more or less compensates the *redshift* after the object is passed. In this treatise, *gravitational redshift* is not further considered.

Einstein combined the *classical Doppler effect* and the *special relativistic effect* to what is called the *relativistic Doppler effect*: $\nu_{obs} = \nu_{src}\sqrt{\left(1-\frac{v}{c}\right)/\left(1+\frac{v}{c}\right)}$ [68]

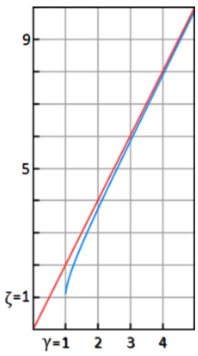
or: $\lambda_{obs} = \lambda_{src}\sqrt{\left(1+\frac{v}{c}\right)/\left(1-\frac{v}{c}\right)}$ [69]

Redshift is defined as: $z = \frac{\lambda_{obs}-\lambda_{src}}{\lambda_{src}}$ [70]

In order to prevent having to use $z+1$ everywhere, I define the far easier *redshift factor* as: $\zeta \equiv \lambda_{obs}/\lambda_{src} = z+1$ [71]

Then, with $\beta = \frac{v}{c}$, we get: $\zeta = \sqrt{(1+\beta)/(1-\beta)}$ [72]

and its inverse is: $\beta = (\zeta^2-1)/(\zeta^2+1)$ [73]



Substituting [6] in [72] yields: $\zeta = \sqrt{2\gamma\left(\sqrt{\gamma^2-1}+\gamma\right)-1}$ [74]

and: $\lim_{\gamma\to\infty}\zeta = 2\gamma$ [75]

as well as: $\lim_{\zeta\to\infty}\gamma = \frac{\zeta}{2}$ [76]

Cosmological or expansional *redshift*

a) A ray of light would be "stretched" because of the expansion of the universe, thus causing an increase of the *wavelength* and a corresponding *redshift*. Since the expansion of the universe must also obey the *speed limit of light*, such a *redshift* would be maximized to $\zeta = 2$ or $z = 1$.
b) *Wave velocity* is only a property of the medium through which an oscillation propagates (in this context, vacuum is the "medium" through which light propagates, but I do certainly not intend to re-introduce the luminiferous ether). As aforementioned, the *speed of light* is a property of empty space, not of light itself.
c) The *frequency* is in fact only a property of the oscillation itself.
d) A wave is an emerging phenomenon that comes into being when an oscillation occurs in a medium. In fact it is a sort of optical illusion, since nothing is really moving in that direction, although there is of course an energy flow.
e) *Wavelength* is not a property at all, but just a symptom of a wave. It is an *equiphase distance*, the shortest *distance* between two different points where the oscillations are in phase. Not more than that.
f) A photon is an amount of *energy* that manifests as an electromagnetic oscillation at a *frequency* according to:

$$E = h \cdot \nu \quad [77]$$

The *frequency* is in fact the only relevant property of a photon. A photon does not have any spatial dimension. It is meaningless to talk about the *size* or *length* of a photon. A photon does not have a *wavelength* because it is not a wave. It is an amount of *energy*. A photon travels at the *speed of light* which is a property of empty *space*. It has this constant *velocity* with respect to the ultimate observer. Due to this *velocity* there are equiphase points at a repeating *distance* which we call *wavelength*. This is not a property of the photon, but a symptom of the combination of a photon and the "medium" called empty *space*, causing light to behave like a wave. It is just an emerging phenomenon.

g) As already mentioned above, empty *space* is a collection of nothing at all and not even that. It especially does not have any reference points. Empty *space* has no grip on anything.
h) An entity that has no grip on anything cannot stretch a property of something that does not even have that property.
i) A photon is an amount of *energy* that directly relates to its *frequency* so the law of conservation of *energy* simply forbids modification of the photon's *frequency*. A photon's *frequency* cannot gradually change. Where would the *energy* go if the *frequency* gets smaller? Other on-the-fly photons? Where are they? Ever observed?
j) As quoted on https://en.wikipedia.org/wiki/Annus_Mirabilis_papers, Einstein stated: *Energy, during the propagation of a ray of light, is not continuously distributed over steadily increasing spaces, but it consists of a finite number of energy quanta localised at points in space, moving without dividing and capable of being absorbed or generated only as entities*[18]. He was awarded the 1921 Nobel Prize for this publication. *Without dividing* implies that photons do not change while travelling.

Conclusion:

COSMOLOGICAL OR EXPANSIONAL REDSHIFT CANNOT AND DOES NOT EXIST. [78]

It is just an assumption that is not based on observed phenomena. It is another mistake of cosmology.

The Cosmological Principle

says that, at a large enough scale, the universe manifests as a homogeneous and isotropic entity. Homogeneous means it is practically the same at any location and isotropic means it is the same in all directions (as seen from anywhere, in agreement with the homogeneity). This Cosmological Principle is in accordance with practically ALL astronomical observations ever done, and please realise that astronomy is the second oldest profession in the world... Wherever we look, we observe the same types of phenomena. It also says the universe has no preferred location or direction. It implies that the universe manifests itself identically or equivalently to all observers anywhere.

Expansion of the universe

The Hubble–Lemaître law implies the universe is expanding. Very distant objects move at a great *velocity* with respect to us, leading to significant *time dilation* and *Lorentz contraction*. Both are the result of a mere *rotation* in Minkowski-space[19]. According to the Cosmological Principle, the universe manifests the same way there and here. So this rotated Minkowski space from overthere looks the same as here. This implies the expansion of the universe must be symmetrical in all four Minkowski dimensions. The fourth dimension in Minkowski space is: ict, the imaginary unit i times the *speed of light* times the quantity we call *time*. And *time* is progressing, isn't it? And doesn't this ict dimension

[18] Albert Einstein: Über einen die Erzeugung und Verwandlung des Lichtes betreffenden heuristischen Gesichtspunkt. Annalen der Physik 17 (6) 132–148 (1905), quoted statement is at p.133.
[19] Hermann Minkowski, Die Grundgleichungen für die elektromagnetischen Vorgänge in bewegten Körpern. Vorgelegt in der Sitzung vom 21. Dezember 1907. Nachrichten von der Gesellschaft der Wissenschaften zu Göttingen, Mathematisch-Physikalische Klasse. 1908, S. 53–111.

expand at the very *speed of light*, just like the *Hubble distance*? So there it is, the symmetrical expansion of the universe in all four Minkowski dimensions, at the *speed of light*.

But this means the progress of *time* actually is the expansion of the universe. And which entity is being expanded by the progress of *time*? It's the past! Is it? Is the past expanding? Stretching? Or is the present constantly being added to it? That is ex**te**nsion, not ex**pa**nsion. The just mentioned symmetry then requires that this extension applies to all four dimensions in Minkowski space, so the universe is not expanding but it is being extended. Space is added. That is easy, since empty space itself is a collection of nothing at all and not even that. And adding an amount of Nothing to a collection of Nothing shouldn't be too hard.

> "I see nobody on the road," said Alice. "I only wish I had such eyes," the King remarked in a fretful tone. "To be able to see Nobody! And at that distance too!"
> *Lewis Carroll, Alice's Adventures in Wonderland.*

A bit of philosophy: one cannot say that the past is (as an existing entity), so as a matter of fact it's just as "nothing" as empty space. The only thing we've got regarding the past are currently observed phenomena, such as a current memory or a currently existing fossilised dinosaur skeleton, that can be logically reduced to events or entities that no longer are.

Quid est ergo tempus? Si nemo ex me quærat, scio; si quærenti explicare velim, nescio.
Then what is time? When nobody asks me, I know; but when I want to explain it, I don't.
Aurelius Augustinus Hipponensis, AD354-430, Confessiones 11.14.17.

THE UNIVERSE IS NOT EXPANDING BUT BEING EXTENDED. [79]

This applies to all its four Minkowski dimensions. And since space is being extended and not expanding, cosmological or expansional *redshift* is a delusion. Space is not being stretched. Space is added.

THE EXTENSION OF THE UNIVERSE MANIFESTS AS THE PROGRESS OF *TIME*. [80]

Since the progress of *time* is in the ict dimension at the *speed of light*, its spatial aspect is *Lorentz contracted* to nought point nought (just like "normal" space is for a photon), so *time* cannot and does not manifest as a spatial coordinate. Have you, like Einstein, ever been curious about how it would be when travelling at the *speed of light*? Then look around! But you won't observe anything spatial in the direction in which you're moving, i.e. *time*.

The Minkowski *spacetime interval* from an observer to an event at (x, y, z, t)

is given by: $s^2 = x^2 + y^2 + z^2 - c^2t^2$ [81]

which simply equals: $s^2 = r^2 - c^2t^2$ [82]

Insertion of the *Hubble distance* and *time* yields the *relativistic distance* to the *IniAll*:

$$s^2 = D_H^2 - c^2t_H^2$$ [83]

which equals zero, since: $D_H = ct_H$ [84]

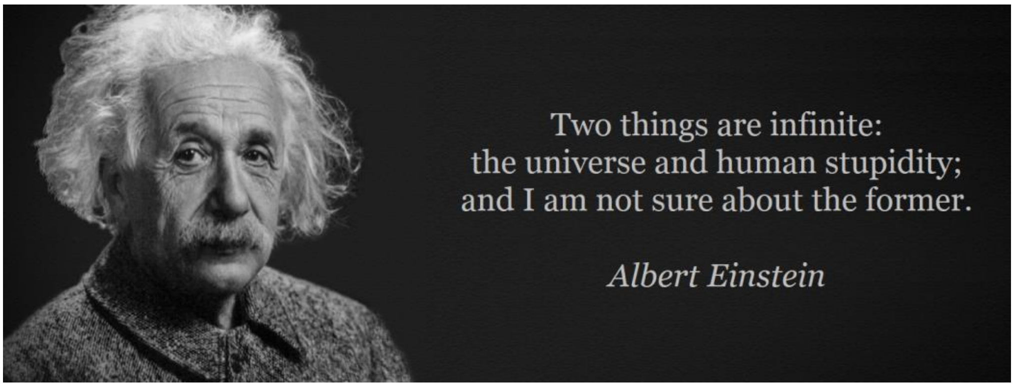
This too makes clear that the *growth* of the *Hubble distance* (which is the extension of the universe) is just the very same as the progress of *time*. As *time* progresses, the universe cannot do anything else than extend at the same rate.

And this rate effectively is the *speed of light*. If the latter would change, then the *Hubble distance growth* would change in the same proportion, as well as the *growth* of the ict dimension. Then their *ratio* would not change. But isn't the *speed of light* just this very *ratio* of the *Hubble distance* and the progress of *time*? Then we've got the situation that if the *speed of light* would change, the result thereof would be that it remains unchanged... In other words: the *speed of light* cannot change. It truly is a *constant of nature* because of the symmetry in (the extension of) the spatial dimensions and the special dimension we call *time*.

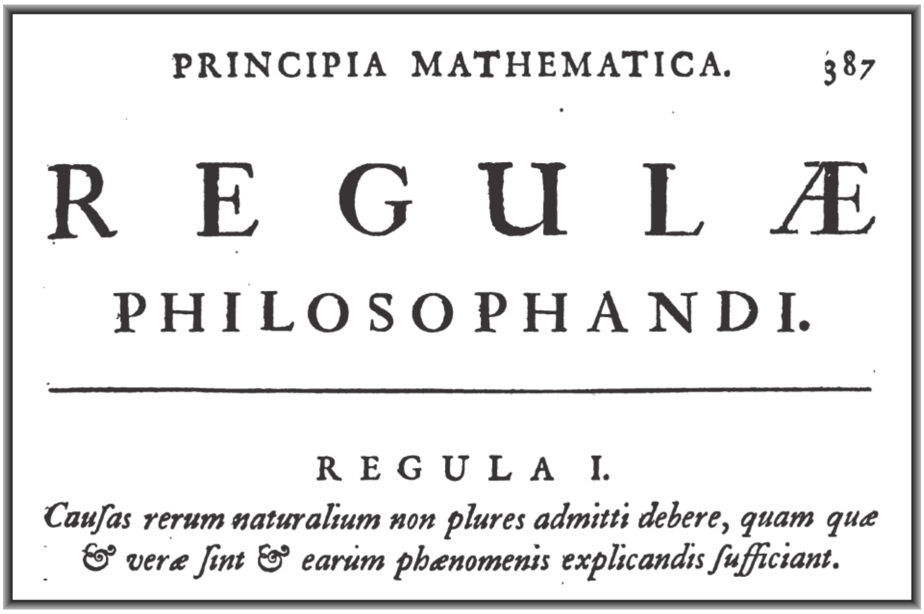
***Size* of the universe**

It should by now be obvious that the universe cannot be larger than the *Hubble distance*, i.e. no two objects in the universe can have a mutual *proper distance* greater than the *Hubble distance*. The 93 Gly diameter as assumed by standard cosmology is far larger than what could have been achieved since the big bang at the *speed of light*. I consider that number an excogitation that is not based on any observed phenomenon.

Even if we see an object at say $0.7D_H$ in one direction and another one at $0.8D_H$ in the exact opposite direction, their mutual *distance* is not $1.5D_H$. According to [60], the dimensionless *current proper distances* (i.e. 0.7 and 0.8) equal the dimensionless *Hubble velocities*, so we must use [7], which is Einstein's *velocity* addition formula, which yields: $\frac{0.7+0.8}{1+0.7\times0.8} = \frac{1.5}{1.56} \approx 0.96 < 1$ Q.E.D. [85]



But I am. It's not. (*quote is disputed, see* https://en.wikiquote.org/wiki/Albert_Einstein)


PRINCIPIA MATHEMATICA. 387

REGULÆ PHILOSOPHANDI.

REGULA I.

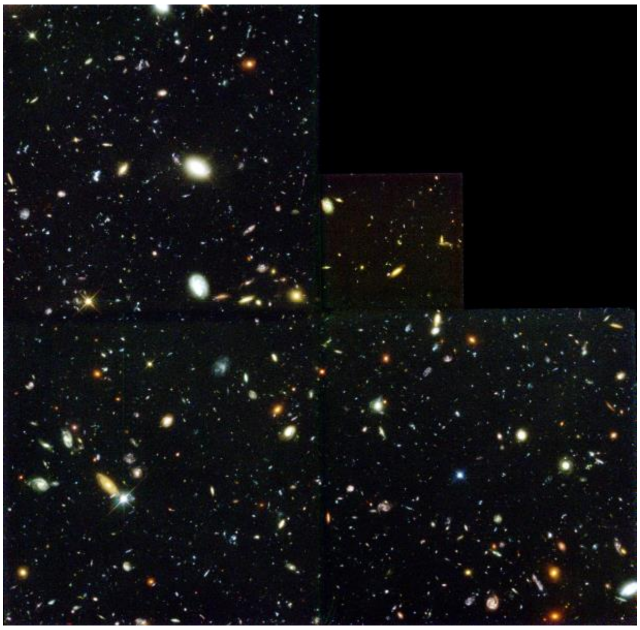
Causas rerum naturalium non plures admitti debere, quam quæ & veræ sint & earum phænomenis explicandis sufficiant.

We are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances.

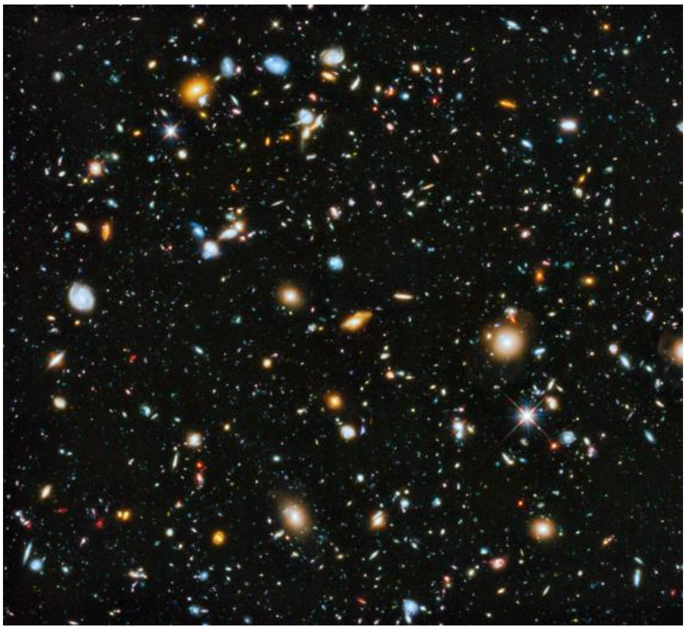
Sir Isaac Newton,
Philosophiæ Naturalis Principia Mathematica, Liber Tertius

Matter in the universe

The Hubble Deep Field and Ultra Deep Field images[20] reveal lots of very distant galaxies:



Hubble Deep Field Image (1995)
just above the Big Dipper,
in the northern constellation Ursa Major;
ca. 3 000 galaxies (3 750 after correction for the upper right area), ca. 2.5×2.5 arcmin^2;
net exposure time: ca. 4 days.



Hubble Ultra Deep Field Image (2003)
far to the southwest of Orion,
in the southern constellation Fornax;
ca. 10 000 galaxies,
ca. 2.5×2.5 arcmin^2;
net exposure time: ca. 23 days.

To compensate the less *exposure time* of the 1995-image, I apply an arbitrary factor of 2 to the galaxy count of 3 750, yielding:

$$\frac{3750*2+10000}{2\cdot\left(\frac{2.5}{60}\right)^2} \approx 5\,000\,000 \text{ galaxies per square degree} \qquad [86]$$

This means there are ca. one million galaxies behind the full moon.

The number of square degrees of the entire firmament (which of course is a full sphere) equals:

$$4\pi/(\pi/180)^2 \approx 41253 \qquad [87]$$

This yields: $N_{g,U} \approx 2 \times 10^{11} = 200$ billion galaxies in the entire universe [88]

which is merely one third of a picomol.

The average number of stars per galaxy is estimated as:

$$N_{s,g} = 1 \times 10^{11} = 100 \text{ billion} \qquad [89]$$

Yielding a total number of stars in the entire universe of:

$$N_{s,U} = 2 \times 10^{22} = 20 \text{ sextillion (Dutch: 20 triljard)} \qquad [90]$$

which equals 33 millimol. A Dutch shotglass of 50 ml (Dutch: borrelglaasje) can hold 2.8 mol of H_2O molecules, which is 84 times the total number of stars in the universe.

Using the solar *mass*: $m_\odot = 1.989 \times 10^{30}$ kg [91]

as an average, we obtain the total *mass* of all stars in the universe:

$$m_{s,U} = 4 \times 10^{52} \text{ kg} \qquad [92]$$

Interstellar (intragalactic) and intergalactic matter is estimated to dominate this by a factor of about 10, yielding the total *mass* of the universe:

$$M_U = 4 \times 10^{53} \text{ kg} \qquad [93]$$

[20] https://www.nasa.gov/mission_pages/hubble/main/index.html

This is only "normal" matter, excluding any dark matter or dark *energy*.
Division of M_U by the *atomic mass unit* yields the total number of nucleons in the universe:

$$N_{n,U} \approx 2.4 \times 10^{80} \quad [94]$$

Nearly all of them are protons, being the nuclei of hydrogen atoms.

2020-07-29: in http://henk-reints.nl/astro/HR-mass-univ-grav-const.pdf are far better estimates hereof.

Space requirement

Aristotle described space as[21]: *the innermost motionless boundary of what contains*. And he said the absolute void is meaningless. Without "things", the concepts *distance* and *motion* (ergo *velocity*) become pointless.

Atomic incompressibility is caused by the *degeneracy pressure* which follows from the Pauli exclusion principle[22]. This also applies to other entities existing of fermions. But "inside" a truly elementary particle there is no such *degeneracy pressure*. Nevertheless, I consider them as fundamentally incompressible to a singularity.

I state that an entity cannot "be" or exist unless it is able to manifest all of its properties. This means that any entity having at least one spatial property requires a minimal amount of space in order to reveal this property. This in turn yields that this entity cannot ever be compressed to something that's essentially smaller than this space requirement. For an entity having *mass*, at least two spatial properties are directly related to this *mass*, namely the *Schwarzschild radius*, which is the '*size*' of a black hole of the given *mass*, and the *Compton wavelength*, which is the *wavelength* corresponding to a photon (not "of" a photon, photons don't have a *wavelength*, as explained above) of the same *energy* as what corresponds to the *mass* according to the perhaps most well-known formula ever, i.e. Einstein's world famous[6]:

$$E = mc^2 \quad [95]$$

The *Schwarzschild radius* equals:

$$r_s = \frac{2Gm}{c^2} \quad [96]$$

so the *Schwarzschild diameter* is:

$$d_s = \frac{4Gm}{c^2} \quad [97]$$

and the *Compton wavelength* is:

$$\lambda_c = \frac{h}{mc} \quad [98]$$

Of course it is the larger of the two that determines the minimal space requirement of the given entity. Their tip-over *mass* is found by putting these quantities equal to each other,

so:

$$\frac{4Gm}{c^2} = \frac{h}{mc} \therefore m = \sqrt{\frac{hc}{4G}} = 27.2780087\ \mu\text{g} = 1.6427201 \times 10^{19}\ \text{amu} \quad [99]$$

and:

$$\lambda_c = d_s = \frac{4Gm}{c^2} = \frac{4G}{c^2}\sqrt{\frac{hc}{4G}} = \sqrt{\frac{16G^2hc}{c^4 \cdot 4G}} = \sqrt{\frac{4hG}{c^3}} = 8.10256748 \times 10^{-35}\ \text{m} \quad [100]$$

which are very similar to the *Planck mass* and *length*:

$$m_P = \sqrt{\frac{\hbar c}{G}} = 21.764702\ \mu\text{g}, \qquad l_P = \sqrt{\frac{\hbar G}{c^3}} = 1.616229 \times 10^{-35}\ \text{m} \quad [101]$$

To me, [99] and [100] seem more fundamental than these Planck units. As it would be quite arrogant to name something to yourself, I'll call them the Van der Trieten *mass* and *length* (the Dutch "*ie*" to be pronounced as in *meat*). *Gerrit van der Trieten* was a *complete stranger* invented in 1972 by Eddy Buys[23] and the name does not actually exist according to the Database of Surnames in The Netherlands[24]).

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[21] Ἀριστοτέλης (*Aristotélēs*, 384BCE-322BCE), Φυσικὴ ἀκρόασις (*Phusike akroasis*, (Lecture on) Physics) Book IV.

[22] Wolfgang Pauli, Über den Zusammenhang des Abschlusses der Elektronengruppen im Atom mit der Komplexstruktur der Spektren, Zeitschrift für Physik, vol. 31, issue 1 (1925), pp. 765-783.

[23] https://www.youtube.com/watch?v=SEyGPPp2La4 (start @11:40, mar ut it is op zun Hellemons).

[24] http://www.cbgfamilienamen.nl/nfb/index.php?taal=eng

From [99] follows that for elementary particles the *Compton wavelength* would be a measure of their minimal space requirement and they would not be compressible to something essentially smaller.

