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2019-07-29, updated 2020-06-25 (page 6: SDF galaxy sizes), last updated 2020-06-25 (page 4: bell curve)

SUMMARY

From an analysis of the observed *magnitudes* of $1\,400\,107$ objects[1] in the Subaru Deep Field (SDF)[2], as well as the observed *magnitudes* and *redshifts* of $525\,607$ quasars in the DR14Q database[3] of the Sloan Digital Sky Survey (SDSS)[4], follows that the geometry of the universe cannot be anything else than a 3-sphere. The quasar *redshifts* yield a *density* over *time* that is almost exactly proportional to t^{-3}, which means the expansion of the universe is as linear as can be.

THE UNIVERSE IS A PERFECTLY LINEARLY EXPANDING 3-SPHERE.

Ex obſervatis phænomenis immediate deductum eſt.

It has directly been deduced from observed phenomena.

Introduction

There exists no observational evidence of anything unobservable. Since *superluminality* is in conflict with Einstein's Special Relativity which he deduced from observed phenomena, it should be firmly rejected. The *speed of light* cannot ever be exceeded (although maybe in quantum mechanics[5], but that is about particles whilst Special Relativity in fact is about empty space). This *speed limit of light* makes the so-called *horizon problem* a figment of imagination. It has not been deduced from or confirmed by any observation.

From the observation-based Hubble-Lemaître law follows that the universe must have had a beginning of *size* zero somewhere in the past, a finite *time* ago. The *speed limit of light* then implies that no two objects in the entire universe can have a mutual *distance* larger than the *Hubble distance*, not even by a *Planck length*, so the universe must be finite. Olbers' paradox[6] also implies the universe must be finite.

The observation-based Cosmological Principle[7] says the universe is homogeneous and isotropic if not viewed in too much detail. This is in agreement with practically all astronomical observations ever done (please note that astronomy is the second oldest profession in the world...). This *homogeneity* and *isotropy* imply there cannot be any boundary to the universe, it is unlimited.

Together, *finiteness* and *unlimitedness* imply a closed universe. This leaves the 3-ellipsoid and the 3-torus as the only possibilities for the geometry of the universe. A toroidal geometry and a rather excentric 3-ellipsoid would at least violate the *isotropy*, which leaves the 3-sphere as the only possible shape of the universe.

Common sense tells that half the *circumference* of this 3-sphere must then be equal to the *Hubble distance*, since both *distances* are the maximum possible. This places the source of the Cosmic Microwave Background radiation (CMB) around the antipodal point, which itself would then be receding at the *speed of light*. The CMB source would then not be very large. The CMB is observed in all directions, i.e. its source is all around us, but this CMB source itself is observed from all directions, i.e. your eye is all around it.

With the antipodal point at the *Hubble distance* which grows at the *speed of light*, the 3-sphere's *hyperradius* grows at c/π. Therefore this *hyperradius* cannot be the same dimension as Minkowski's ict-coordinate, which evidently grows at exactly c.

Note: I try to deduce as much as possible from observed phenomena only, thus minimising any assumptions. I do not use FLRW geometry since it is not truly deduced from phenomena, and I firmly reject anything that would require *superluminality*.

3-Sphere mathematics

An ellipsoid has several axes (like a normal ellipse has a major and a minor one) and their end points would be special locations in the universe. This would violate the homogeneity that follows from the Cosmological Principle. A 3-torus is not isotropic and it may have several different *radii* of *curvature*, which makes it inhomogeneous as well.

A ball around us would be a 3-sphere cap. The *surface area* thereof as a function of its *radius* is shown in next image. In this image, $\rho = \frac{r}{D_H}$ is the dimensionless *distance*, with r being the true *distance* and D_H the *Hubble distance*.

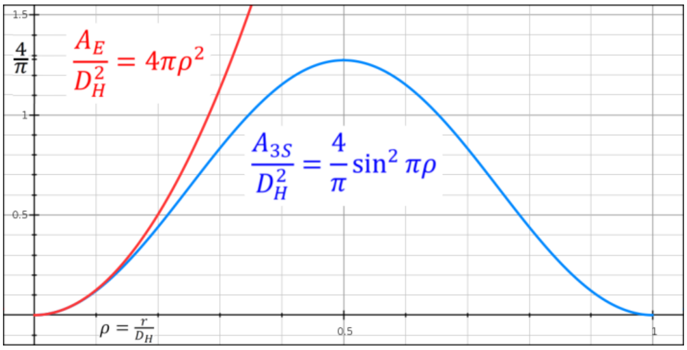


Fig. 1: Euclidean and 3-spherical dimensionless surface area of a ball around us

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*.

Observed data in the Subaru Deep Field

The Subaru Deep Field is a patch of sky observed with the Subaru Telescope at Hawaii, operated by the National Astronomical Observatory of Japan (NAOJ). They released next image.