ASSUMPTION:

ELEMENTARY PARTICLES CANNOT BE COMPRESSED TO A ZERO SIZE SINGULARITY [102]

Nucleons

For a neutron we've got:	m_n	$=$	$1.674\,929 \times 10^{-27}$	kg	[103]
so:	$r_{s,n} = \frac{2Gm_n}{c^2}$	$=$	$2.487\,576 \times 10^{-39}$	fm	[104]
and:	$\lambda_{c,n} = \frac{h}{m_n c}$	$=$	$1.319\,590$	fm	[105]
The known neutron *radius* is:	r_n	$\approx$	0.8	fm	[106]
For a proton we have:	m_p	$=$	$1.672\,622 \times 10^{-27}$	kg	[107]
yielding:	$\lambda_{c,p} = \frac{h}{m_p c}$	$=$	$1.321\,410$	fm	[108]
The proton's *charge radius* is:	r_p	$\approx$	0.8768	fm	[109]

It appears that: $r_n < r_p$ [110]

as well as: $\lambda_{c,n} < \lambda_{c,p}$ [111]

and both *Compton wavelengths* are just a bit smaller than the corresponding particle's *diameter*:

$$\lambda_{c,n} \lesssim 2r_n \quad [112]$$

and: $\lambda_{c,p} \lesssim 2r_p$ [113]

which does not contradict my earlier assumption that they cannot be compressed to below the *Compton wavelength*. Both are larger.

By the way, for the up and down quarks we've got[25]:

up: $m = 2.3\ \text{MeV/c}^2 = 4.1 \times 10^{-30}\ \text{kg} \quad \therefore\ \lambda_{c,qu} = 539\ \text{fm} \gg \lambda_{c,p}$ [114]

down: $m = 4.8\ \text{MeV/c}^2 = 8.6 \times 10^{-30}\ \text{kg} \quad \therefore\ \lambda_{c,qd} = 258\ \text{fm} \gg \lambda_{c,p}$ [115]

Might this be a reason why free quarks cannot exist? The rather naive "tiny little marble" reasoning says they must be smaller than a proton, which is far below this minimal space requirement.

A quark duplet, for example the π^0 meson, has a *mass* of:

$$m = 135\ \text{MeV/c}^2 = 2.4 \times 10^{-28}\ \text{kg} \quad \therefore\ \lambda_{c,\pi^0} = 9.2\ \text{fm} < 7 \cdot \lambda_{c,p} \quad [116]$$

As just said it is quite naive to regard nucleons or elementary particles as tiny little marbles or so, but a *mass* m that would have been compressed to a spherical thing with a *diameter* equal to its *Compton wavelength*, would then have

a "*Compton volume*" of: $V_c = \frac{4}{3}\pi\left(\frac{\lambda_c}{2}\right)^3 = \frac{\pi}{6}\lambda_c^3 = \frac{\pi h^3}{6c^3} \cdot \frac{1}{m^3}$ [117]

so its "*Compton density*" is: $\rho_c = \frac{m}{V_c} = \frac{6c^3 m^4}{\pi h^3}$ [118]

Insertion of [103] into [118] then yields the maximum possible *density* of a neutron:

$$\rho_{n,max} = 1.392\,134 \times 10^{18}\ \text{kg/m}^3 \quad [119]$$

For your imagination: 10^{18} kg/m^3 equals one megatonne per cubic millimetre, which is a million cars of 1000 kg each, filling a 2.5×4 km^2 car park with 2×5 m^2/car and no "roads" between them, all compressed into one cubic millimetre.

[25] https://en.wikipedia.org/wiki/Quark#Mass

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Neutronium

is the stuff you would get if all electrons of all atoms of which a body consists would be forced into the atomic nucleus, by a *pressure* that exceeds the atom's *degeneracy pressure* (its *incompressibility*). It consists of only neutrons. Neutron stars are presumed to consist of neutronium, based on their (measured) *mass* and *rotation frequency* (the "pirouette effect"). To me, neutronium is the ultimate form of tangible matter. A neutron consists of course of three quarks, but I do not consider quarks tangible matter.

In the conventional big bang theory where the universe came out of a singularity there must also have been a moment when the universe had a *density* equal to that of neutronium, so it seems plausible that the *IniAll* consisted of neutronium.

According to Oppenheimer and Volkov (see below), an amount of neutronium greater than a given limit would collapse because the *gravitational pressure* exceeds the *degeneracy pressure*. But does that mean the neutrons themselves would collapse to zero? As already mentioned, I think they won't.

Then, in its most compact form thinkable, all vacuum would have been "squeezed out" of the neutronium, yielding a *density* according to [119] (the neutrons would then isovolumetrically have been reshaped to cubes). From now on, this is what I mean with the term neutronium, unless stated otherwise. The densest thinkable tangible matter. [120]

In this case, the *IniAll* would have a *volume* of:

$$V_{IniAll} = \frac{M_U}{\rho_{n,max}} \qquad = 2.873 \times 10^{35} \text{ m}^3 \qquad [121]$$

and its *radius* would then be:

$$R_{IniAll} = \sqrt[3]{\frac{3V_{IniAll}}{4\pi}} \qquad \approx 410\,000\,000 \text{ km} \approx 2.74 \text{ AU} \qquad [122]$$

Taking into account that I do not look further back in *time*, this would be the beginning of the universe as far as tangible matter is concerned. A ball of neutronium with a *size* of say three times Earth's orbit around the Sun. Not smaller and not more than that. It can be considered (the nucleus of) one single atom of the "element" nilnilnilium, with $Z = 0$ and $A = N_{n,U} \approx 2.4 \times 10^{80}$.

Let's call this isotope: Iniallium. [123]

Inside elementary particles

I'll use the term *elementary matter* for both elementary particles and neutronium.

If anywhere a particle is prominently present then it must be in its own inside, whatever interpretation of the word *inside* would be appropriate. Litterally, *vacuum* means *emptyness*, *void*, which implies the total absence of any particles whatsoever. Therefore I think it is meaningless to consider *vacuum* inside any elementary particle.

ASSUMPTION:

THERE EXISTS NO VACUUM INSIDE ELEMENTARY PARTICLES. [124]

This is based on common sense and I state this is not a concoction as described in the introduction of this treatise.

As a matter of fact, both Special and General Relativity are about empty space, where the former describes how Minkowski space rotates due to *velocity* and the latter how *energy* and *momentum* deform it. Relativity never mentions the inside of elementary matter, does it? And isn't the bulk of the calculations done using just two observers or one observer and some point mass in a further empty *space-time* environment?

RELATIVITY APPLIES TO EMPTY SPACE AND NOT TO THE INSIDE OF ELEMENTARY MATTER. [125]

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I state that the already mentioned singularity is only a singularity of the net empty space around and between the elementary particles, not of the particles themselves. Usually, physical calculations are done using point masses. Have you ever contemplated their true existance?
Please note that the above does in no way mean there is no gravitation inside elementary matter, only the math according to general relativity (the Einstein equation) may need a significant correction, just like general relativity does not replace, but adjust Newtonian gravitation by adding higher order terms.

If there is no vacuum inside elementary matter, then its properties, i.e. ε_0, μ_0, and c, don't exist either, and then the *speed of light* would be a meaningless concept. And isn't light just the transfer of *energy* from one particle to another, i.e. *between* them? Wouldn't it be meaningless at all to consider light *inside* elementary matter?

Now a bit of philosophy. Free neutrons are unstable, they disintegrate into a proton, an electron, and an antineutrino. As assumed, inside the neutron there would be no vacuum, no emptyness, but between the resulting particles there is. So in a way, we could say that vacuum or empty space is created by neutron decay or particle decay in general... But (cf. Alice seeing Nobody) it is the creation of nothing at all.

Please note that an atom is not elementary matter at all. Its inside is mainly vacuum, e.g. for a hydrogen atom we obtain:

Bohr radius:	a_0	$= 52.917\,721$	pm	[126]
classical electron *radius*:	$r_e = \frac{e^2}{4\pi\varepsilon_0 m_e c^2}$	$= 2.817\,840$	fm	[127]
volume of a single electron:	$V_e = \frac{4\pi}{3} r_e^3$	$= 93.721\,145$	fm^3	[128]
proton *volume* using [109]:	$V_p = \frac{4\pi}{3} r_p^3$	$= 2.823\,156$	fm^3	[129]
net atomic *volume*:	$V_{H,n} = V_e + V_p$	$= 96.544\,554$	fm^3	[130]
gross atomic *volume* based on [126]:	$V_{H,g} = \frac{4\pi}{3} a_0^3$	$= 620\,715$	pm^3	[131]
so the atom's *volumetric voidness* is:	$\frac{V_{H,g}}{V_{H,n}}$	$= 6.43 \times 10^{12} : 1$		[132]
and then the *linear voidness* equals:	$\sqrt[3]{\frac{V_{H,g}}{V_{H,n}}}$	$= 18595 : 1$		[133]
For the *density* of a single H-atom we find:	$\rho_{H,a} = \frac{m_p + m_e}{V_{H,g}}$	$= 2696$	kg/m^3	[134]

which is of the same order as that of rock. After applying the close-packing factor of $\frac{\pi}{3\sqrt{2}} \approx 0.74$, it would be the greatest thinkable *density* of atomic hydrogen.

Cf. the *density* of liquid hydrogen:	$\rho_{H,l}$	$= 70.85$	kg/m^3	[135]

which corresponds to a linear interatomic *voidness* of $\sqrt[3]{\frac{2696}{70.85}} \approx 3.36$ [136]

The electron's *Compton wavelength* equals 2.4263102367 pm, which exceeds its *classical radius* by a factor of $\frac{2\pi}{\alpha} \approx 861$. This would reduce the *linear atomic voidness* to roughly $\frac{18595}{861} \approx 21.6$ and the *volumetric voidness* to the 3rd power thereof, which is about 10000. Still quite empty. It would allow a Lorentz factor of up to say $\gamma = \frac{1}{2} \cdot 21.6 = 10.8 \triangleq \beta \approx 0.9957 \triangleq v = 298\,504\,573$ m/s without "bumping" against the possible *incompressibility* of elementary matter. To my knowledge we are still unable to shoot a rod or so at this *velocity* in order to measure its Lorentz contracted *length*, which would be necessary to verify this *incompressibility* of elementary matter.

Superluminality

If there exists no *speed of light* there can also not exist any *speed limit of light*. This would imply the *velocity* of information (of any form) could within elementary matter easily exceed the *speed of light*, since that applies to vacuum only.

It would be no contradiction with Einstein's theory of relativity if the *speed limit of light* just isn't applicable in that particular situation, since relativity actually deals with (the geometry of) empty space.

And what if [124] would apply to entangled particles as well, like those used at the Technische Universiteit Delft (NL) in their 2015 experiment[26], where the *speed of light* seems to have significantly been exceeded? [137]

Black holes

Karl Schwarzschild found the first solution[27] of the Einstein equation, the outcome of Einstein's theory of general relativity[28]. This solution is the black hole. One of the aspects of the black hole is the event horizon of a mass point.

At a distance of: $$r_S = \frac{2Gm}{c^2} \qquad [138]$$

the *escape velocity* equals the *speed of light* (Newtonian gravitation yields the very same value for that), so absolutely nothing can escape from the sphere inside, not even light. This distance is called the *Schwarzschild radius* or the event horizon of a non-rotating black hole. Its inside is unobservable.

Consider a homogeneous massive ball with *radius* r_b and *density* ρ_b, then its *mass* is:

$$m_b = \rho_b \cdot \frac{4\pi}{3} r_b^3 \qquad [139]$$

so [138] becomes: $$r_S = \frac{2G \cdot \rho_b \cdot \frac{4\pi}{3} r_b^3}{c^2} = \frac{8\pi G \rho_b}{3c^2} r_b^3 \qquad [140]$$

This ball will be a black hole if all *mass* is contained within r_S,

which means: $$r_S > r_b \rightarrow \frac{r_S}{r_b} > 1 \rightarrow \frac{8\pi G \rho_b}{3c^2} r_b^2 > 1 \rightarrow r_b^2 > \frac{3c^2}{8\pi G \rho_b} \qquad [141]$$

or: $$r_b > \sqrt{\frac{3c^2}{8\pi G \rho_b}} \equiv r_{bh,cr} \qquad [142]$$

which I'll call the *critical black hole radius*.

The corresponding *critical black hole mass* is:

$$m_{bh,cr} = \rho_b \cdot \frac{4\pi}{3} \cdot r_{bh,cr}^3 = \rho_b \cdot \frac{4\pi}{3} \cdot \sqrt{\left(\frac{3c^2}{8\pi G \rho_b}\right)^3} = \sqrt{\frac{3c^6}{32\pi G^3 \rho_b}} \qquad [143]$$

for a ball of neutronium, we've got:

$$\rho_b = \rho_{n,max} \qquad [144]$$

with [118] this yields: $$r_{bh,cr,N} = \sqrt{\frac{3c^2}{8\pi G \rho_{n,max}}} = \frac{1}{4m_n^2}\sqrt{\frac{h^3}{Gc}} \qquad = 10.745 \text{ km} \qquad [145]$$

Its *mass* is: $$m_{bh,cr,N} = \sqrt{\frac{3c^6}{32\pi G^3 \rho_{n,max}}} \qquad = 3.6376\odot \qquad [146]$$

which would then be the smallest possible black hole under the assumption that neutronium would be incompressible below the neutron's *Compton wavelength*, as aforementioned. Below a *diameter* of say 22 km, it would be a neutron star. It would mean mini black holes, let alone micro black holes, are a fiction.

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[26] https://arxiv.org/abs/1508.05949 - Experimental loophole-free violation of a Bell inequality using entangled electron spins separated by 1.3 km.

[27] K. Schwarzschild. Über das Gravitationsfeld eines Massenpunktes nach der EINSTEINschen Theorie. Reimer, Berlin 1916, pp.189-196.

[28] Albert Einstein, Die Grundlage der allgemeinen Relativitätstheorie, Annalen der Physik 49 (1916), pp.769-822.

Schwarzschild *radius* of the universe

This one is easy. First of all, [146] tells us right away the *IniAll* was a black hole. That simply means the entire universe must still be a black hole, since nothing can escape from it.

Insertion of [93] into [138] yields:

$$r_{S,U} = \frac{2GM_U}{c^2} \approx 63 \text{ Gly} \approx 4.5D_H \qquad [147]$$

Which is indeed larger than the *Hubble distance*, as expected. So the universe must be a black hole. Just look around and then you'll know how it is inside a black hole.

According to https://en.wikipedia.org/wiki/Universe, the *current proper diameter* of the universe equals 93 Gly, so its *radius* would be: $46.5 \text{ Gly} > 3.3D_H$. [148]

As should be obvious by now, I don't agree with that, but at least it is less then [147].

Please note that according to the conventional big bang theory the universe must be a black hole as well. If it started as a zero *size* but non zero *mass* singularity then it is evident that its true *radius* was smaller then its *Schwarzschild radius*. And as said, nothing can escape from a black hole, so it must still be one. This 46.5 Gly then also is a lower limit of the universe's *Schwarzschild radius* according to conventional cosmology, which yields a minimum total *mass* of:

$$M_{U,min} = \frac{c^2 r_{S,min}}{2G} \approx 2.96 \times 10^{53} \text{ kg} \qquad [149]$$

Wikipedia gives a *mass* of: at least 10^{53} kg [150]

Who knows what will happen when the extending universe bumps against its *Schwarzschild radius* from the inside? As far as I'm concerned, it will be at the *speed of light*, and according to conventional cosmology it'll be more than three times faster.

Tolman-Oppenheimer-Volkoff limit

Oppenheimer and Volkoff did calculations on neutronium which they verified with analytical solutions by Tolman[29]. They did their calculations using the equation of state for a cold Fermi gas, and general relativity. They found that above about 0.75 times the *solar mass*, there are no stable solutions. This is the TOV limit. As they say, the neutronium must then contract forever, although more and more slowly, never reaching true equilibrium. This is an ever lasting asymptotical collapse.

But the facts contradict this theoretical limit. There exist neutron stars that are significantly heavier than 0.75⨀. The heaviest neutron star currently known, PSR J0348+0432, is 2.01⨀. As a result of such measurements the TOV limit has been adjusted several times by taking more aspects into account then only the premises made by Oppenheimer and Volkov.

One of these premises is: general relativity. But according to [125] this premise does not or not fully apply to neutronium. And if the premises are non realistic then the theory might collapse instead of the neutron star. And a collapse of neutronium does not imply a collapse of the neutrons (or the quarks from which they consist) themselves.

The TOV limit is analogous to the Chandrasekhar limit for white dwarf stars, which is about electron degeneracy, i.e. surpassing the incompressibility of atoms. But neutronium is something else. From [118] and [134] follows that the neutronium to single-H-atom-*density ratio* $\approx 5 \times 10^{14} : 1$. This value applies to maximum density neutronium, but for "normal" (less dense) neutronium the ratio would still be of the same order. The neutronium collapse would asymptotically approach maximum *density* neutronium.

[29] J.R. Oppenheimer & G.M. Volkoff (1939). "On Massive Neutron Cores".Physical Review 55 (4): 374–381.

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And might, taking [125] into account, an adjusted form of gravitation for the inside of elementary matter result in a TOV limit equal to $m_{bh,cr,N}$ according to [146]? That would seamlessly connect it to the black hole.

By the way, I associate the term *gas* with freely moving particles, and *neutronium* definitely not, so I also have my concerns about Oppenheimer and Volkov's other premise, i.e. to consider neutronium a cold Fermi gas.

And then there is another fact: we are here! And Edwin Hubble discovered something important, which we named after him: The Hubble–Lemaître law. So the *IniAll*, which can be seen as an extreme neutron star of $2 \times 10^{23} \odot$ did not collapse. It flew apart. Isn't that in contradiction with the TOV limit?

Relativity

In Special Relativity, the formulas for *time dilation* and *Lorentz contraction* contain the 'magic square root' by which must be divided for the former or multiplied for the latter:

SR magic root: $$\Re_s = \sqrt{1 - \frac{v^2}{c^2}} \qquad [151]$$

In General Relativity, using Schwarzschild metrics, we obtain another square root for gravitational *time* dilation and *length* contraction, which must be applied similarly (m = central *mass, r* = *distance* to it):

GR magic root: $$\Re_g = \sqrt{1 - \frac{2Gm}{rc^2}} \qquad [152]$$

We also have:

escape velocity: $$v_e = \sqrt{\frac{2Gm}{r}} \qquad \rightarrow 2Gm = v_e{}^2 r \qquad [153]$$

Schwarzschild radius: $$r_S = \frac{2Gm}{c^2} \left(= \frac{v_e{}^2 r}{c^2}\right) \qquad \rightarrow 2Gm = r_S c^2 \qquad [154]$$

So the GR magic root equals: $$\Re_{g1} = \sqrt{1 - \frac{r_S}{r}} \qquad [155]$$

as well as: $$\Re_{g2} = \sqrt{1 - \frac{v_e{}^2}{c^2}} \qquad [156]$$

Please note the correspondance between [156] and [151]. When standing on a planet's surface, the *escape velocity* is a sort of would-be *velocity* with respect to your own inertial free fall from infinity. As a matter of fact it is the *velocity* at which the planet's surface forces you to escape from your own inertial movement. A sort of *velocity* within your own 'inertial frame'.

Black holes once again

When an object falls into a black hole, it takes infinitely long as seen from the outside before it disappears. Then the birth of a black hole must take infinitely long as well, as seen from outside.

New black holes do not come into being in a finite *time*. [157]

This means all existing black holes cannot have come into being after the big bang, since that is a finite *time*. This implies they must be remnants of the inital exploding thing. Blobs of neutronium larger than 22 km that spattered off. They then have gathered matter around them, forming quasars and galaxies. "Becoming a black hole" is another misconception of conventional cosmology.

Inside a black hole

Just like [151] implies the *speed of light* cannot ever be exceeded since the square root of a negative number does not have a real solution, [155] implies you cannot ever get inside the *Schwarzschild radius*. This implies it is meaningless to consider any spatial entity within the *Schwarzschild radius*.

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But if you fall into a black hole you take your own local frame with you, taken't you? Suppose you came falling freely from infinity. Then, at any moment, you would be falling at the *escape velocity* that applies to that *distance*, wouldn't you? But it would be in the opposite *direction*, towards the black hole instead of escaping from it, wouldn't it? Your *velocity* would be with respect to the black hole's centre, wouldn't it? In your own local frame, this center would have been falling towards you all the *time*, wouldn't it? And in this frame its *velocity* would continuously have the very same absolute value with respect to you as yours with respect to it, wouldn't it? And your own free fall would simply continue at the *Schwarzschild radius*, wouldn't it? So in your local frame the black hole's centre would keep on falling towards you, wouldn't it? And it would still be accelerating towards you, wouldn't it? It would then of course exceed the *escape velocity* as it is at the *Schwarzschild radius*, wouldn't it? Of course it wouldn't, would it?

This *escape velocity* equals the *speed of light*, which under no circumstances can ever be exceeded. From your point of view, at that moment there is special relativistic *Lorentz contraction* conform [151] due to this *velocity*, and from its own perspective there is general relativistic *length contraction* of the black hole's *radius* conform [155] because of the black hole's *mass*. Both will have reduced the black hole's *radius* to zero, nought point nought. So at the moment of the irreversible event that you would fall into it, in your local frame the *depth* of the black hole is diddly squat, nada, zilch. In outside co-ordinates the Black hole's *depth* matches the *Schwarzschild radius*, but in your local co-ordinates it is sweet Fanny Adams. It is meaningless to consider the inside of a black hole.

I define a quantity which is the reciprocal of the *radius* or *distance*:

proximity: $$p = 1/r \qquad [158]$$

In Einstein's words the *speed of light* plays the role of the infinite *velocities*. A finite value behaving like infinity. Now the very same applies to *proximity*. Infinite *proximity* is reduced to a finite upper limit behaving like infinity, so as a matter of fact, zero *radius* is blown up to the *Schwarzschild radius*. A sort of optical illusion if you're at rest at a great *distance* from the black hole. That's why the inside of a blackhole is a meaningless concept. It's the inside of a zero-*size* entity.

Whilst you're falling towards the black hole, the black hole is coming towards you at an increasing *velocity* which is approaching the *speed of light*. In your own local frame, you'll see it getting more and more Lorentz contracted in the *direction* of its *velocity*, so its *depth* will approach zero, but its *width* will ever remain twice its *Schwarzschild radius*. This goes on until it is fully flattened to zero, 'pancakified', and then another type of big bang will occur: a fully impenetrable massive thing with zero *depth* or *thickness*, hence infinite *stiffness* or zero *elasticity* and zero *absorbency* hits you at the *speed of light*. It seems plausible you'll be pounded to elementary particles. And from the black hole's perspective, you'll arrive at the very *speed of light*. At that *velocity*, the *Lorentz contraction* will have contracted you to zero *length*.

The final singularity will occur in the *deceleration* from c to nought over zero *distance* in zero *time*:

$$\frac{d^2r}{dt^2} \to -\infty \qquad [159]$$

In outside co-ordinates it takes infinitely long for anything to actually hit the *Schwarzschild radius*, but in the object's own local frame, this infinity is reduced to a finite *time*. Just like the *speed of light* and the *maximum proximity* are finite entities behaving as infinity.

But, presuming the incompressibility of elementary matter, the black hole itself cannot be (gravitationally or Lorentz) contracted to zero. General relativity is about the geometry of empty space, and I suppose only the empty space around this matter would be contracted. Gravitation inside elementary matter would not be about geometry of empty space, since there isn't any. Since atoms are

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practically void as indicated by [132] and [133], contraction of atomic matter would not be a problem in case of a "normal" *Lorentz factor*.

Tidal *force*

Consider Newton's law of gravitation:

$$F_G = m\frac{GM}{r^2} \qquad @[18]$$

where $\frac{GM}{r^2}$ is the gravitational field around M, which exerts a *force* on m.

To find the difference in *force* at different *distances*, we have to differentiate this with respect to r, yielding the *tidal field*: $g' = \frac{dg}{dr} = \frac{-2GM}{r^3}$ [160]

of which I'll discard the sign since I'm only interested in the absolute value.

When substituting the *Schwarzschild radius* for r we obtain:

$$g' = \frac{2GM}{\left(\frac{2GM}{c^2}\right)^3} = \frac{c^6}{4G^2M^2} \qquad [161]$$

"At the *surface* of" a *critical black hole* conform [145] and [146] this is:

g'_{cr} = 778 284 342 N/kg/m ≈ 79 kilotonne-force/kg/m [162]

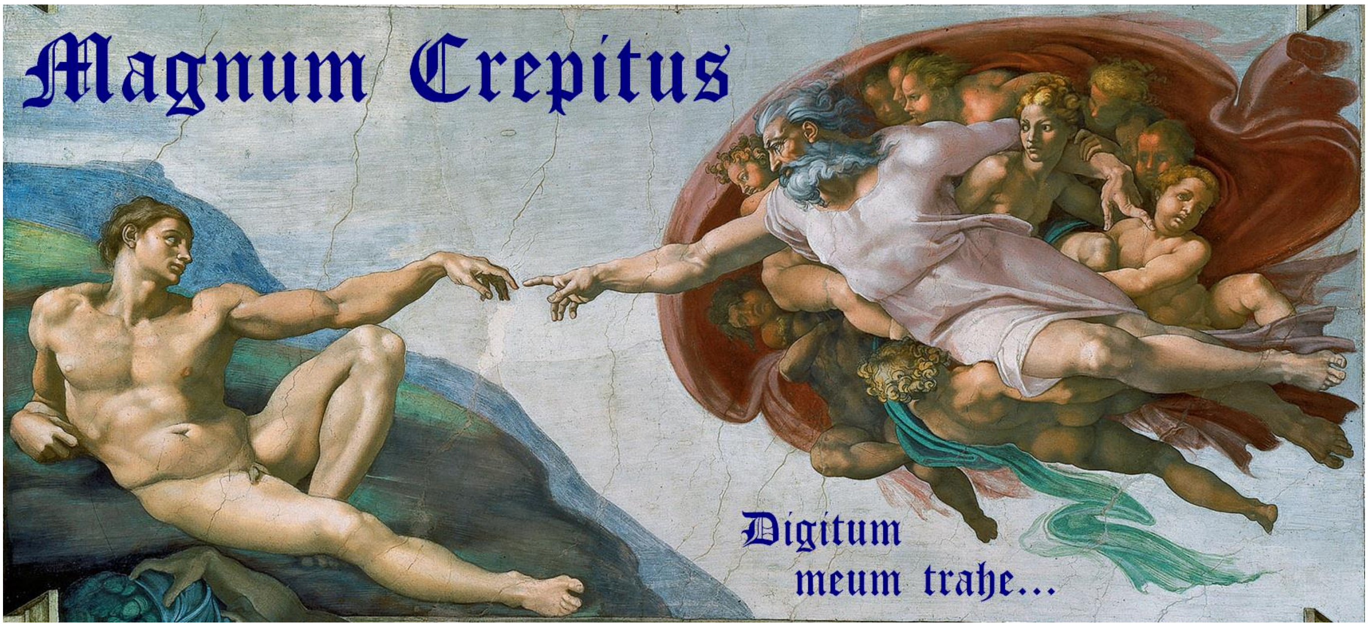
This will definitely tear you apart. Before that, you would be "spaghettified".

For a black hole of 1 million solar *masses* however, it becomes:

$g'_{M\odot}$ = 0.01 N/kg/m = 1 gram-force/kg/m [163]

Which can neglected. You will not be spaghettified when falling into a large black hole.

A simple big bang model



Michelangelo Buonarroti, La Creazione di Adamo, 1511, Cappella Sistina, musei Vaticani, Roma

Free neutrons are unstable. They disintegrate. In an atomic nucleus with a neutron surplus there is neutron decay too, which causes β radiation. Now consider Iniallium, the nilnilnilium isotope as given by [123], with $Z = 0$ and $A = N_{n,U} \approx 2.4 \times 10^{80}$. Isn't that an atom with no electrons and a huge neutron surplus in its nucleus? The *energy* that would be released if all neutrons of the *IniAll* would disintegrate can easily be calculated.

Please note that also in the standard big bang theory there must have been a moment when the universe had the density of neutronium, so it is plausible that it indeed was neutronium. And currently

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hydrogen is by far the most abundant element in the universe, so the bulk of this neutronium must have disintegrated.

Neutron decay: $$n \to p + e + \bar{\nu}_e + E_{1n}\ (+\gamma\ ) \qquad [164]$$
where: $$E_{1n} = E_p + E_e + E_\nu \qquad [165]$$
is the total *kinetic energy* of the particles.
The γ photon is produced in just about one in thousand disintegrations[30], so I'll neglect it.
Then: $$E_{1n} = (m_n - m_p - m_e)c^2 = 0.78257 \text{ MeV} \qquad [166]$$
Together with [94], this yields the total neutron *disintegration energy* of the entire *IniAll*:
$$E_{disint} = N_{n,U} \cdot E_{1n} \approx 2.4 \times 10^{80} \times 0.78257 \text{ MeV} \qquad \approx 3.01 \times 10^{67} \text{ J} \qquad [167]$$
[93] says: $M_U = 4 \times 10^{53}$ kg, which according to [95] corresponds to: $\approx 3.56 \times 10^{70}$ J [168]
Evidently, this ratio of roughly 1000 corresponds to the *mass defect* that occurs in nuclear reactions, since after all, that's exactly what [166] means.

A significant fraction of E_{disint} is carried away by the neutrinos, but the remainder is the *kinetic energy* of the protons and electrons in the reciprocal ratio of their *masses*. In order to have some number for calculations I now presume E_{disint} will fully turn into *thermal energy* and I disregard what's necessary for the *kinetic energy* in the Hubble flow.

Thermal energy is the average *kinetic energy* of the molecules, certainly after a number of collisions, and the universe should soon have a well defined *temperature*. That means it radiates according to Planck's law. Presumably this is what we nowadays observe as the CMB, the Cosmic Microwave Background radiation. In the next calculations I'll use the value of E_{disint} as an estimate of the total CMB *energy*.

Usually, a body cools down when it thermally radiates, but in this case it is the entire universe, which does not have any outer environment. So it is radiating only to itself which then obviously cannot cause cooling down. The lack of an outer environment implies the expansion of the cloud occupied by all matter must be adiabatical, which does cause a cool down.

Extragalactic Background Light

Assuming the total number of stars has been more or less the same all the *time* and using the sun as an average star, the estimated total *energy* radiated by all stars in the universe since the big bang, is simply calculated (estimated) by multiplying [90] with the *Hubble time* and the solar *luminosity*. The sun's *intensity*, as measured by earth orbiting satellites, is[31]:
$$I_\odot = 1360.8 \pm 0.5 \text{ W/m}^2 \qquad [169]$$
by multiplying this by the *surface area* of a sphere with a *radius* of 1 AU, which has been established[32] as 149 597 870 700 m exactly, we obtain:
$$L_\odot = 1360.8 \times 4\pi \cdot (149\,597\,870\,700)^2 = 3.827 \times 10^{26} \text{ W} \qquad [170]$$
yielding: $$EBL_{1,tot} = N_{s,U} \cdot L_\odot \cdot t_\text{H} = 3.38 \times 10^{66} \text{ J} \qquad [171]$$
where EBL stands for Extragalactic Background Light, which excludes the CMB. [171] is of course just a very rough estimate of its total *energy*. It yields $\frac{E_{disint}}{EBL_{1,tot}} = 8.9$, which is of the same order as the value of $\frac{CMB}{EBL} \approx 20$ as published by Simon Driver et al[33].

[30] https://en.wikipedia.org/wiki/Free_neutron_decay
[31] https://en.wikipedia.org/wiki/Solar_irradiance#2011_reassessment
[32] https://en.wikipedia.org/wiki/Astronomical_unit

By the way, when assuming an "average photon" corresponds to (please remember *wavelength* is not a property of a photon) $\lambda_{avg} = 500$ nm when emitted (which is the Sun's λ_{max}), [171] yields an estimate of the total number of photons ever emitted by all stars since the big bang:

$$n_{ph} = \frac{EBL_{1,tot}}{hc/\lambda_{avg}} \approx 8.5 \times 10^{84} \qquad [172]$$

Practically all of them are still flying around (the average grayscale of the Subaru Deep Field image is #0B0B0B, so I estimate the probability of a photon hitting an object as roughly $\frac{0\text{xB}=11}{255} = 4\%$).

[171] assumes all starlight escapes from the galaxies, which of course eventually must be so. The *galaxy luminosity* of our Milky Way however approximates[34]:

$$L_g = 5 \times 10^{36}\ \text{W} \qquad [173]$$

which means: $$L_g \approx 13 \times 10^9 L_\odot \qquad [174]$$

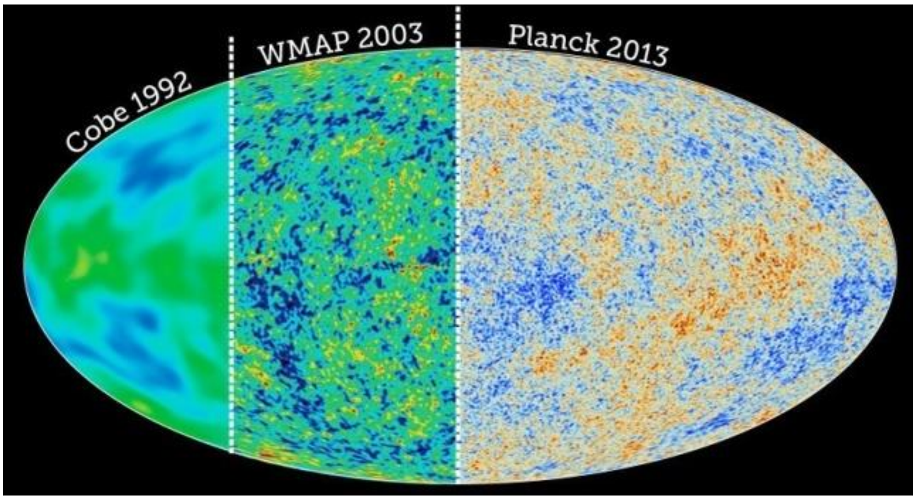
This factor is ≈ 20 times less than the estimated number of stars in the Milky Way of ≈ 250 billion[35]. This means the Sun might not be a proper measure of the average *stellar luminosity* in the entire universe. By using [88], we obtain:

$$EBL_{2,tot} = N_{g,U} \cdot L_g \cdot t_H = 4.42 \times 10^{65}\ \text{J} \qquad [175]$$

which is $\approx 7\frac{1}{2}$ times less (and it lowers the total no. of photons traversing the universe to just $\approx 10^{84}$). A recent publication[36] yields $n_{ph} = 4 \times 10^{84}$, and I already calculated it[37] as 4.4×10^{84} back in 2016...

Cosmic Microwave Background

Discovered in 1964 by Arno Penzias and Robert Wilson, the Cosmic Microwave Background or CMB is the oldest observable we know. It originates from the big bang. It perfectly matches Planck's radiation law. There exists no other natural phenomenon where theory and practice do so closely match. The CMB has been and is being investigated very thoroughly, with ever more and more detailed results.



https://briankoberlein.com/wp-content/uploads/cmb1.jpg

[33] http://s3-ap-southeast-2.amazonaws.com/icrar.org/wp-content/uploads/2016/08/09152012/eblfinal.pdf = Simon P. Driver et al.: MEASUREMENTS OF EXTRAGALACTIC BACKGROUND LIGHT FROM THE FAR-UV TO THE FAR-IR FROM DEEP GROUND- AND SPACE-BASED GALAXY COUNTS, submitted to ApJ Letters 01/23/15

[34] https://en.wikipedia.org/wiki/Orders_of_magnitude_%28power%29#Greater_than_one_thousand_yottawatts, which refers to: van den Bergh, S. (1999). The local group of galaxies. Astronomy and Astrophysics Review. 9 (3–4): 273–318. Bibcode:1999A&ARv...9..273V. doi:10.1007/s001590050019.

[35] https://en.wikipedia.org/wiki/Milky_Way

[36] http://newsstand.clemson.edu/mediarelations/clemson-scientists-measure-all-of-the-starlight-ever-produced-by-the-observable-universe/ (2018-11-29)

[37] http://henk-reints.nl/astro/documents/aantal-fotonen-in-het-heelal.pdf

The CMB has its maximum *intensity per frequency unit* at a frequency of:

$$\nu_{max} = 160.23 \text{ GHz} \qquad [176]$$

and its maximum *intensity per wavelength unit* at a wavelength of:

$$\lambda_{max} = 1.063 \text{ mm} \qquad [177]$$

As should be familiar to every physicist, their product does not equal the *speed of light*, since they are not the *frequency* and *wavelength* of the same light wave, but the points where two different quantities (*intensity per frequency unit* and *intensity per wavelength unit*) each have their own maximum.

Wien's displacement law applies to [177]:

$$\lambda_{max} \cdot T \quad = b_\lambda \qquad = 2.897\,772\,9 \times 10^{-3} \quad \text{m·K} \qquad [178]$$

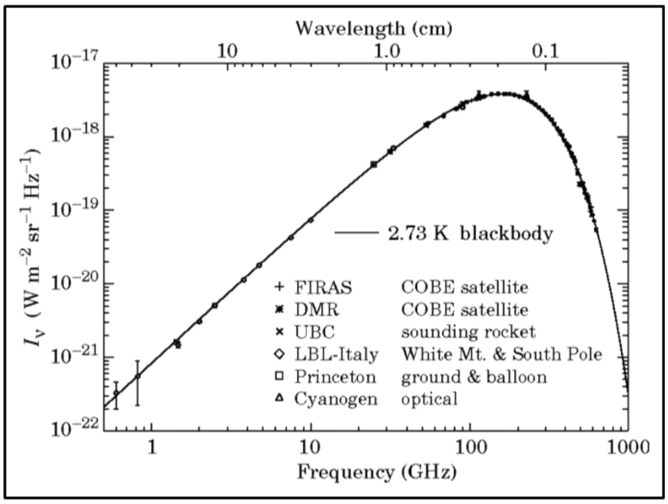
where b_λ is Wien's displacement constant (usually denoted as b without suffix).
Its frequency equivalent[38] applies to [176]:

$$\frac{\nu_{max}}{T} \quad = b_\nu \qquad = 58.789\,238\,1 \times 10^{9} \quad \text{Hz/K} \qquad [179]$$

The photon *energy* then is: $E_{\gamma,max} = h \cdot \nu_{max} = hb_\nu T = \frac{2hb_\nu}{3k} \cdot \frac{3}{2} kT = f \cdot E_{therm}$ [180]

where: $f = \frac{E_{\gamma,max}}{E_{therm}} = \frac{2hb_\nu}{3k} = 1.880\,959\,58$ [181]

so the photon *energy* at maximum *intensity* exceeds the *mean kinetic energy* of the molecules.



https://www.semanticscholar.org/paper/22.-Cosmic-Background-Radiation-22.1.-Introduction-Smoot/d15f1706cc4c59d0a36f8903dfe67919e152738a/figure/0[39]

The CMB *temperature* corresponding to [176] and [177] has been established as[40]:

$$T_{CMB,now} = 2.725\,48 \text{ K} \qquad [182]$$

Since the CMB perfectly matches Planck's radiation law, it must be thermal radiation. According to conventional cosmology, it originates from the post-recombination hydrogen cloud that at that *time* made up the universe. Recombination (protons and electrons combining to H-atoms) is a process we can reproduce in laboratories. Both theory and practice tell us this hydrogen was at a temperature of about 3000 K. From that temperature, we can easily calculate the CMB *redshift factor* as:

$$\zeta_{CMB,conv} = \frac{T_{recomb}}{T_{CMB,now}} = \frac{3000}{2.72548} \approx 1100 \qquad [183]$$

which is a simple application of Wien's displacement law.
But according to [66], the CMB source's *proper age* would then be:

[38] https://en.wikipedia.org/wiki/Wien%27s_displacement_law#Alternate_Maxima
[39] https://pdfs.semanticscholar.org/d15f/1706cc4c59d0a36f8903dfe67919e152738a.pdf
[40] Fixsen, D. J. (2009). The Temperature of the Cosmic Microwave Background. The Astrophysical Journal. 707 (2): 916–920. arXiv:0911.1955 Freely accessible. Bibcode:2009ApJ...707..916F. doi:10.1088/0004-637X/707/2/916

$$\frac{t_H}{\zeta} = 12.7 \text{ million years} \quad [184]$$

which does not match the moment of this very same recombination that should have emitted the CMB according to standard cosmology ($0.38 - 0.48$ million years).

2020-07-29: please see http://henk-reints.nl/astro/HR-CMB.pdf for a new, better and more accurate version of the *CMB* calculations below, yielding 12.4 instead of 12.7.

The CMB originates from the big bang, and as we look very far away, we also look that far back in *time*. So at the "edge of the universe", which currently is at the *Hubble distance* (and definitely not farther away), we "see" the big bang, which is moving away from us at practically the *speed of light*.

But didn't the corrected Hubble–Lemaître law in [61] state we cannot look further back in *time* than half the *Hubble time*? Well, if its *velocity* is close enough to the *speed of light*, relativistic *time dilation* solves that problem. Half the *Hubble time* equals 7 Ga, so, the CMB source was still shining by then, as its *age* was the first half of the *Hubble time*, which of course also equals 7 Ga, [185]
as measured in the *time* of our earth-bound local frame. In its own frame, it was far less. Let's try to determine its redshift and find out its proper age.

Since E_{1n} as given by [166] is *kinetic energy* of the particles, it is *thermal energy*, certainly after a number of collisions with other particles, apart from the *energy* carried away by the neutrinos. In normal β decay in an atomic nucleus, the β particle can have an *energy* that exceeds the *neutron disintegration energy*, where the excess must come from differences in nuclear *binding energy*. But the *IniAll* as a whole was completely blown into pieces, and then such an excess cannot be valid for the universe as a whole. A little more than 50% of the *disintegration energy* is taken away by the neutrino[41] and [166] then yields (using a factor ½):

$$\tfrac{3}{2}kT = \tfrac{1}{2}E_{1n} = \tfrac{1}{2} \cdot 0.78257 = 0.391285 \text{ MeV} \quad [186]$$

from which we obtain: $T_{IniAll} = 3 \times 10^9$ K [187]

This value matches the *temperature* of the big bang nucleosynthesis according to conventional cosmology. If the CMB were emitted at this *temperature*, its *redshift factor* would be:

$$\zeta_{CMB,HR} = \frac{T_{IniAll}}{T_{CMB,now}} = \frac{3\times10^9}{2.72548} \approx 1.1 \times 10^9 \quad [188]$$

which is quite something else than [183], isn't it?

Using this value, equation [76] yields the corresponding *Lorentz factor*:

$$\gamma_{CMB,HR} = \frac{\zeta_{CMB,HR}}{2} = 0.55 \times 10^9 \quad [189]$$

and [73] then yields: $\beta_{CMB,HR} = (\zeta^2 - 1)/(\zeta^2 + 1) = 0.999\,999\,999\,999\,999\,998\,347$

(I used this big precision calculator on ttmath.org) $= 1 - 1.653 \times 10^{-18}$ [190]

As a true *velocity*, this equals: $v = 299\,792\,457.999\,999\,999\,504$ m/s [191]

which is very near the *speed of light*: $c = 299\,792\,458$ m/s

At this *Lorentz factor*, the *energy* of a proton would be 516 PeV. Those guys of the Large Hadron Collider at CERN can't hold a candle to that!

Using [176] (ν_{max} of CMB) and [188] (redshift), we obtain the original photon *frequency* of the CMB:

$$\nu_{max,0} = 160.23 \times 10^9 \cdot 1.1 \times 10^9 = 1.76253 \times 10^{20} \text{ Hz} \approx 176.3 \text{ EHz} \quad [192]$$

Usage of [179] (Wien's displacement law by *frequency*) and [187] (T_{IniAll}) yields:

$$\nu_{max,0} = 58.7892381 \times 10^9 \cdot 3 \times 10^9 = 1.7636771 \times 10^{20} \text{ Hz} \approx 176.3 \text{ EHz} \triangleq 0.729 \text{ MeV} \quad [193]$$

[41] http://www.radioactivity.eu.com/site/pages/Beta_Spectrum.htm

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which is in the range of "normal" γ radiation (in astronomy, the X-ray/γ boundary = 100 keV/photon $\approx 2.418 \times 10^{19}$ Hz). [193] and [186] have a ratio of $\frac{0.729}{0.391} = 1.864$, which is consistent with [181].

[189] also gives the value by which [185] should be divided to get the *proper age* of the *universe* when it emitted the CMB we now observe. I'll call it the *minimal proper big bang duration* $t_{bb,min}$ for which we find:

$$t_{CMB} = t_{bb,min} = 7\ \text{Ga}/0.55 \times 10^9 \quad = 12.7\ \text{years} \qquad [194]$$

which I consider no strange value at all. This is not the *duration* of the (just assumed) neutron disintegration itself, but the age of the post-bang particle cloud universe at the moment it emitted the CMB we observe right now, so the CMB source. Since we may presume the CMB will keep on shining for a while, the *true proper big bang duration* may have been a few decades or so.

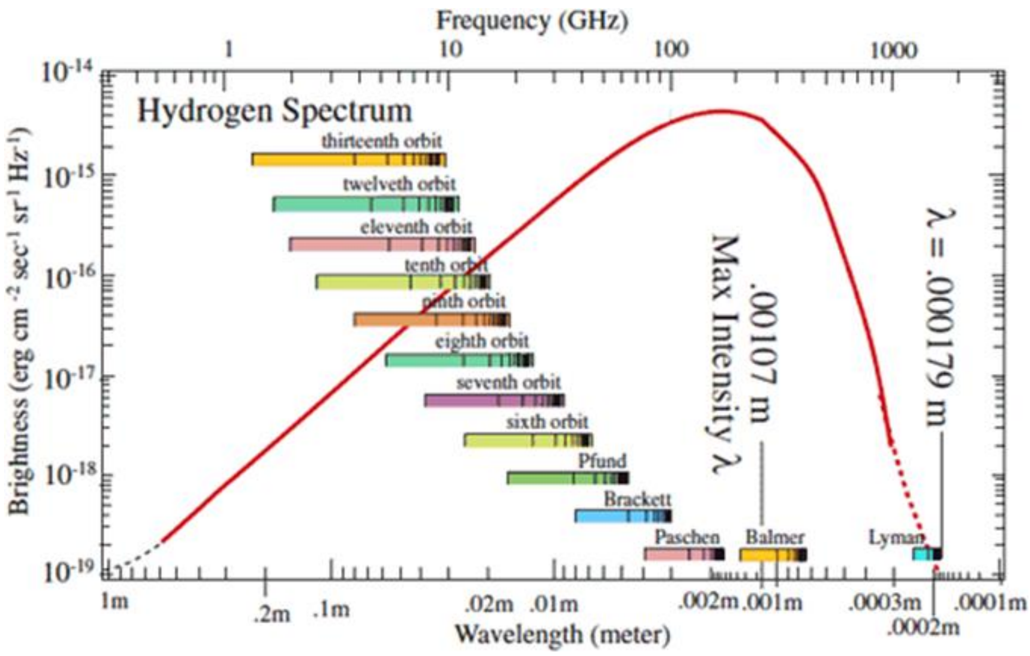
Since the *Hubble distance* (or the "*size* of the universe") grows at the *speed of light*, it always equals the *age* of the universe times the *speed of light*, so the *size* of the CMB source equals:

$$R_{CMB} = 12.7\ \text{light years.} \qquad [195]$$

In this model I ignore what must have occurred during the expansion to 12.7 light years and I simply presume the universe had reached this temperature by then. It is just to get an idea and to have some number to be used in further calculations.

Hydrogen spectrum

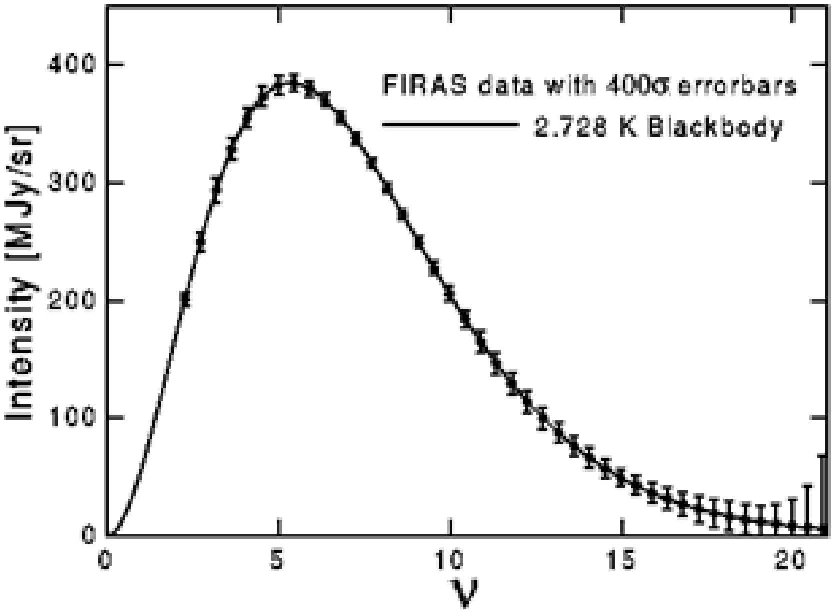
As mentioned in [67], for a photon, *time dilation* is in fact an immediate transition from the source's *time* domain to that of the observer, since a photon is only relevant to its ultimate observer and it is independent of the light source as soon as it has been emitted. It'll approach its ultimate observer at the ever constant *speed of light*, without any cosmological or expansional *redshift* since that cannot exist according to [78]. This means the *redshift*, which is only due to the *relativistic Doppler effect*, must have taken place at the moment of emission. This means the CMB must have had its *redshift* of 1.1 billion as given in [188] all the *time* since the very moment at which it was emitted. This would fully explain the complete absence of the hydrogen spectrum in the CMB spectrum, which is almost exactly conform Planck's radiation law. There exist no hydrogen lines at the *wavelength* the CMB has always had. Next image shows where the hydrogen spectrum should appear in the CMB after applying the conventional *redshift* of 1100 as given by [183]. As can be seen, there are no peaks or spikes at all at any *frequency*.



http://living-universe.com/questions-and-answers/hydrogen-spectrum-at-the-beginning-of-the-living-universe/

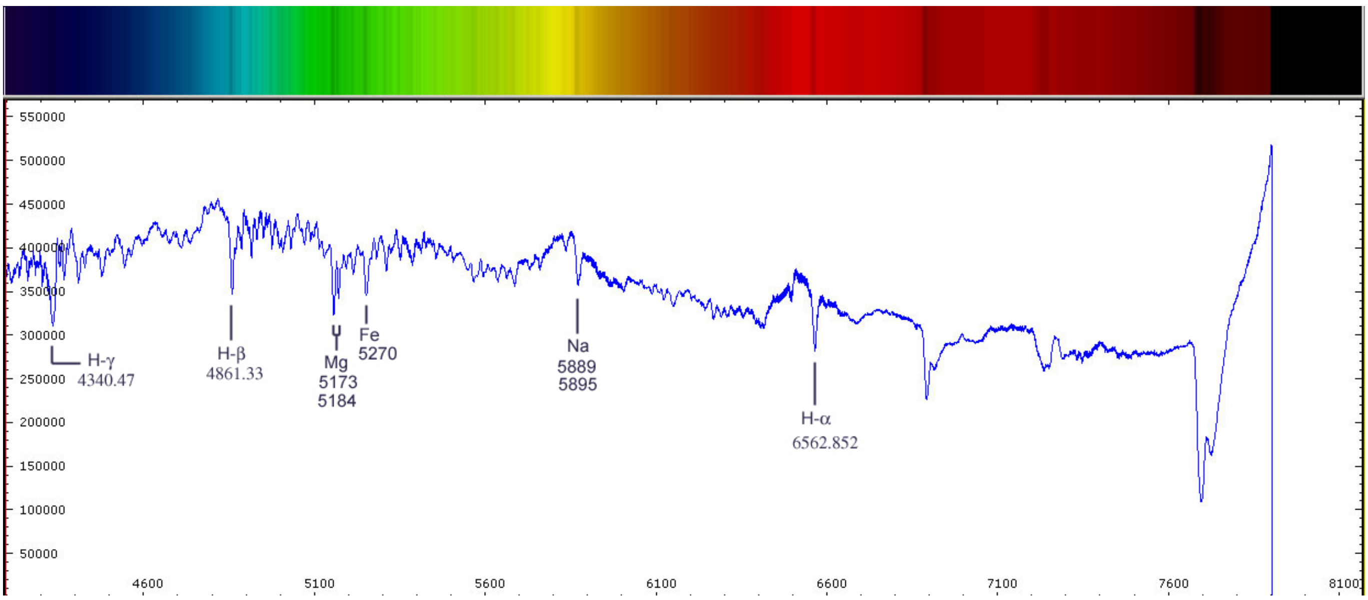
  universe@henk-reints.nl

In the image below, the error bars have been expanded by a factor of 400 in order to be able to show how accurate the measured CMB corresponds to the theoretical curve:



http://abyss.uoregon.edu/~js/ast123/lectures/lec23.html

For comparison, below is the solar spectrum, which also is thermal radiation. It is just the visible part of it (i.e. the rainbow). No doubt it shows lots of so called Fraunhofer lines, including hydrogen lines, i.e. H-α at 6562.852 Å, H-β at 4861.33 Å, and H-γ at 4340.47 Å. The CMB spectrum shows none.



http://igss.wikidot.com/local--files/the-sun-s-continuous-spectrum/solar_spectra_graph.jpg

The pre-recombination universe is said to have been opaque, as a result of Thomson scattering, which does not modify the photon's *frequency*. Of course scattering makes the resulting radiation diffuse, but how can it make the medium in which the scattering takes place opaque? Opaque is the opposite of transparent. Absorption and reflection can make it opaque. But scattering in its inside can't. Especially if that was the universe itself, which cannot be viewed from outside. It was radiation within the entire universe and however it scattered, it remained radiation within this very same universe. Just like how we observe the CMB today. It's everywhere and in all directions and it still fills the entire universe. *Opacity* is a misconception.

Thomson scattering actually is the low-*energy* limit of Compton scattering, which modifies the photon *energy* as follows:

$$E_{\gamma'} = \frac{E_\gamma}{1+\frac{E_\gamma}{m_e c^2}(1-\cos\theta)} \quad [196]$$

For a photon according to [176], the energy equals:

$$E_\gamma = h\nu \quad = 1.062 \times 10^{-22}\ \text{J} \quad [197]$$

and: $$m_e c^2 \quad = 8.187 \times 10^{-14}\ \text{J} \quad [198]$$

so: $$\frac{E_\gamma}{m_e c^2} \quad = 1.297 \times 10^{-9} \quad [199]$$

which makes the denominator of [196] equal to $1.000\ 000\ 001(1)$. It means the CMB photon *energy* did not change in the pre-recombination universe. And as this was not opaque, but only made the radiation more diffuse and homogeneous, this radiation effectively was not altered by the pre-recombination plasma. Altogether this means:

THE CMB *REDSHIFT* EQUALS 1.1×10^9 WHICH FULLY EXPLAINS THE COMPLETE ABSENCE OF THE HYDROGEN SPECTRUM IN THE CMB. [200]

Recombination

As mentioned before, the CMB spectrum perfectly matches Planck's radiation law. This means the CMB was radiated at just **one** *temperature*, otherwise such a perfect match would be impossible. But the universe cooled down and must have emitted thermal radiation at every *temperatur*e, so we should observe a "smeared out" spectrum, which we don't.

According to the Stefan-Boltzmann law, the *intensity* is proportional to T^4, so the hotter the CMB source, the more this fourth power makes the highest *temperature* absolutely dominate the spectrum. This is another argument for [200]. The post-recombination *temperature* of approximately 3000 K is too low to dominate the spectrum and leave it conform Planck's law.

According to conventional cosmology, the recombination (formation of hydrogen atoms from the until then free protons and electrons) started about $380\ 000$ years after the big bang and it lasted circa $100\ 000$ years. Let's do some calculations, using what I found so far. Since it is about the entire universe, there are no surroundings with which to exchange heat, so the expansion of the plasma definitely was adiabatic. The below calculation is for adiabatic expansion of a monatomic ideal gas, although the pre-recombination universe of course was a plasma of protons, electrons, and photons.

Adiabatics equation: $$T \cdot V^{2/3} \quad = constant \quad [201]$$

which yields: $$T_1 \cdot V_1^{2/3} \quad = T_2 \cdot V_2^{2/3} \quad [202]$$

so: $$\left(\frac{V_1}{V_2}\right)^{2/3} \quad = \frac{T_2}{T_1} \quad [203]$$

or: $$\frac{V_1}{V_2} \quad = \left(\frac{T_2}{T_1}\right)^{3/2} \quad [204]$$

and then: $$\frac{R_1}{R_2} \quad = \sqrt[3]{\frac{V_1}{V_2} = \left(\frac{T_2}{T_1}\right)^{3/2}} \quad [205]$$

or: $$R_1 \quad = R_2 \cdot \sqrt{\frac{T_2}{T_1}} \quad [206]$$

and: $$T_1 \quad = T_2 \left(\frac{R_2}{R_1}\right)^2 \quad [207]$$

We've got:

radius of CMB source: R_{CMB} $= 12.7$ light years @[195]

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temperature of CMB source:	T_{CMB}	$= 3 \times 10^9$ K	@[187]
recombination *temperature*:	T_{recomb}	$= 3000$ K	[208]
so:	$\sqrt{\frac{T_{CMB}}{T_{recomb}}}$	$= 1000$	[209]
yielding:	R_{recomb}	$= 12700$ ly	[210]
and therefore:	t_{recomb}	$= 12700$ a	[211]

Compare this to $R_{recomb} = 42$ million ly and $t_{recomb} = 380\,000$ a according to conventional cosmology. The inital *temperature* however more or less matches what conventional cosmology states, as is given on https://en.wikipedia.org/wiki/Chronology_of_the_universe (transition from the Lepton Epoch to the Big Bang nucleosynthesis around $t = 10$ seconds).

Chronology

Let's have a better look at what the just mentioned Wikipedia page says (as of 2018-08-08). Below, *radius* means what is there called the *radius of the spherical volume of space which will become the observable universe*.

Inflationary epoch	$< 10^{-32}$ s		HR: so it ultimately lasted until 10^{-32} s;
Neutron decoupling	1 s	*radius* $= 10$ ly;	this means $v = 10$ light years per second, but OK, it would be including this figment of imagination called inflation. That should however definitely have terminated by now, but look:
BB nucleosynthesis	$10 - 1000$ s	*radius* $= 300$ ly;	$\Rightarrow v = 290$ ly in $9 - 999$s $\approx 10^9 c - 10^7 c$;
Recombination	380 000 years	*radius* $= 42$ Mly;	$\Rightarrow v = 110c$;
Present *time*	13.8 Ga	*radius* $= 46$ Gly;	$\Rightarrow v = 3.33c$.

This list is completely stupidly ridiculous! (Sorry, I'm Dutch and we say things straight forward, not always watching our Ps and Qs...). Even after the fictitious inflationary epoch the *speed limit of light* is extremely seriously violated. I think I've already been quite clear on that. I don't call this science. That word comes from the Latin word scire which means: *to know*, and not: *to contrive concoctions*. I know of no verifyable observation whatsoever that could support these absurd numbers. This list is a cock and bull story.

Edge of the universe

As already mentioned, the Cosmological Principle says the universe is homogeneous and isotropic, which is in agreement with all observations. Both the homogeneity and the isotropy would however be violated if there were any boundary anywhere, since on the other side of it, things would be different. That's the essence of a boundary, isn't it? This can lead to just one conclusion: the universe is unlimited. There is no edge to the universe.

ACCORDING TO THE COSMOLOGICAL PRINCIPLE, THE UNIVERSE IS UNLIMITED. [212]

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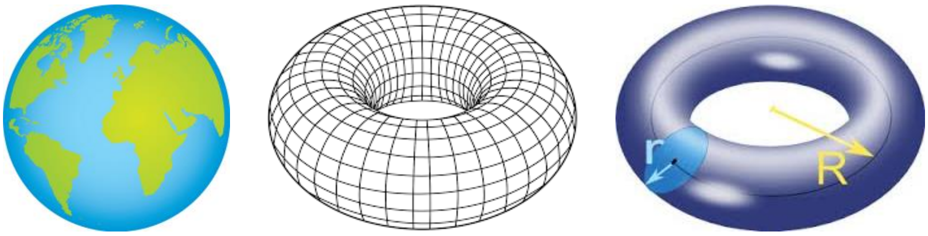
Shape of the universe

For the combination of [32] and [212], mathematical reasoning can lead to just one conclusion: the universe must be closed in itself, cf. Earth's surface, which also is finite (≈ 510 million km^2, which definitely is a finite number) and unlimited, it has no edge at all. Basically, two shapes are possible for a finite and unlimited surface: the sphere (ball shape) and the torus (donut shape), both of which require an extra dimension for their curvature.

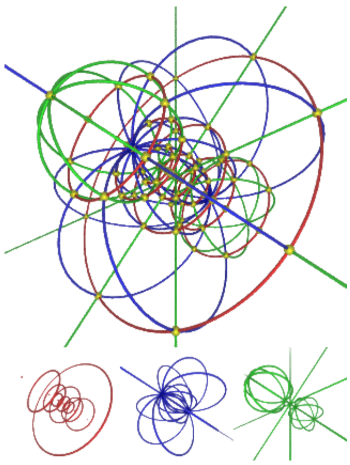
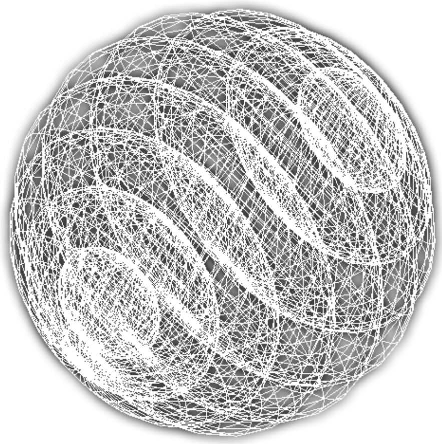


A sphere and a torus

https://www.vectorstock.com/royalty-free-vector/colorful-earth-world-map-with-continents-in-3d-vector-13626403
http://leemath.net/mathematics/AnalyGeometric-calculus/surface-area-torus/

For reasons of homogeneity and isotropy, the concept of a torus cannot be realistic since that has different *radii* of curvature as well as inhomogeneous *density*, which leaves the sphere. Since the universe is 3-dimensional, this must then be a 3-sphere, which is a 4-dimensional hypersphere.

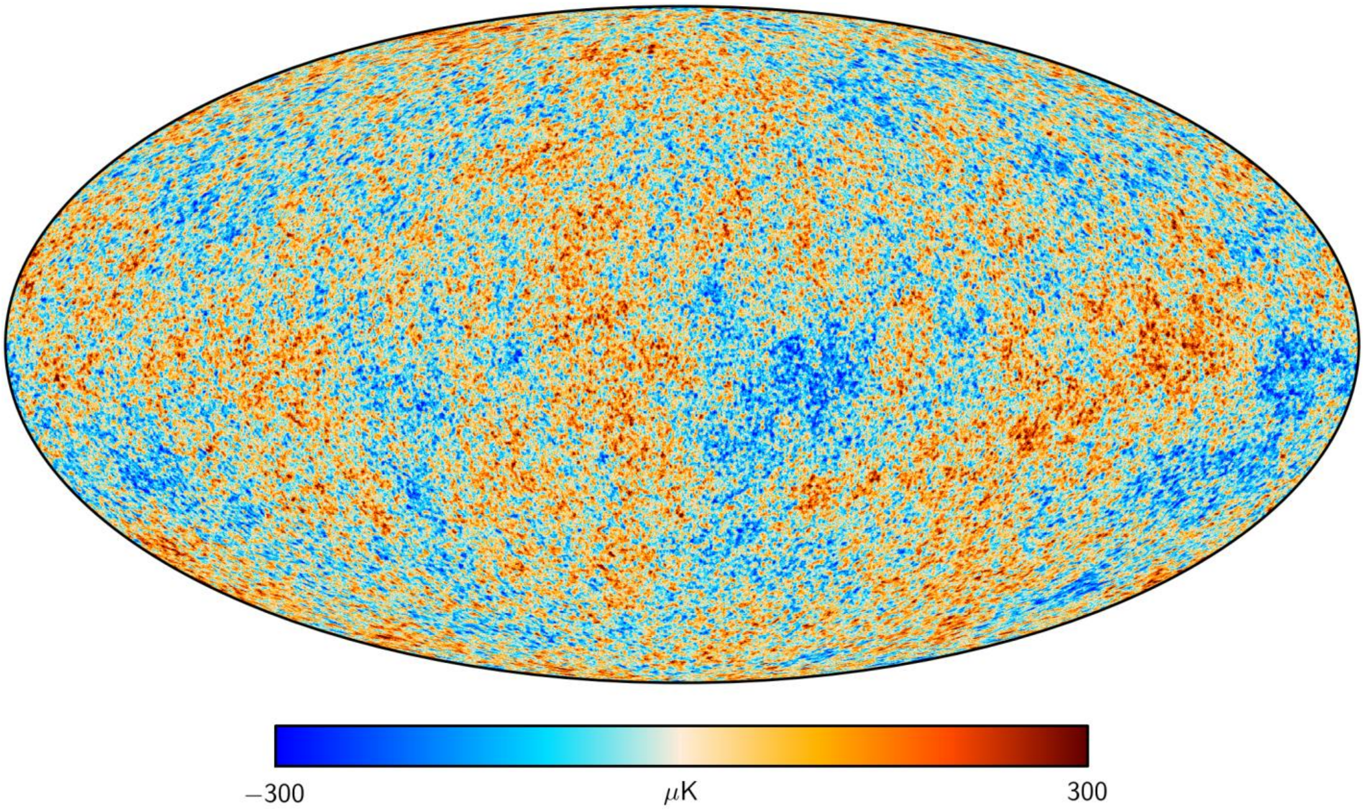
FROM THE HUBBLE–LEMAÎTRE LAW AND THE *SPEED LIMIT OF LIGHT*,
TOGETHER WITH THE COSMOLOGICAL PRINCIPLE,
FOLLOWS THAT THE UNIVERSE CAN BE NOTHING ELSE THAN A 3-SPHERE. [213]

	
Stereographic projection of the hypersphere's parallels (red), meridians (blue) and hypermeridians (green). Because this projection is conformal, the curves intersect each other orthogonally (in the yellow points) as in 4D. All curves are circles: the curves that intersect ⟨0,0,0,1⟩ have infinite radius (= straight line). In this picture, the whole 3D space maps the surface of the hypersphere.	Direct projection of 3-sphere into 3D space and covered with surface grid, showing structure as stack of 3D spheres (2-spheres).

Images and explanations from https://en.wikipedia.org/wiki/3-sphere

The problem with these images is that we are in no way capable of visualising anything 4-dimensional, not even if it is projected on our 3-dimensional space, especially when that projection itself is projected once again on the 2-dimensional space of this document. Any projection causes loss of information. As if you would try to explain a ball to a "flatlander" by showing him a line segment. It's not your fault if you find the above images rather incomprehensible.

Some years ago, when the Planck mission was just completed, some scientist on TV was pointing at the then new very detailed all-sky image of the CMB that was spawned by this mission, and he said: "I can see the universe is flat". And then I thought: "I see a sort of easter egg and Earth used to be flat as well".

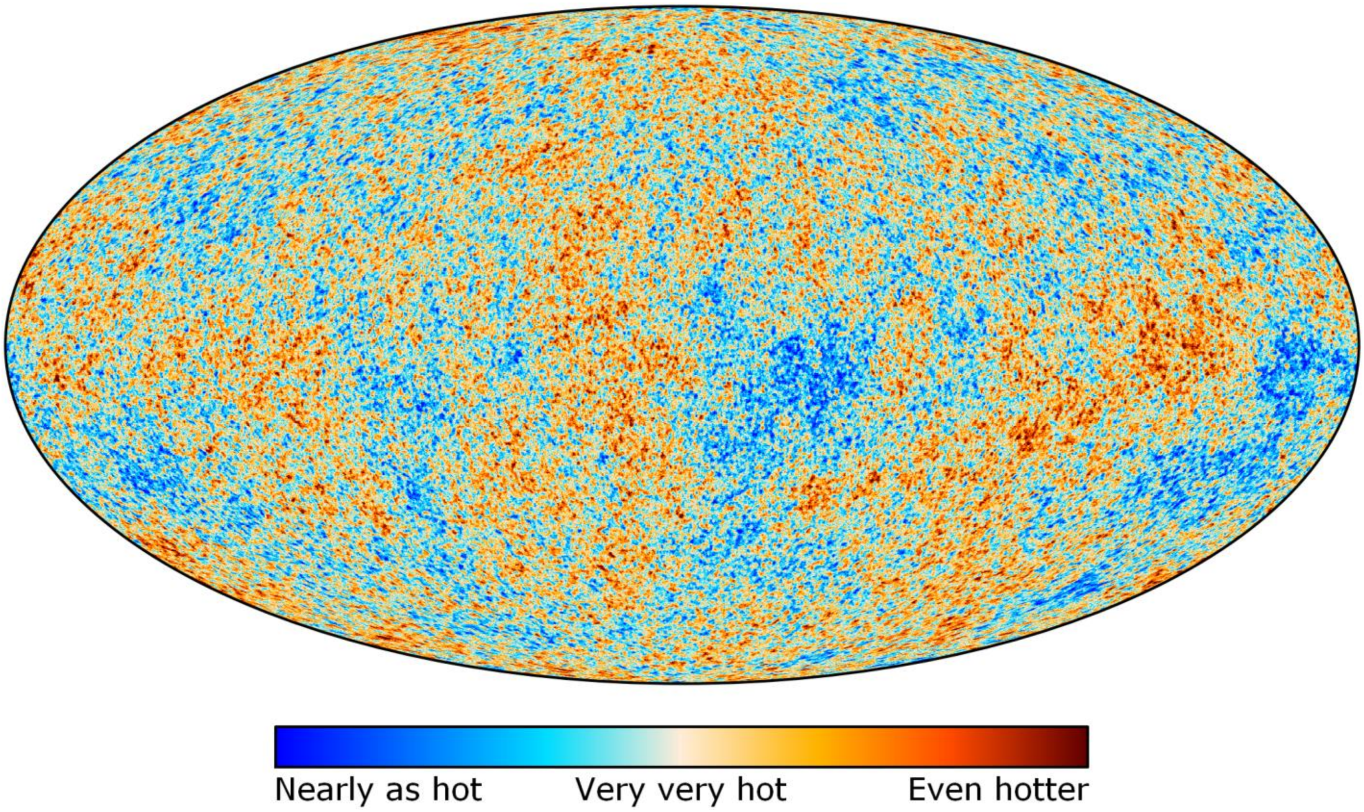


The Max Planck all-sky CMB image, average temperature = 2.72548 K
Temperature variation (anisotropy): ± 300 μK $= \pm 0.11‰$

But Earth isn't flat. Suppose you are on the North Pole and that there is a purple barling on the South Pole, the so called South Pole pole. Also suppose light would geodetically follow the *curvature* of Earth's surface. Then there would be no horizon and as long as the viewing *direction* is parallel to the surface, you would see this purple South Pole pole in every *direction* you look. It would be evenly smeared out in all *directions*, so you would not recognize it as a rod. You'll see it in every direction, so it apparently is all around you, but from its own point of view it is seen from all directions and *you* are all around *it*. A well-known characteristic of all pole poles[42], especially the purple ones, is that they're opaque, so you can't see through them. This means you cannot look beyond it and you would never ever be able to look all the way round and see the back of your own head.

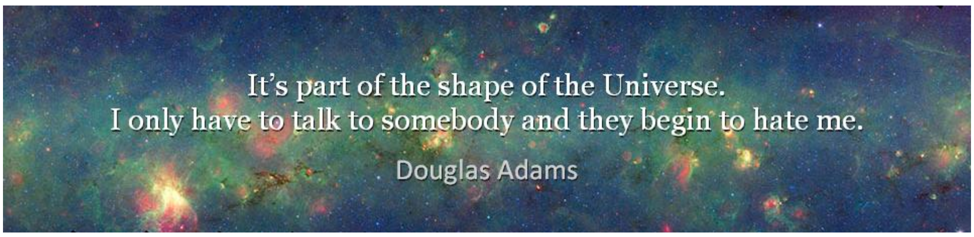
Now look at the CMB. It is also seen in all directions. And in a 3-spherical universe, the CMB source would be a not too large thing, the exploding *IniAll* or its very young remainder, residing around the antipodal point. From its own point of view, it would be seen from all directions.

[42] Henkus Tancus Sapiens, In Investigationis Ad Diaphanum Purpura Polus Polus Australis, Plena Libro De Miris Rerum Figmenta Et Alias Ineptias 18, XI.1, (957).



The CMB source seen *from* *all directions, average temperature* ≈ 3 billion K

As a matter of fact, this ball would be a 3-sphere cap around our antipodal point on the 3-sphere. And it is the oldest entity in the universe at the greates *distance* possible, the *Hubble distance*.
But we observe it as it was half the *Hubble time* ago, when it was at half the *Hubble distance*, which at that moment was the *proper size* of the universe.
Half the 3-sphere's circumference equals the *Hubble distance, which* grows at the *speed of light*, so the antipodal point is receding at that *velocity*. This means the 3-sphere is growing at a *hyperradial velocity* of $\frac{c}{\pi}$. It would be hyperspherically symmetrical in such a way that the universe manifests in the same way anywhere. Let's nickname the Cosmological Principle the Cosmetical Principle...
This 3-spherical geometry also deals with the seemingly abrupt end of the universe at the *Hubble distance*, which would contradict the absence of any boundary and which lead to the fictitious horizon problem. As explained before, the absence of any boundary follows from the Cosmological Principle.
You can definitely never ever look beyond the antipodal point for two reasons. 1: it recedes at the *speed of light*, which, as Einstein said[43], physically plays the role of the infinite *velocities*, and 2: you would look further back in *time* than the big bang. It also means you can definitely not look all the way round to see the back of our own Milky Way, simply said because it would need to be twice as old as the universe itself.



http://www.spitzer.caltech.edu/images/3354-ssc2008-11a7-GLIMPSE-MIPSGAL-Milky-Way-7

[43] Albert Einstein, Zur Elektrodynamik bewegter Körper, Annalen der Physik 17, 891-921 (1905), §4, near end of p.903.

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As said, the *CMB source*, which resides around our antipodal point, recedes from us at nearly the *speed of light*, see [191]. And it emits thermal radiation corresponding to [187], which immediately undergoes a *relativistic Doppler redshift* conform [188] at the moment of emission since it immediately belongs to its ultimate observer and then it travels ever unmodified towards the observer's eye at the never changing *speed of light*. It emits that light in all directions and we receive it from all directions.
As given by [195], the *CMB source* we now observe had a *radius* of just 12.7 light years.

I already found:	$\zeta_{CMB,HR}$	$= 1.1 \times 10^9$	@[188]
as well as:	$\gamma_{CMB,HR}$	$= 0.55 \times 10^9$	@[189]
and with:	β	$= (\zeta^2 - 1)/(\zeta^2 + 1)$	@[73]
we obtained:	$\beta_{CMB,HR}$	$= 0.999\,999\,999\,999\,999\,998\,347 = 1 - 1.653 \times 10^{-18}$	@[190]

According to [60], the CMB source is at a *current proper distance* of:

$$D_{CMB} = \beta \cdot D_H \quad [214]$$

giving it an apparent *radius* of:

$$R_{CMB,app} = (1 - \beta) \cdot D_H = 1.653 \times 10^{-18} \cdot D_H = 218\,940 \text{ km} \quad [215]$$

which is 0.57 times the average Earth - Moon *distance*.
But this *distance* is largely Lorentz contracted. Reverse Lorentz contraction yields:

$$R_{CMB} = R_{CMB,app} \cdot \gamma_{CMB,HR} = 12.7 \text{ light years} \quad [216]$$

which (of course) matches [195], because after all, this calculation is circular reasoning.

The antipodal point recedes at the *speed of light*, which, as just said, plays the role of the infinite *velocities*, i.e. it behaves like infinity. This implies the antipodal point itself also behaves like infinity. Effectively, it is the virtual edge of the universe, you cannot look beyond it, and it pretends to reside at an infinite *distance*.

In a 3-spherical universe, it does not matter in which direction you look, you are always looking in the direction of the antipodal point, cf. the South Pole pole. The antipodal point makes itself appear as if it were infinitely far away, because it recedes at the *speed of light*. This effectively makes it just as opaque as the purple South Pole pole. And every point in space has its own antipodal point, which perfectly matches the Cosmological Principle.

https://www.hvitserk.com/assets/components/phpthumbof/cache/PolarExpeditionHvitserkofNorway.70491f768a508b56909aa72abdee746b.jpg

The South Pole pole is not a fiction. It was placed on the 14th of December 1911 by Roald Amundsen (r)

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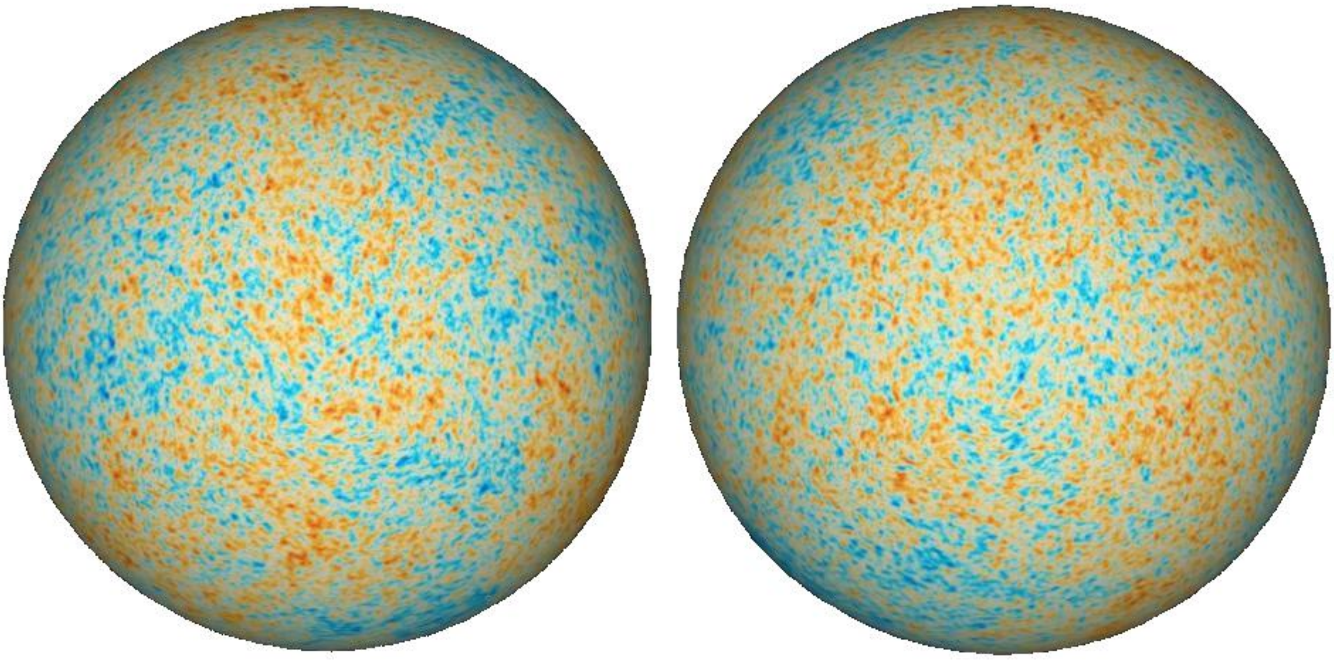
The 12.7 light year in *radius* ($\approx 220\,000$ km in *our* local frame) CMB source, residing around the antipodal point, looks like the image below (it shows the temperature in what I call *bathroom colors*, i.e. *red* meaning *hotter* and *blue* meaning *colder*).

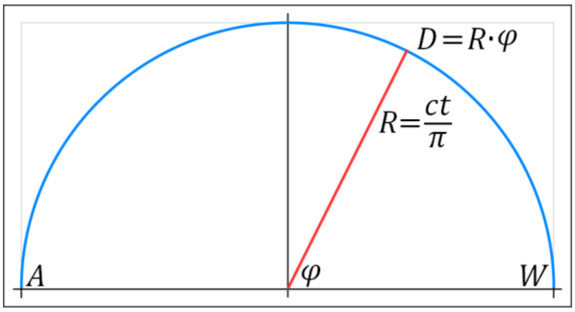


The two hemispheres of the exploded IniAll, as it resides around our antipodal point.
https://medium.com/starts-with-a-bang/where-is-the-cosmic-microwave-background-67cd0b1ba9

According to conventional cosmology, the universe would be larger than 42 million light years in *radius* at that moment. Those 42 million light years are the amount of space that would become the now observable universe, a fiction I already tackled. At this presumed *size* however this post-recombination cloud would be too large to achieve thermal equilibrium, since even the *speed of light* would be insufficient for the necessary information interchange at those *distances*. Hey, now they're suddenly obeying the *speed limit of light*, which they heavily tresspassed to achieve this far too large universe. But the Planck mission measured an *anisotropy* of just $\pm 0.11‰$, which at the *recombination temperature* of 3000 K corresponds to a variation of just ± 0.33 K in the entire $\geq 2 \times 42$ million light year in *diameter* hydrogen cloud. If that isn't thermal equilibrium, then what is it? This mismatch is part of that figment of imagination called the horizon problem, but I can hardly stop laughing about those 42 million light yeaheheahears. It merely was 12.7 ly, measured in its own local frame.
The *extension velocity* of this universe equals the *speed of light*, and if we may assume that a *constant of nature* is really constant, i.e. does not change over time, the extension of the universe has always had this same *velocity* and then the extension of the universe is certainly not accelerating.
To my opinion, accelerating expansion is another misconception of conventional cosmology, for which even a Nobel Prize was awarded.
Although I have not yet found a watertight logical reasoning for it, I think the causality between the universe's *extension velocity* and the *speed of light* is just the other way around. I think the universe simply applies its *extension velocity* to its interior as the maximum possible *velocity* at all.

3-sphere

It's *time* to do some math. Assuming the universe is a 3-sphere with the CMB source in the antipodal point (as seen from anywhere in the universe, but every point has its own antipodal point), we can make the following image.



A = antipodal point, W = observer's point (Dutch for *observer* = *waarnemer*)
$\varphi \triangleq$ *comoving distance*, D *(arc length)* = *proper distance*
half *circumference* = *Hubble distance*

The *radius* of the 3-sphere would be: $R = ct/\pi$ [217]

which then grows at a *velocity*: $V = \frac{dR}{dt} = c/\pi$ [218]

Any *distance* from the observer corresponds to an angle φ as seen from the 3-sphere's centre. That angle would correspond to the *comoving distance* and the *proper distance* would be:

$$D = R \cdot \varphi \quad [219]$$

The *distance* from any observer to his antipodal point would be:

$$D_A = \pi R = ct \quad [220]$$

so the *antipodal distance* increases at the *speed of light*. That's exactly what the *Hubble distance* does. And it is in agreement with t being the age of the universe, so:

$$D_A = D_H \quad [221]$$

The point at angle φ would have a *velocity*:

$$v = V \cdot \varphi = \frac{V \cdot D}{R} = \frac{\frac{c}{\pi} \cdot D}{D_H/\pi} = \frac{D}{D_H} \cdot c \quad [222]$$

so: $\frac{v}{c} = \frac{D}{D_H}$ [223]

which is exactly the corrected Hubble–Lemaître law for *current proper distance*.

Ball in Euclidean *space*

In Euclidean geometry the *volume* of a ball with radius r around an observer equals:

$$V_E = \frac{4}{3}\pi r^3 \quad [224]$$

with: $\rho = \frac{r}{D_H}$ (dimensionless *distance*) [225]

the dimensionless *volume* becomes: $\frac{V_E}{D_H^3} = \frac{4}{3}\pi\rho^3$ [226]

and the ball's dimensionless *surface area* then is:

$$\frac{A_E}{D_H^2} = 4\pi\rho^2 \quad [227]$$

The total *Euclidean volume* of the entire (spherical) Euclidean universe is found by substituting $\rho = 1$:

$$V_E = \frac{4}{3}\pi {D_H}^3 = 11494 \text{ Gly}^3 \quad [228]$$

yielding an average density of: $\rho_{U,E} = \frac{M_U}{V_E} = 4.11 \times 10^{-26}$ kg/m^3 [229]

or: $\frac{N_{n,U}}{V_E} = 24.7$ nucleons/m^3 [230]

Conventional cosmology assumes: $\rho_{U,conv} \approx \rho_{U,crit} = \frac{3H_0^2}{8\pi G} = 9.2 \times 10^{-27}$ kg/m^3 [231]

so $\rho_{U,E} \approx 4.5\rho_{U,conv}$ not taking any dark matter or *energy* into account.

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Ball in 3-spherical *space*

In 3-spherical geometry that ball would be a 3-sphere cap and its *volume* is given by:

$$V_{3S} = \pi R^3 \left(\frac{2r}{R} - \sin\frac{2r}{R}\right) \qquad [232]$$

where R is the *hyperradius* of the 3-sphere and r is the radius of the ball.

With: $$R = \frac{D_H}{\pi} \qquad [233]$$

we obtain: $$V_{3S} = \frac{D_H^3}{\pi^2}\left(\frac{2\pi r}{D_H} - \sin\frac{2\pi r}{D_H}\right) \qquad [234]$$

after substituting: $$\rho = \frac{r}{D_H} \qquad [235]$$

the dimensionless *volume* becomes: $$\frac{V_{3S}}{D_H^3} = \frac{(2\pi\rho - \sin 2\pi\rho)}{\pi^2} \qquad [236]$$

The ball's *surface area* is: $$A_{3S} = \frac{dV_{3S}}{dr} \qquad [237]$$

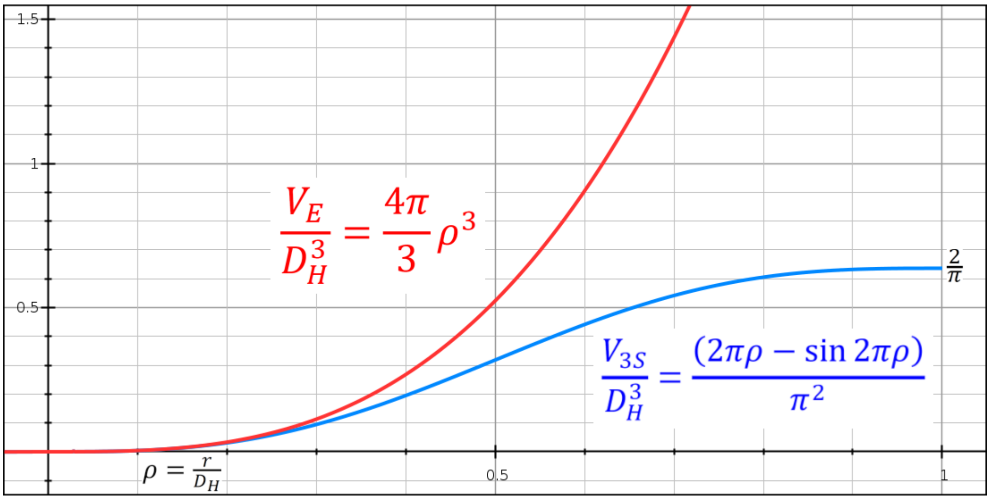
yielding: $$\frac{A_{3S}}{D_H^2} = \frac{4\sin^2\pi\rho}{\pi} \qquad [238]$$

The total *volume* of the entire 3-spherical universe is found by substituting $\rho = 1$:

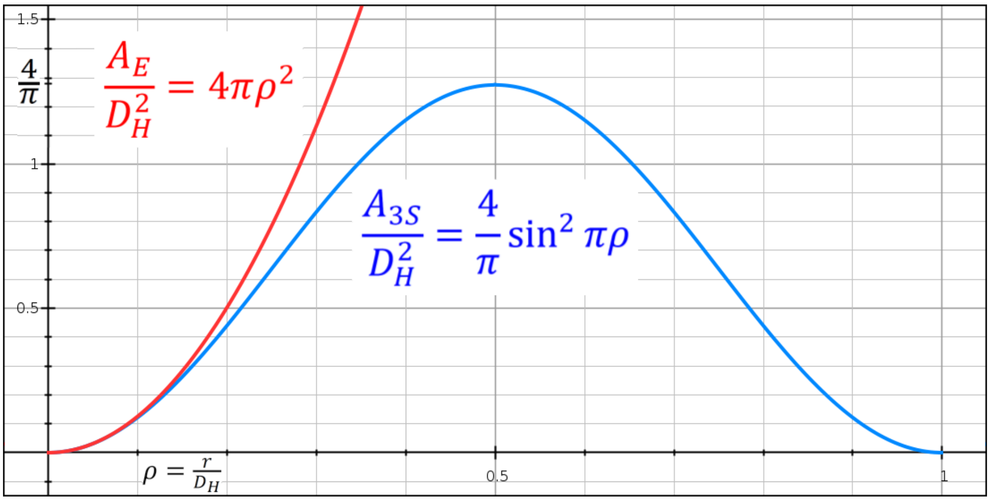
$$V_{3S} = \frac{2D_H^3}{\pi} = 1747\ \text{Gly}^3 \qquad [239]$$

yielding an average density of: $$\rho_{U,3S} = \frac{M_U}{V_{3S}} = 2.70 \times 10^{-25}\ \text{kg/m}^3 \qquad [240]$$

or: $$\frac{N_{n,U}}{V_{3S}} = 162\ \text{nucleons/m}^3 \qquad [241]$$



Euclidean and 3-spherical volume of a ball around us



Euclidean and 3-spherical surface area of a ball around us

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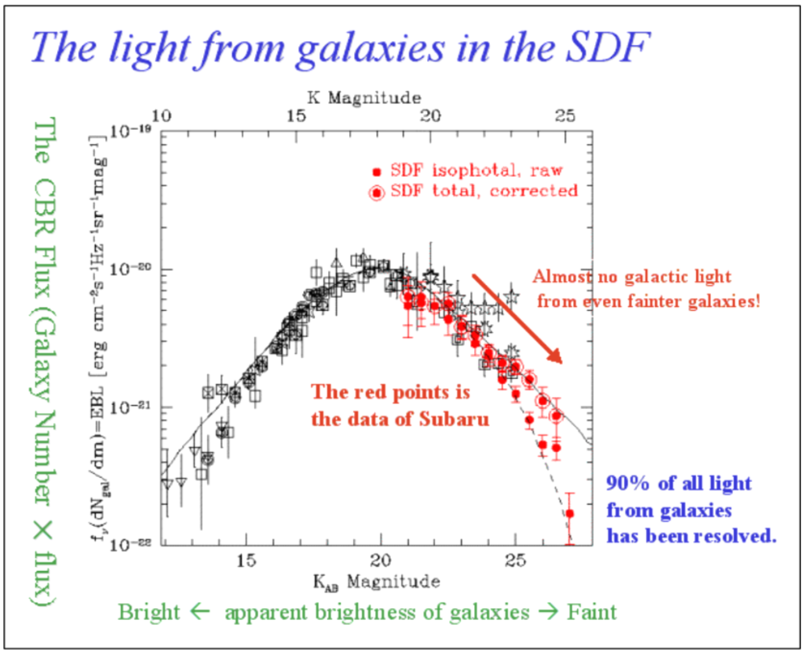
As can be seen, in a 3-spherical universe the ball's *surface area* has a maximum at half the *Hubble distance*. In a homogeneous universe the number of objects should then also have such a maximum, which should be observable in the *objects count* as a function of their *distance*.

Subaru Deep Field

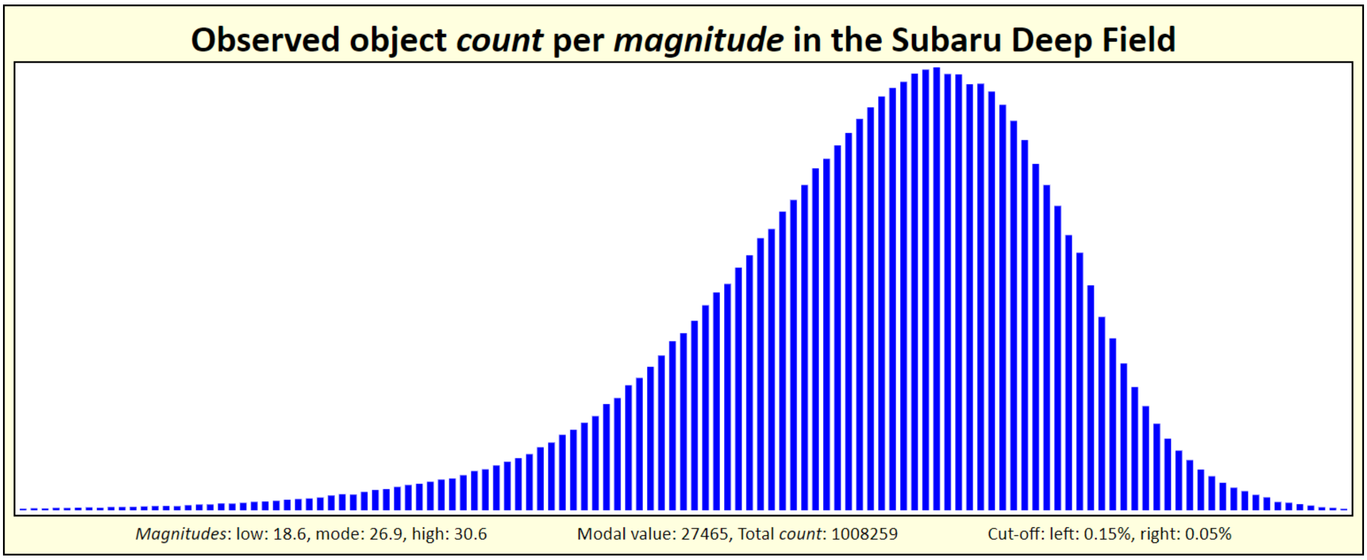
In August 2017 I downloaded the file Lecture 2, Galaxy number counts and luminosity functions from http://www.ifa.hawaii.edu/~cowie/ast626, containing the image below. SDF is the Subaru Deep Field, which was observed from 2002 - 2004 using the 8.2-m Subaru Telescope in Hawaii. The SDF is a bit greater than the full moon and it contains ca. 1 million galaxies, which is in accordance with [86].



https://subarutelescope.org/Pressrelease/2001/04/30/Fig2_e.gif

It does not exactly show galaxy counts as a function of distance, but it made me smile, it more confirms than contradicts a 3-spherical universe. Similar images are contained in the aforementioned (p.28) publication by Simon P. Driver[33], in figures 1, 2, and A1-A6.

In November 2018 I finally found the SDF catalogs on http://soaps.nao.ac.jp/SDF/v1/index.html. I downloaded sdf_v1_B.cat, sdf_v1_ip.cat, sdf_v1_Rc.cat, sdf_v1_V.cat, sdf_v1_V_Rcmag.cat, and sdf_v1_zp.cat. Unfortunately they do not contain redshifts. I calculated the average of all MAG_BEST values per object id and created a histogram of the actual *galaxy count per magnitude*:

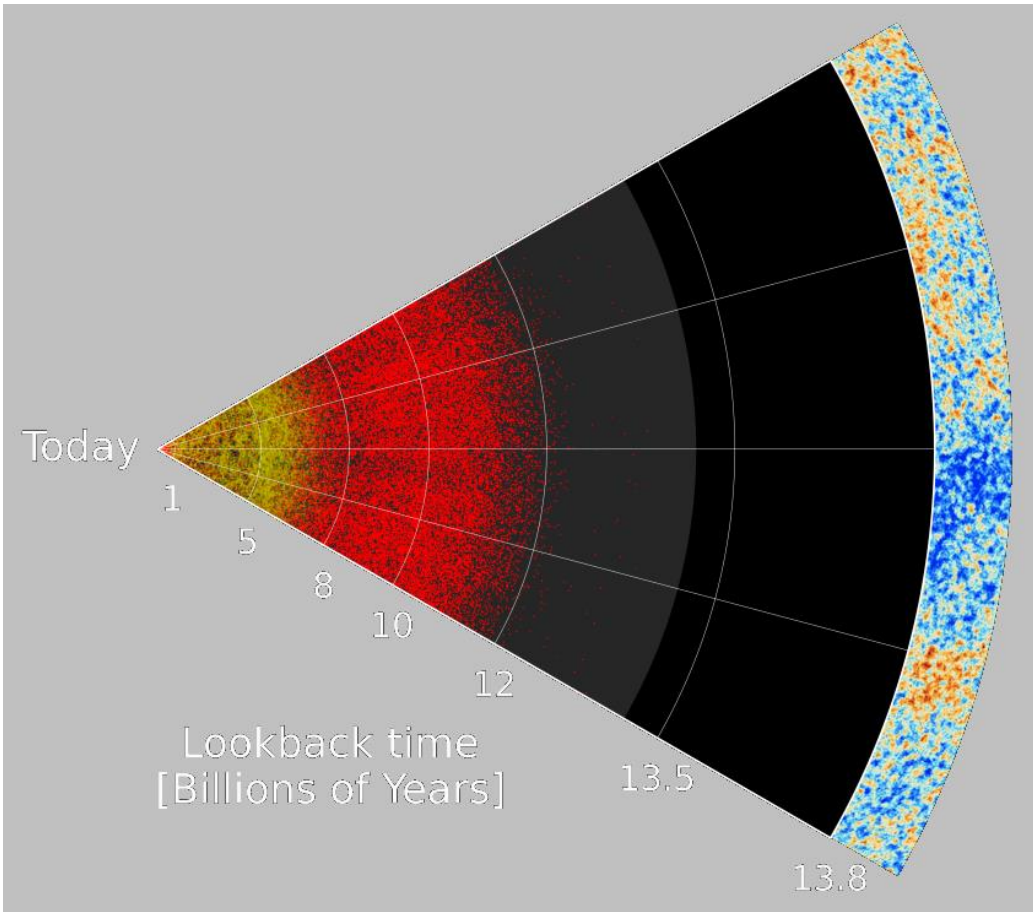


Compare this to the above graph of the 3-sphere cap *surface area* as a function of the *radius* = *distance* and keep in mind that *magnitude* is not *distance*, but further below I do some calculations about the *magnitude* as a function of the *distance*, and they show the *apparent magnitude* is roughly linear with the *distance* over quite a large intergalactic *distance* span. There (at page 53) also appears a graph of the *galaxy count* per *distance* for both geometries.

The full Subaru Deep Field, a bit larger than the full moon
http://www.astro.tau.ac.il/~orgraur/sdf/images/sdf_mosaic.jpg

Quasars

In May 2017 the image below was published by the Sloan Digital Sky Survey, showing galaxies and quasars in a section of the universe which spans about one third of the full sky.



Do you also see a dog just within 5 billion years from today?

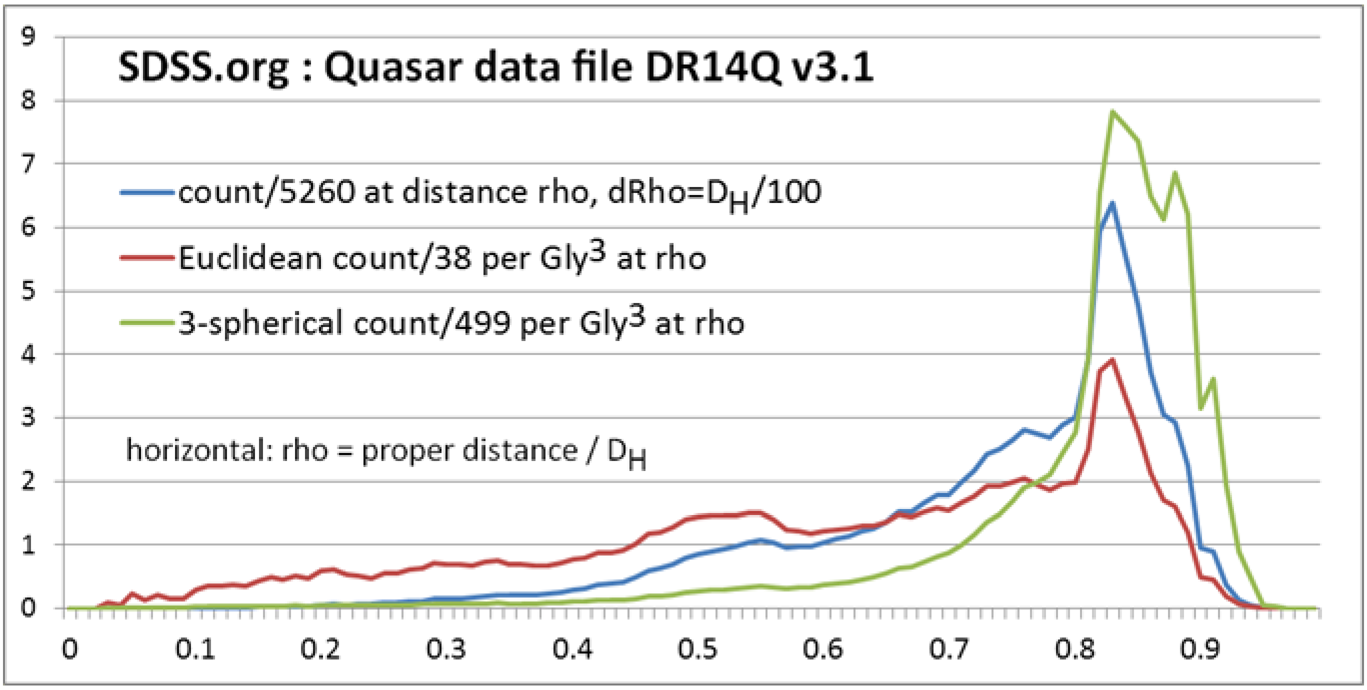
https://www.sdss.org/press-releases/astronomers-make-the-largest-map-of-the-universe-yet/

According to the corrected Hubble–Lemaître law, the given *lookback time* is of course incorrect, proper math yields it is the *current proper distance*.

After I contacted SDSS, they told me the underlying data of this image were in the *DR12Q.fits* file from SDSS Data Release 12. Meanwhile, they have arrived at Data Release 14, from which I downloaded and analysed https://data.sdss.org/sas/dr14/eboss/qso/DR14Q/DR14Q_v3_1.fits which was released on 2017-08-25. It contains data of 525982 quasars, including their *redshifts*. On 2017-12-08 they released https://data.sdss.org/sas/dr14/eboss/qso/DR14Q/DR14Q_v4_4.fits. It contains practically the same data, its quasar count is 526356.

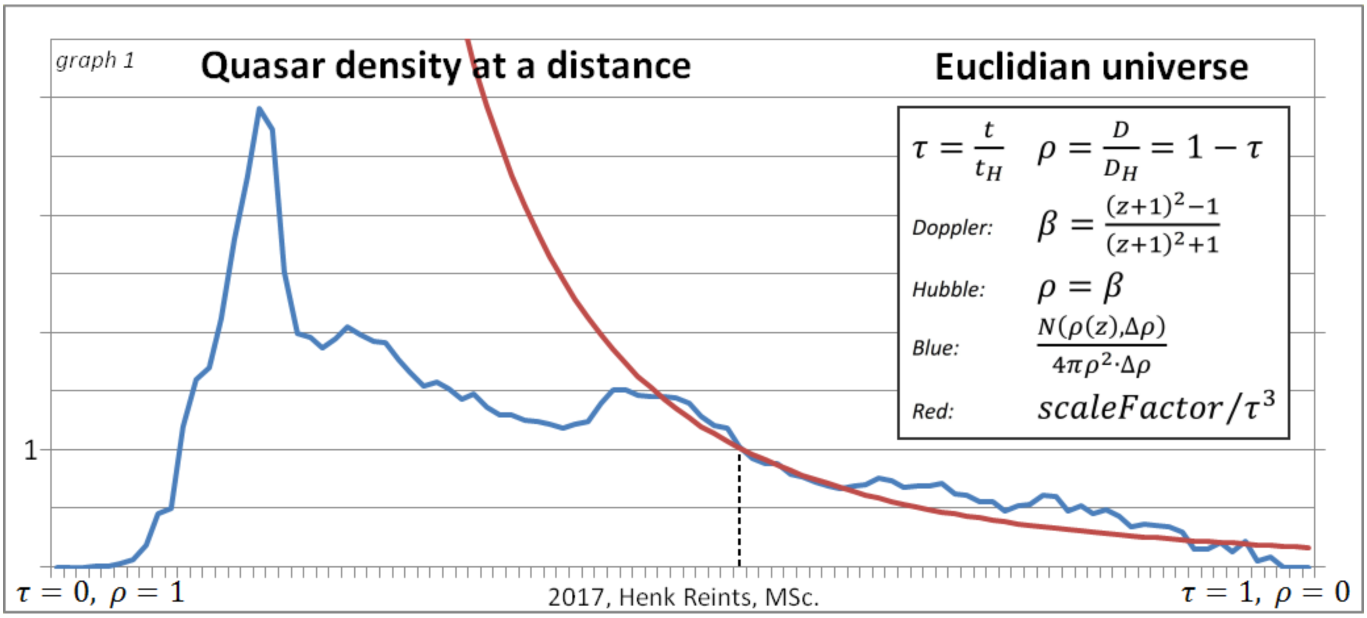
The images below are the result of my analysis of DR14Q_v3_1.fits on 2017-09-03, which for me was a special date. It is my late grandmother's birthday (whom I was named after) as well as the day when my own age in days was exactly the same as my mother's when she died.

I computed the counts at each $D_H/100$ *distance* interval using only the relativistic Doppler effect [73] and the corrected form of the Hubble–Lemaître law [60]. The resulting *counts* and *densities* are in the image below. The values are all relative to their own averages, which are mentioned in the denominators in the legend.



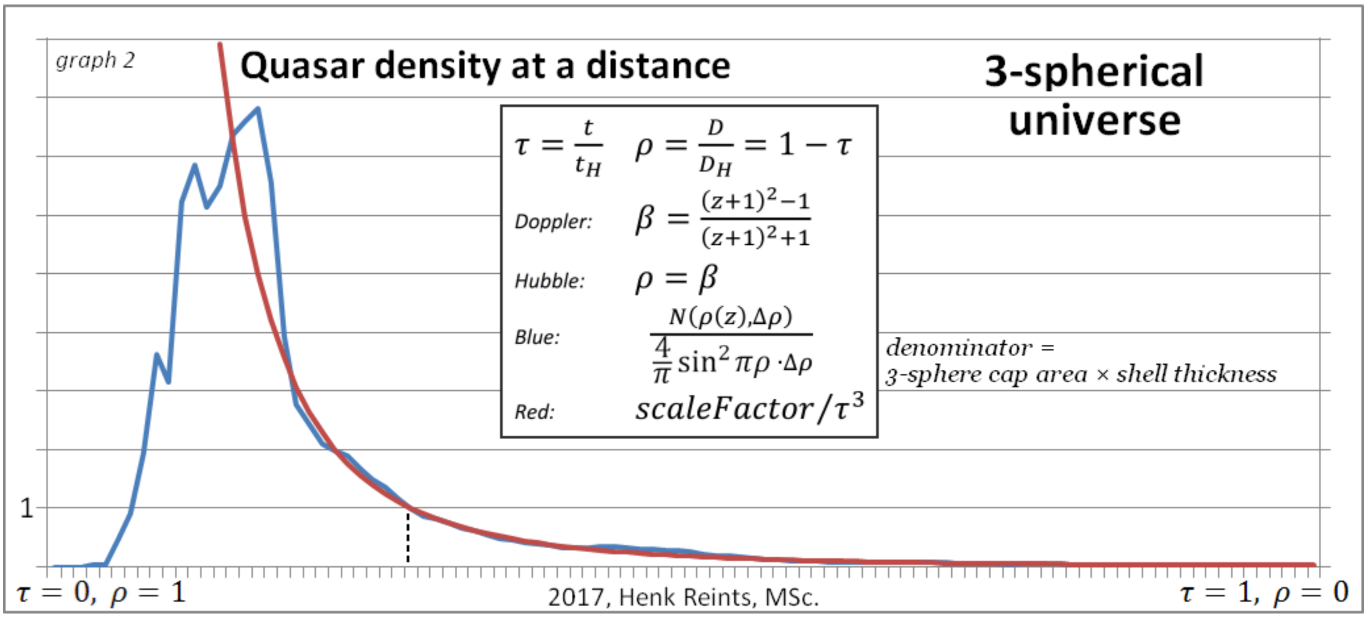
There is a slight maximum in the *quasar count per distance* (in blue), but not very prominently.

However, when taking a better look at the *quasar density per distance*, which from far to near also is the *density* over *time*, I found:



The red curve is proportional to t^{-3}, which corresponds to the theoretical *reciprocal volume* of a linearly extending universe. It has been scaled to the *quasar density* at its average value, which has been normalised to 1. In the above Euclidean model of the universe it is not possible to match the curves anyhow, whatever scaling is used.

But look at the *quasar density* over *time* for the 3-spherical calculation:



Now both curves have a nearly perfect match. We see the quasar genesis which has a small shoot-over, and since roughly $\tau \approx 0.2$ the *quasar density* over *time* nearly perfectly matches a linear extension of the universe. This means there has been practically no change in the total number of quasars ever since. I was cheering. To me this is convincing evidence that

THE UNIVERSE IS A PERFECTLY LINEARLY EXPANDING 3-SPHERE [242]

WITH HALF THE *CIRCUMFERENCE* EQUAL TO THE *HUBBLE DISTANCE*
AND THE CMB SOURCE AROUND THE ANTIPODAL POINT.

Ex obſervatis phænomenis immediate deductum eſt.

It has directly been deduced from observed phenomena.

It was derived from the *redshifts* only, using only the *relativistic Doppler effect* and the corrected Hubble–Lemaître law for *current proper distance* and it yielded a nearly perfect agreement of the *density* over *time* and a linearly extending universe. The data and script I used for this analysis can be downloaded for verification: http://henk-reints.nl/astro/The-universe-HR-zip.php

The *IniAll* must of course already have been a 3-sphere. Its *hyperradius* is calculated using [236] and [121]:

$$V_{3S} = 2\pi^2 R^3 = V_{IniAll} \quad = 2.873 \times 10^{35}\ \text{m}^3 \quad = 85.8\ \ \text{AU}^3 \qquad [243]$$

so:

$$R_{IniAll}^{hyper} = \sqrt[3]{\frac{V_{IniAll}}{2\pi^2}} \quad = 1.632\ \ \text{AU} \qquad [244]$$

This perfect match also shows that the accelerating *expansion* of the universe, for which a Nobel Prize has been awarded, is a mistake. Observed quasar *redshifts* reveal that their *density over time* perfectly matches a linearly expanding universe. This assumed *acceleration* also contradicts the constant growth of the *Hubble distance*, which is at the very *speed of light* and that's a *constant of nature* of which we may presume it really is a constant, so it has ever had the very same value.

Obvious is that the 3-sphere's *hyperradius* cannot be the same dimension as Minkowski's ict, since the former grows at $\frac{c}{\pi}$ conform [218] and the latter progresses at c, so it must be a 5th dimension. This means the 3-spherical geometry is not due to gravitational curvature as described by general relativy. I have no idea what it could be instead, & hypotheſes non fingo.

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Black hole universe

Consider Earth's surface once again, and suppose there is no land at all. The entire surface is one single ocean. Suppose a fleet is floating on it, occupying just a small part of it, small enough to consider it flat. For an observer at a large enough *distance* this flat floating fleet behaves as if it were one large ship carrying all *mass* of the fleet, located at its centre of *mass*. But what if a very large fleet would homogeneously be spread over the entire surface around the earth? Its centre of *mass* would be at the centre of the earth, i.e. not within the fleet, not within the space that's available to this fleet. No ship can get there. It is completely uncome-at-able.

Now consider the 3-spherical universe. Doesn't the same reasoning apply here? It simply means the centre of *mass* of the entire universe is not within this very same universe! "Centre of *mass*" is only a meaningful concept in a relatively small part of space that can be considered more or less Euclidian.

Karl Schwarzschild derived his solution for a point *mass*. At a large enough *distance*, all *mass* can be considered concentrated in the centre of *mass*. Schwarzschild geometry is about the deformation of Euclidean space around it. But this does not apply to the entire universe. It is not Euclidean and its centre of *mass* is nowhere. So my earlier calculation [147] that the entire universe must be a black hole was a misconception. Although the universe is smaller than the *Schwarzschild radius* corresponding to its total *mass*, it cannot be a black hole since it is a 3-sphere. So it'll never bump against its *Schwarzschild radius* whilst extending, because it hasn't got one. And it doesn't "need" a *Schwarzschild radius*, since it is closed in itself so nothing can get out anyway.

THE CENTRE OF *MASS* OF THE ENTIRE UNIVERSE
DOES NOT RESIDE WITHIN THE UNIVERSE. [245]

SCHWARZSCHILD GEOMETRY DOES
NOT APPLY TO THE UNIVERSE AS A WHOLE. [246]

FLRW

I did not make any use of the Friedmann–Lemaître–Robertson–Walker geometry. The only math used is the *relativistic Doppler effect* and the corrected Hubble–Lemaître law for *current proper distance*. To me, FLRW seems not in correspondance with reality, and that ugly integral with all those Ω's seems not applicable. Einstein too did not welcome Friedmann's equations with open arms.

Inverse-square law

The inverse-square law is Euclidean. In 3-spherical geometry we of course get something else. It becomes an inverse-square-sine law. In 3-spherical geometry a sphere around the light-emitting object actually is a 3-sphere cap, which has a smaller *surface area* than a Euclidean sphere. This makes far-away objects appear brighter in 3S-geometry, which of course will have its consequences for *magnitude*-based *distance* measurements.

Suppose an object with *luminosity*: L_0 [247]

which is the total emitted *power*.

The 3-sphere cap *surface area* at a dimensionless *distance* of ρ

equals: $A_{3S} = \frac{4D_H^2 \sin^2 \pi\rho}{\pi}$ @[238]

and its Euclidean equivalent is: $A_E = 4\pi D_H^2 \rho^2$ @[227]

For the respective *intensities* (i.e. *energy fluxes* through these *surface areas*) we obtain:

$$I_{3S} = \frac{\pi L_0}{4D_H^2 \sin^2 \pi\rho} \quad [248]$$

and: $I_E = \frac{L_0}{4\pi D_H^2 \rho^2}$ [249]

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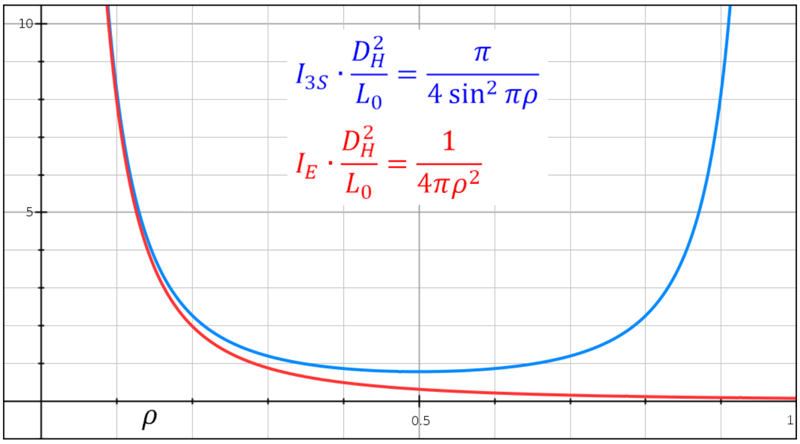


At *distances* of up to say $0.15D_H \approx 2$ Gly, the difference is negligible and hardly detectable, but the Euclidean *intensity* gets less and less at a greater *distance*, whilst the 3-spherical *intensity* has a minimum at half the *Hubble distance*, and beyond that it increases.

But on a cosmic scale, besides *distance*, there are two more effects influencing this *intensity*. There is *attenuation* of the light because of *absorption* and *scattering* by the interstellar and intergalactic media, and there is *relativistic time dilation* due to the object's *velocity*. The latter implies the emitted *energy* is weakened, for which Einstein[3] gives: $E' = E\sqrt{\frac{1-\beta}{1+\beta}}$ [250]

which is the same formula as for the *relativistic Doppler effect*.
For *attenuation* I assume a *transmittance* function T by which the intensity should be multiplied:

$$T(\rho) \quad [251]$$

Altogether we then obtain: $I_{3S} = T(\rho) \cdot \sqrt{\frac{1-\beta}{1+\beta}} \cdot \frac{\pi L_0}{4D_H^2 \sin^2 \pi\rho}$ [252]

and: $I_E = T(\rho) \cdot \sqrt{\frac{1-\beta}{1+\beta}} \cdot \frac{L_0}{4\pi D_H^2 \rho^2}$ [253]

If ρ were the *light travel distance*: $\beta = \frac{\rho}{1-\rho}$ @[49]

this would yield: $\sqrt{\frac{1-\beta}{1+\beta}} = 1 - 2\rho$ [254]

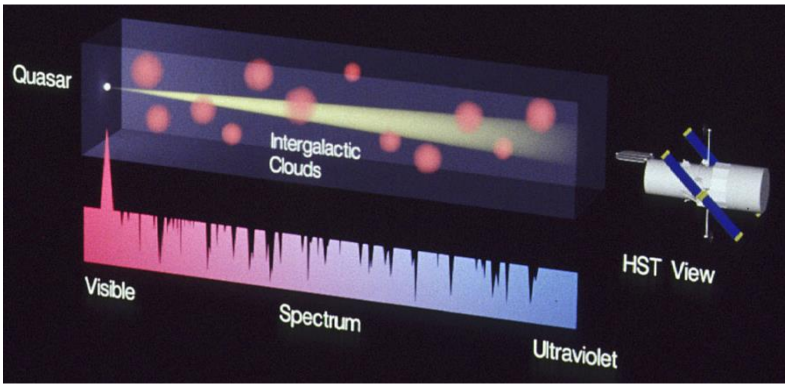
which becomes less than or equal to zero for $\rho \geq ½$ which of course cannot be correct. This means ρ can only be the *current proper distance*, which in fact is evident since *intensity* should not depend on the *speed of light*. Especially in an extending universe this is an important notice. We observe the light right now, when the sphere around the light source has its *current proper radius* and, moreover, its *current surface area*, so the currently observed *intensity* is as if the light came from the *current proper distance*. This is in correspondence with Einstein's remark that the *speed of light* plays the role of the infinite *velocities*. It behaves like infinity.
Then we've got: $\beta = \rho$ @[60]

therefore: $I_{3S} = T(\rho) \cdot \sqrt{\frac{1-\rho}{1+\rho}} \cdot \frac{\pi L_0}{4D_H^2 \sin^2 \pi\rho}$ [255]

and: $I_E = T(\rho) \cdot \sqrt{\frac{1-\rho}{1+\rho}} \cdot \frac{L_0}{4\pi D_H^2 \rho^2}$ [256]

Now I have to find or estimate the *transmittance* function $T(\rho)$. Of course there are various publications about intergalactic *attenuation*, but they are mostly about *frequency* dependent *attenuation*, whilst I am looking for an overall *attenuation*. And I found them a bit too complex for now, so I'll build my own simple model. Evidently, $T(\rho)$ depends on the total amount of matter through which the light passes. I'll use N for this. Since every equal portion of matter attenuates the light by the same percentage, we obtain an exponential function: $T(\rho) = e^{f_1 N(\rho)}$ [257]

where f_1 is a calibration factor (which for *attenuation* is less than zero).



https://cdn.spacetelescope.org/archives/images/screen/opo9204a.jpg *(partly copied)*

Conform the Cosmological Principle, the matter is presumed uniformly distributed, so its *density* is the same everywhere. But due to the *Hubble velocity* there is *Lorentz contraction* and the apparent *density* of an amount of matter is proportional to the *Lorentz factor* at its *distance*. According to [60], this *distance* equals β. With Ω being the *linear density* of intergalactic matter, i.e. the amount of matter a ray of light encounters per *distance* unit, we obtain:

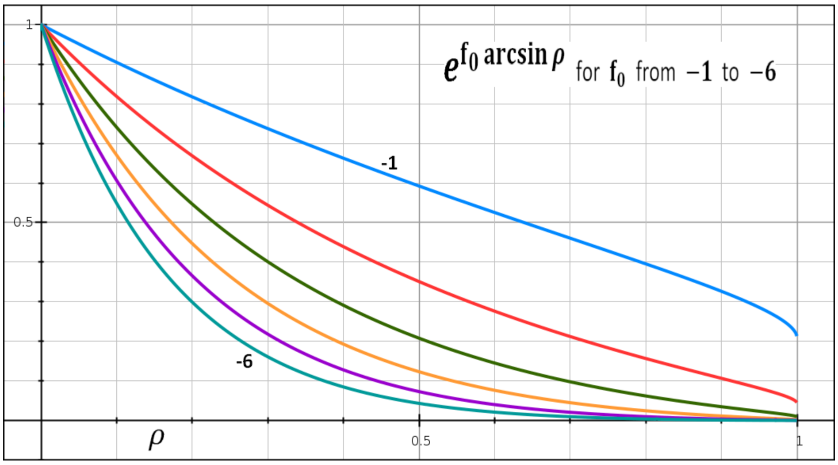
$$\Omega(\rho) = \frac{\Omega_0}{\sqrt{1-\rho^2}} \quad [258]$$

For the total amount of matter in the line of sight we then obtain:

$$N(\rho) = \int_0^\rho \Omega(\rho')\, d\rho' = \int_0^\rho \frac{\Omega_0}{\sqrt{1-\rho'^2}} d\rho' = \Omega_0 \arcsin\rho \quad [259]$$

so: $T(\rho) = e^{f_0 \arcsin\rho}$ [260]

where $f_0 = f_1\Omega_0$ is the overall calibration factor which I'll call the *attenuation coefficient*.



Transmittance function for various *attenuation coefficients*

This yields: $I_{3S} = e^{f_0 \arcsin\rho} \cdot \sqrt{\frac{1-\rho}{1+\rho}} \cdot \frac{\pi L_0}{4D_H^2 \sin^2 \pi\rho}$ [261]

and: $I_E = e^{f_0 \arcsin\rho} \cdot \sqrt{\frac{1-\rho}{1+\rho}} \cdot \frac{L_0}{4\pi D_H^2 \rho^2}$ [262]

I used: $f_0 = -4$ [263]

as the *attenuation coefficient* for creating the next graph, which more or less is an arbitrary choice.

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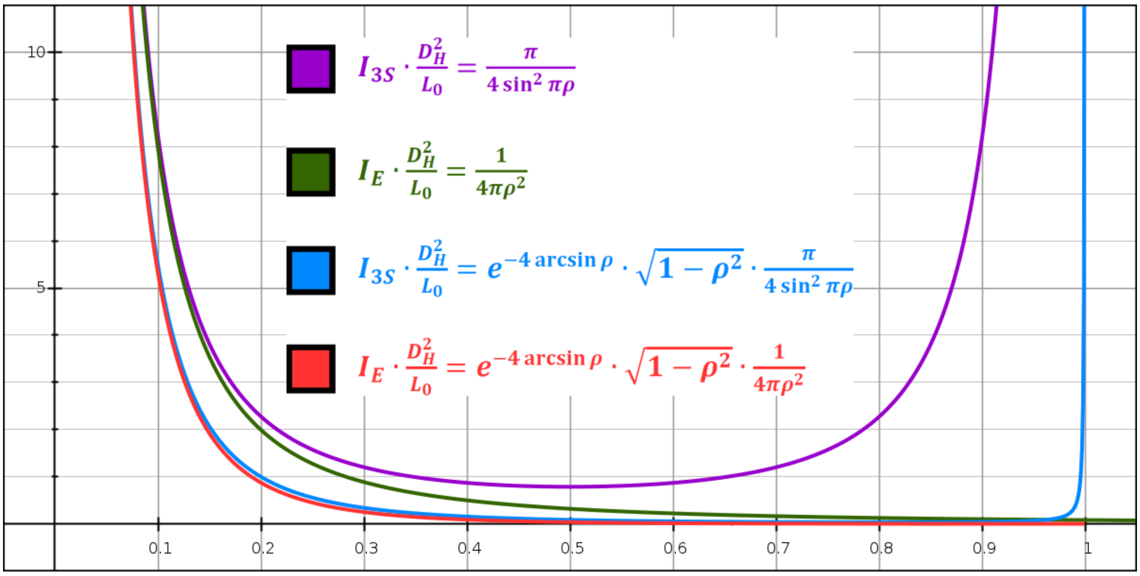
NOTE: I originally made a mistake and the image erroneously shows $\sqrt{1-\rho^2}$ instead of $\sqrt{\frac{1-\rho}{1+\rho}}$.

Since the actual curves (surprisingly) are very similar I did not reproduce the entire image.



There seems to be hardly any difference between [261] and [262], which are the lowest two curves, but this is a bit misleading. Horizontally (i.e. *distance* as a function of *intensity*) the difference is not small.

And... the 3-spherical attenuated curve [261] starts ascending towards infinity near the antipodal point where the CMB source would reside, whereas both Euclidean curves asymptotically approach zero, especially the attenuated one.

MIGHT THE SIMPLE FACT THAT WE ACTUALLY DO OBSERVE THE CMB
SUGGEST THAT THE UNIVERSE MUST BE A 3-SPHERE? [264]

For the total *intensity* of all objects at *distance* ρ the individual *intensity* should be multiplied by the *object number density* (*no. of objects* per *volume*) times the *shell volume* at that *distance*,

so:

$$I_{3S,tot} = e^{f_0 \arcsin\rho} \cdot \sqrt{\frac{1-\rho}{1+\rho}} \cdot \frac{\pi L_0}{4D_H^2 \sin^2 \pi\rho} \cdot Q \cdot A_{3S}(\rho) \cdot \Delta\rho \quad [265]$$

$$\rightarrow \frac{I_{3S,tot}}{Q\Delta\rho} = e^{f_0 \arcsin\rho} \cdot \sqrt{\frac{1-\rho}{1+\rho}} \cdot \frac{\pi L_0}{4D_H^2 \sin^2 \pi\rho} \cdot \frac{4D_H^2 \sin^2 \pi\rho}{\pi} \quad [266]$$

$$= L_0 \cdot e^{f_0 \arcsin\rho} \cdot \sqrt{\frac{1-\rho}{1+\rho}} \quad [267]$$

and:

$$I_{E,tot} = e^{f_0 \arcsin\rho} \cdot \sqrt{\frac{1-\rho}{1+\rho}} \cdot \frac{L_0}{4\pi D_H^2 \rho^2} \cdot Q \cdot A_E(\rho) \cdot \Delta\rho \quad [268]$$

$$\rightarrow \frac{I_{E,tot}}{Q\Delta\rho} = e^{f_0 \arcsin\rho} \cdot \sqrt{\frac{1-\rho}{1+\rho}} \cdot \frac{L_0}{4\pi D_H^2 \rho^2} \cdot 4\pi D_H^2 \rho^2 \quad [269]$$

$$= L_0 \cdot e^{f_0 \arcsin\rho} \cdot \sqrt{\frac{1-\rho}{1+\rho}} \quad [270]$$

where Q is the *object number density*, which according to the Cosmological Principle should be more or less constant if regarded on a large scale. It is obvious that [267] and [270] are identical, so the *total flux* as function of the *distance* cannot be used to determine the shape of the universe.

Apparent *magnitude*

The calculations below are in fact for *bolometric magnitudes*.

To calculate a *magnitude difference* between two *intensities* (or *fluxes*), we've got:

$$\Delta m = -5 \cdot \log_{100}\left(\frac{I_1}{I_2}\right) = -2.5 \cdot \log_{10}\left(\frac{I_1}{I_2}\right) \quad [271]$$

for the *apparent magnitude* corresponding to a given *intensity* this becomes:

$$m = -2.5 \cdot \log_{10}\left(\frac{I}{I_{ref}}\right) \quad [272]$$

so: $$\log_{10}\left(\frac{I}{I_{ref}}\right) = \frac{-m}{2.5} = -0.4 \cdot m \quad [273]$$

and: $$\frac{I}{I_{ref}} = 10^{-0.4 \cdot m} \quad [274]$$

therefore: $$\frac{1}{I_{ref}} = \frac{10^{-0.4 \cdot m}}{I} \quad [275]$$

The Sun's *intensity* has been measured by Earth orbiting satellites as[44]:

$$I_{\odot} = 1360.8 \text{ W/m}^2 \quad [276]$$

and the Sun's magnitude is: $$m_{\odot} = -26.74 \quad [277]$$

yielding: $$\frac{1}{I_{ref}} = \frac{10^{-0.4 \cdot m_{\odot}}}{I_{\odot}} \approx 36492675 \quad [278]$$

and: $$I_{ref} = 1/36492675 = 2.740276 \times 10^{-8} \text{ W/m}^2 \quad [279]$$

For the conversion of an *intensity* to a *magnitude* we obtain:

$$m = -2.5 \cdot \log_{10}\left(\frac{1}{I_{ref}} \cdot I\right) = -2.5 \cdot \log_{10}\left(\frac{36492675 \cdot I}{\mathrm{W/m^2}}\right) \quad [280]$$

In this equation either [261] or [262] should be substituted for I,

so: $$m_{3S} = -2.5 \cdot \log_{10}\left(\frac{1}{I_{ref}} \cdot e^{f_0 \arcsin\rho} \cdot \sqrt{\frac{1-\rho}{1+\rho}} \cdot \frac{\pi L_0}{4D_H^2 \sin^2 \pi\rho}\right) \quad [281]$$

and: $$m_E = -2.5 \cdot \log_{10}\left(\frac{1}{I_{ref}} \cdot e^{f_0 \arcsin\rho} \cdot \sqrt{\frac{1-\rho}{1+\rho}} \cdot 2\right) \quad [282]$$

We can find $L_G \equiv L_0$ from M_G, the *absolute magnitude* of a galaxy. From [274] we obtain:

$$I = I_{ref} \cdot 10^{-0.4 \cdot M_G} \quad [283]$$

and on a sphere of *radius* r around an object of *luminosity* L we get:

$$I = \frac{L}{4\pi r^2} \quad \therefore \quad L = 4\pi r^2 \cdot I \quad [284]$$

so: $$L_G = 4\pi r^2 \cdot I_{ref} \cdot 10^{-0.4 \cdot M_G} \quad [285]$$

The standard *distance* for *absolute magnitudes* is: $r = 10$ parsec and at this distance Euclidean geometry can safely be used, yielding:

$$A_{10\text{pc}} = 4\pi(10 \text{ pc})^2 = 1.19649518 \times 10^{36} \text{ m}^2 \quad [286]$$

and: $$L_G = A_{10\text{pc}} \cdot I_{ref} \cdot 10^{-0.4 \cdot M_G} = 3.278727 \cdot 10^{28-0.4 \cdot M_G} \text{ W} \quad [287]$$

Equations [281] and [282] then become (I_{ref} appears to cancel out):

$$m_{3S} = -2.5 \cdot \log_{10}\left(A_{10\text{pc}} \cdot 10^{-0.4 \cdot M_G} \cdot e^{f_0 \arcsin\rho} \cdot \sqrt{\frac{1-\rho}{1+\rho}} \cdot \frac{\pi}{4D_H^2 \sin^2 \pi\rho}\right)$$

and: $$m_E = -2.5 \cdot \log_{10}\left(A_{10\text{pc}} \cdot 10^{-0.4 \cdot M_G} \cdot e^{f_0 \arcsin\rho} \cdot \sqrt{\frac{1-\rho}{1+\rho}} \cdot \frac{1}{4\pi D_H^2 \rho^2}\right)$$

so: $$\mu_{ar,3S} = m_{3S} - M_G = -2.5 \cdot \log_{10}\left(e^{f_0 \arcsin\rho} \cdot \sqrt{\frac{1-\rho}{1+\rho}} \cdot \frac{\pi \cdot A_{10\text{pc}}}{4D_H^2 \sin^2 \pi\rho}\right) \quad [288]$$

[44] Kopp, G. & Lean, J. L. (2011): "A new, lower value of total solar irradiance: Evidence and climate significance" (PDF). GEOPHYSICAL RESEARCH LETTERS, VOL. 38, L01706, doi:10.1029/2010GL045777, 2011. https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2010GL045777

and: $\mu_{ar,E} = m_E - M_G = -2.5 \cdot \log_{10}\left(e^{f_0 \arcsin\rho} \cdot \sqrt{\frac{1-\rho}{1+\rho}} \cdot \frac{A_{10pc}}{4\pi D_H^2 \rho^2}\right)$ [289]

In general: $\mu_{ar} = m - M = -2.5 \cdot \log_{10}\left(e^{f_0 \arcsin\rho} \cdot \sqrt{\frac{1-\rho}{1+\rho}} \cdot \frac{A_{10pc}}{\{A_{3S}|A_E\}}\right)$ [290]

where μ_{ar} is what I call the *attenuated relativistic distance modulus*, i.e. the *distance modulus* corrected for both *relativistic dimming* due to *time dilation* and *intergalactic attenuation* including the correction for *Lorentz contraction*.

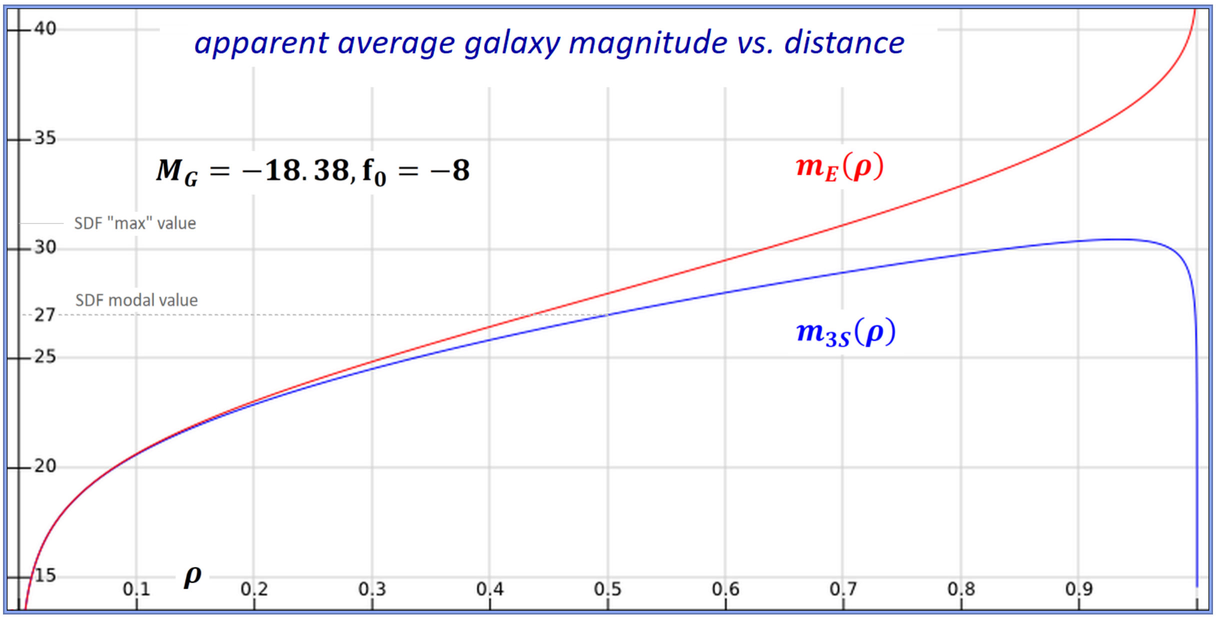
Subaru Deep Field once again

The average *absolute magnitude* of nearby galaxies[45] is approximately $M_G = -18$.
Being a violinist I found after some fiddling ♬ with different values

that: $M_G = -18.38$ [291]

and: $f_0 = -8$ [292]

seem to be proper values matching the aforementioned SDF *galaxy count per magnitude* (yes, this is curve fitting, but the observed values are leading). These values match the SDF *modal value* of $m \approx 27$ and they yield a 3-spherical *maximum magnitude* of ca. 30.5, above which the SDF *count* is practically zero. Please note this is about "average" galaxies, specific ones can of course be far dimmer. The result is in the next image.



graph made at http://fooplot.com

As can be seen, both graphs are rougly somewhere in the neighbourhood of linearity for ρ from ≈ 0.2 to ≈ 0.8, which means the *apparent magnitude* should be a fairly good linear indicator of the *distance*. As already explained just after [254], brightness is according to the *current proper distance*, so the history of the universe during *light travel time* is irrelevant.

Altogether this means the SDF *galaxy count per magnitude* given on page 42 should indeed quite linearly reflect the *surface area* of a sphere around us at a given *distance* and it confirms the 3-spherical shape of the universe.

[45] Yu. P. Pskovskii, MEAN INTEGRAL ABSOLUTE MAGNITUDES OF GALAXIES, Soviet Astronomy vol.5 no.3 (1961), pp.387-392, http://adsbit.harvard.edu/cgi-bin/nph-iarticle_query?1961SvA.....5..387P&classic=YES

After (numerically) inverting equation [290] = $\mu_{ar}(\mathrm{f}_0,\rho)$ to $\rho(m,\mathrm{f}_0,M_g)$ and a bit more fiddling ♬ with the average *absolute galaxy magnitude* M_G and the *attenuation coefficient* f_0, I came to the conclusion that:

$$M_G = -18 \qquad [293]$$

and:

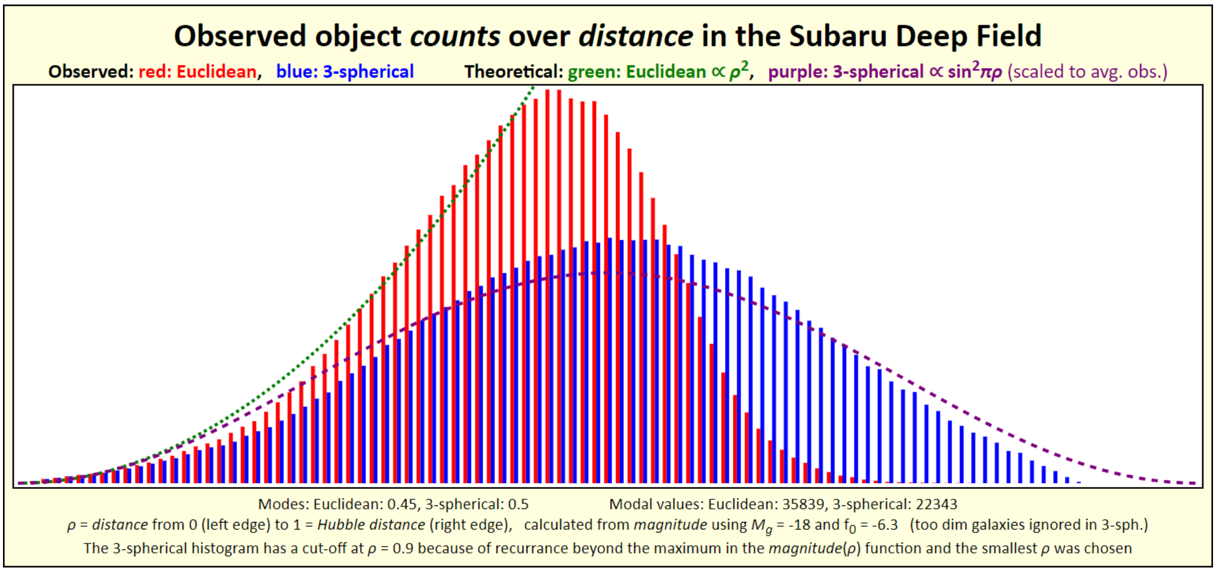
$$\mathrm{f}_0 = -6.3 \qquad [294]$$

yield better results. Especially the modal value of the 3-spherical *distance* calculation then equals half the *Hubble distance*.

NOTE: this was also based on the aforementioned mistake of using $\sqrt{1-\rho^2}$ instead of $\sqrt{\frac{1-\rho}{1+\rho}}$

$\mathrm{f}_0 = -5.5$ now gives the proper result.

The image below shows count$\left(\rho(m,\mathrm{f}_0,M_g)\right)$ for both geometries, where the *Hubble distance* has been divided into 100 equal intervals, as well as the theoretical curves, scaled to the observed values.



The 3-spherical geometry clearly puts objects at a greater *distance* than the Euclidean, which is in accordance with [248], [249], and the *magnitude* vs. *distance* graph on page 52. The observed maximum at a given *magnitude* of course appears for both geometries, but the 3-spherical one has a far better (although not perfect) correspondance with the theoretical distribution than the Euclidean.
Together with the mere existance of this maximum and the results of the SDSS quasar densities (which is a completely different data set) this can only mean that

THE UNIVERSE IS A 3-SPHERE @[242]

WITH HALF THE *CIRCUMFERENCE* EQUAL TO THE *HUBBLE DISTANCE*
AND THE CMB SOURCE AROUND THE ANTIPODAL POINT.

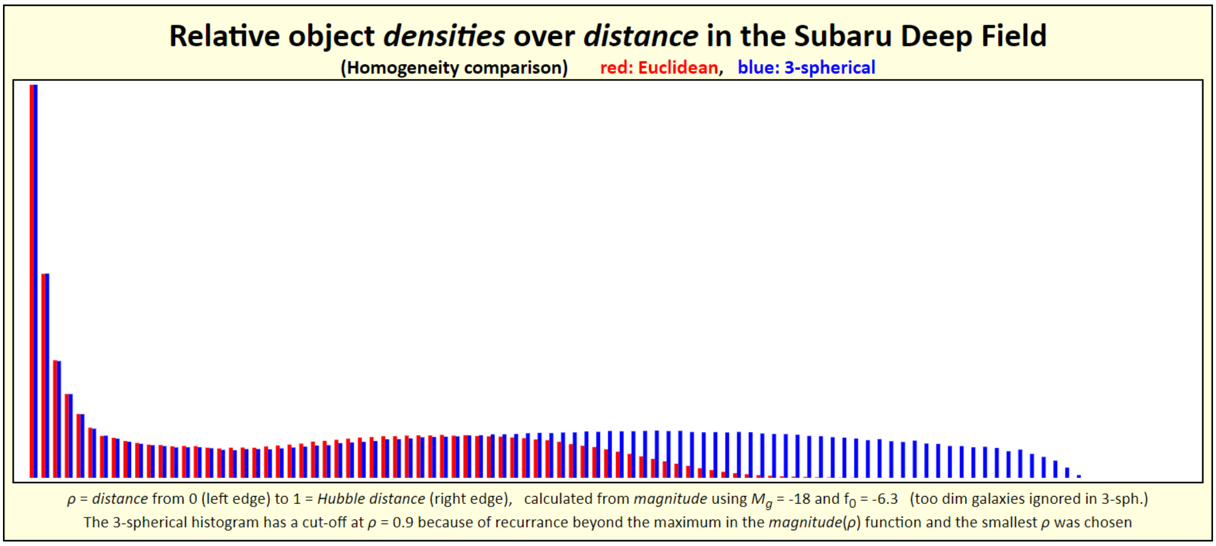
Ex obſervatis phænomenis immediate deductum eſt.

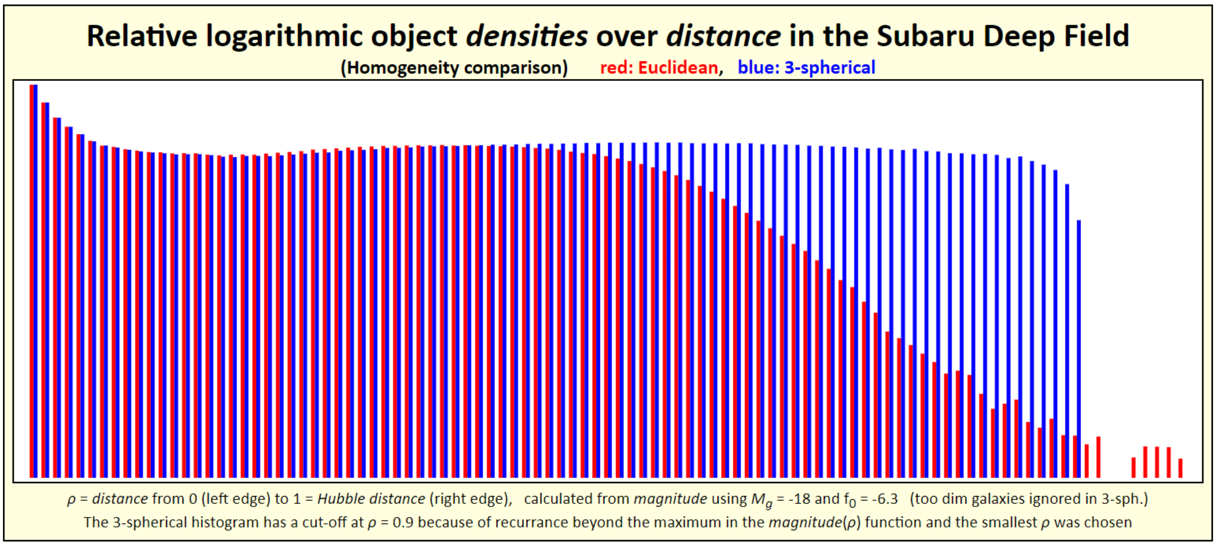
It has directly been deduced from observed phenomena.

If it were Euclidean ("flat"), the observed galaxy distribution would be far from homogeneous, which would be a severe violation of the Cosmological Principle.

Homogeneity of the universe

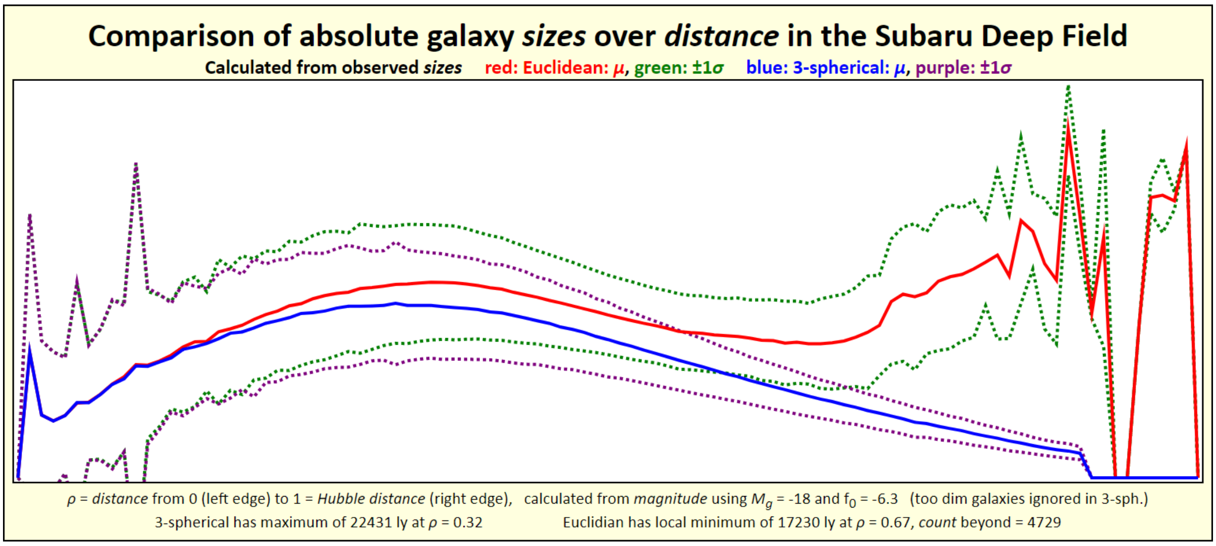
Division of the galaxy *counts* over *distance* by the *surface area* times the *shell thickness* of a ball around us at each *distance* yields the *density* (i.e. galaxy *count* per *volume*) over *distance*. See the next two images. I suggest you choose yourself which geometry yields the best homogeneity of the universe...





Galaxy *sizes* in the SDF

The SDF calatogs also contain the apparent galaxy *sizes* (in pixels), which can be converted to their absolute size (in light years or whatever *distance* unit), once again for both geometries. Next image shows their *averages* and *standard deviations*.



The *sizes* of very distant galaxies seem far too large in the Euclidean geometry (it becomes a bit chaotic because there are just a few really very dim galaxies in the catalogs). The 3-spherical geometry seems to yield a far better result. When read from right to left we see the blue line steadily increase, i.e. the galaxies did grow over *time*.

I do not yet understand why the size of nearby galaxies shrinks with decreasing distance. It may have to do with the way the Subaru Deep Field was selected. It was to contain as little as possible known galaxies or Milky Way objects, which then obviously yielded a patch of sky without large well observable galaxies.

In the 3-spherical geometry we also see the *standard deviation* decrease with increasing *distance*, whilst it stays large in Euclidean geometry. The 3-spherical cut-off at $\rho = 0.9$ is explained below the earlier *count*-over-*distance* image.

ALSO THE GALAXY *SIZE* COMPARISON SUGGEST THE UNIVERSE IS 3-SPHERICAL. [295]

Type-Ia supernovae

On http://www.cbat.eps.harvard.edu/lists/Supernovae.html from CBAT is a list of Type Ia supernovae containing their *magnitudes*, and the *redshifts* of most of them can be found in the SIMBAD database, operated at CDS, Strasbourg, France. Together they yield 1499 usable supernovae. But the most distant one I encountered has $z = 1.199 \triangleq \rho = 0.6573$, which makes it not a really distant object.

For each supernova I calculated the *estimated absolute magnitude* as the *observed apparent magnitude* minus the *calculated distance modulus* derived from the *distance* according to the *redshift*,

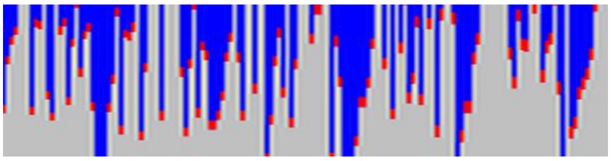
so: $$M_{3S} = m - \mu_{ar,3S}\left(\rho(z)\right) \quad [296]$$

as well as: $$M_E = m - \mu_{ar,E}\left(\rho(z)\right) \quad [297]$$

For calculating μ_{ar} I used the same *attenuation coefficient* as for the above SDF histogram:

$$\mathrm{f}_0 = -6.3 \quad [298]$$

As can be seen in the *magnitudes* image on page 52, the Euclidean *distance modulus* is always practically equal to or greater than the 3-spherical one; the difference grows with the *distance*. If a too large *distance modulus* would be applied, a too bright supernova would result, i.e. a more negative *estimated absolute magnitude*. In the image below the Euclidean *estimated absolute magnitude* (red) drops below the 3-spherical one (blue) for the larger *redshifts* to the right. If a line seems only blue then its bottom pixel is red:



The average *absolute magnitude* found is ≈ -19, which nearly matches the "official" value. It can also be seen that the *absolute magnitudes* are more or less the same at every *distance*, although not exactly, so the used value of $\mathrm{f}_0 = -6.3$ probably still needs some correction.

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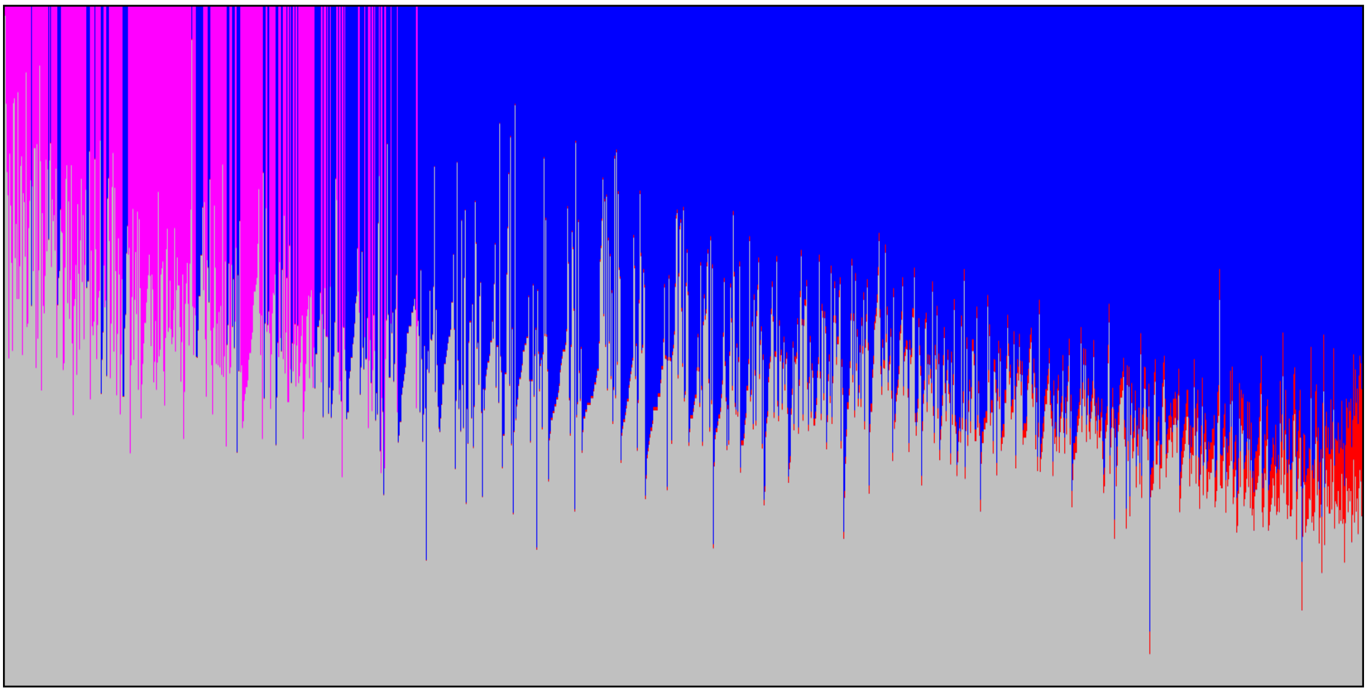
Type Ia supernovae -- estimated absolute magnitudes ordered by redshift

(blue = 3-spherical, red = Euclidean, magenta = equal values)

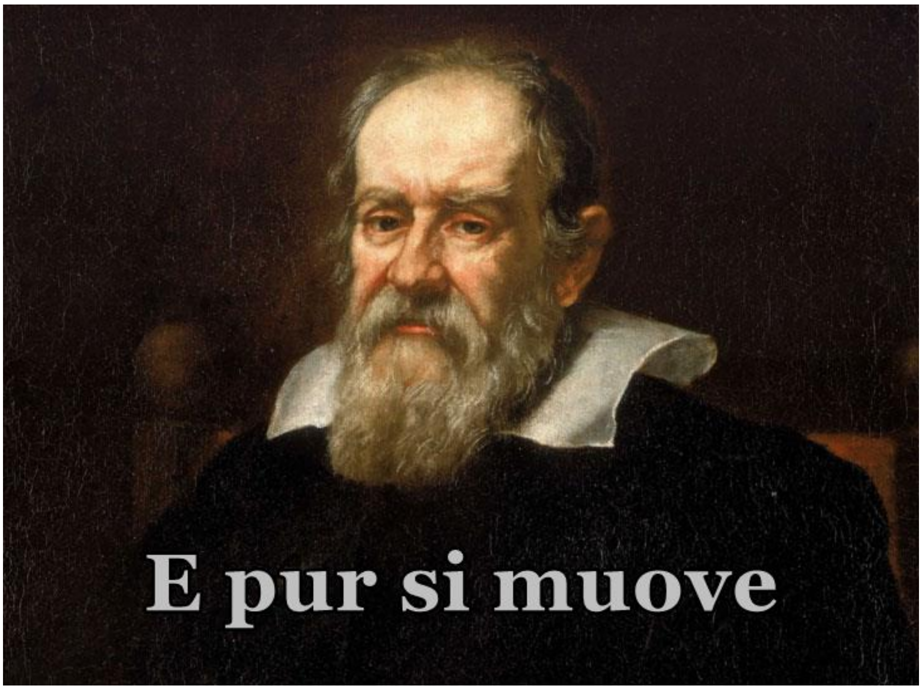


$\mu_{3Sph} = -19.01$, $\sigma_{3Sph} = 1.26$, $\min_{3Sph} = -23.13$, $\max_{3Sph} = -13.78$
$\mu_{Eucl} = -19.17$, $\sigma_{Eucl} = 1.42$, $\min_{Eucl} = -23.46$, $\max_{Eucl} = -13.78$
Attenuation coefficent $f_0 = -6.30$
Redshifts from z = 0.0024 (left) to z = 1.1990 (right)

Color of value closest to zero
is in front of the other
(magnitudes are negative)

As already mentioned, the Euclidean values (red) start to drop clearly below the 3-spherical values (blue) for the more distant supernovae at the right side of the image. This is not due to accelerated expansion of the universe, but to the Euclidean *calculated distance modulus* being too large.

THE TYPE IA SUPERNOVAE DATA SEEM TO CONFIRM A 3-SPHERICAL UNIVERSE [299]
although not very strongly since the data contain no really very distant supernovae.



And yet it moves

Galileo Galilei

Inside out

Finally, I'll do some philosophising, not based on observed phenomena. It's just a thought that came into my mind as I paced through the living room. Suppose we do the following relatively simple transformation, where r_S of course is a black hole's *Schwarzschild radius*.

Reciprocal *radius*: $$\frac{r'}{r_S} = \frac{r_S}{r} \quad \rightarrow \quad r' = \frac{{r_S}^2}{r}$$ [300]

and reciprocal *time*: $$\frac{ct'}{r_S} = \frac{-r_S}{ct} \quad \rightarrow \quad t' = \frac{-{r_S}^2}{c^2 t}$$ [301]

This mathematically turns the black hole inside out at the *Schwarzschild radius*. Its center would become *infinity* in this inside-out space and vice versa. And if t is monotonously growing, so is t', thanks to the above minus sign. Both go towards the future. I'll call this *inside out space*. And from the other point of view it'll be *outside in space*. Mathematically there's nothing wrong with this, is it?
And now suppose it is not just a mathematical transformation, but something real, although it hardly is within the boundaries of my own imagination of 'reality'. Anything that is falling into the black hole takes infinitely long as seen from outside. In this inside out space however, this would become an infinitesimally small *time*. And our spatial radial *infinity* outside the black hole would also become infinitesimally small in this inside out space. So the whole bunch of matter falling into the black hole in an infinitely long interval as observed from outside, will in this inside out space initially be very small and dense and it will fly apart in a very small amount of *time*. Hey, isn't that a big bang?
Could it be that your own local frame would suddenly simply turn inside out when hitting the *Schwarzschild radius* at the end of our fall towards it?

Multiverse

What if black holes would indeed be such inside out universes? Then their inside out space would be a 'big banged' smaller universe by itself, in which even smaller black holes might exist. And the same applies to those 'inner' black holes, which in turn would be inside out universes. This recursion would definitely end at the aforementioned critical black hole, which as an inside out universe would not contain any other black holes.
Our own universe could then be an outside in black hole within some 'container universe', which itself...
This would become an infinite chain of outside in container universes, each carrying many black holes which are other inside out universes.
The entire multiverse would then be one single infinitely large entity.

* * * * *

Incomprehensible is not the same as impossible.

Not being able to think of anything better
does not mean your theory is correct.

(these quotes are my own)

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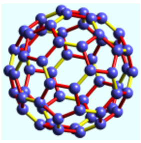
EINSTEIN: [...] And here I will say that the scientist finds his reward in what Henri Poincaré calls the joy of comprehension, and not in the possibilities of application to which any discovery of his may lead.

From: Where is science going *by Max Planck, 1932, p.211*



When I am working on a problem, I never think about beauty, but when I have finished, if the solution is not beautiful, I know it is wrong.

Richard Buckminster Fuller

But alas, the buckyball (C_{60}) *is not a 3-sphere...*

The Answer to the Ultimate Question of Life, The Universe, and Everything.

Douglas Adams, The Hitchhiker's Guide to the Galaxy, 1979

Further readings

See http://henk-reints.nl/UQ/

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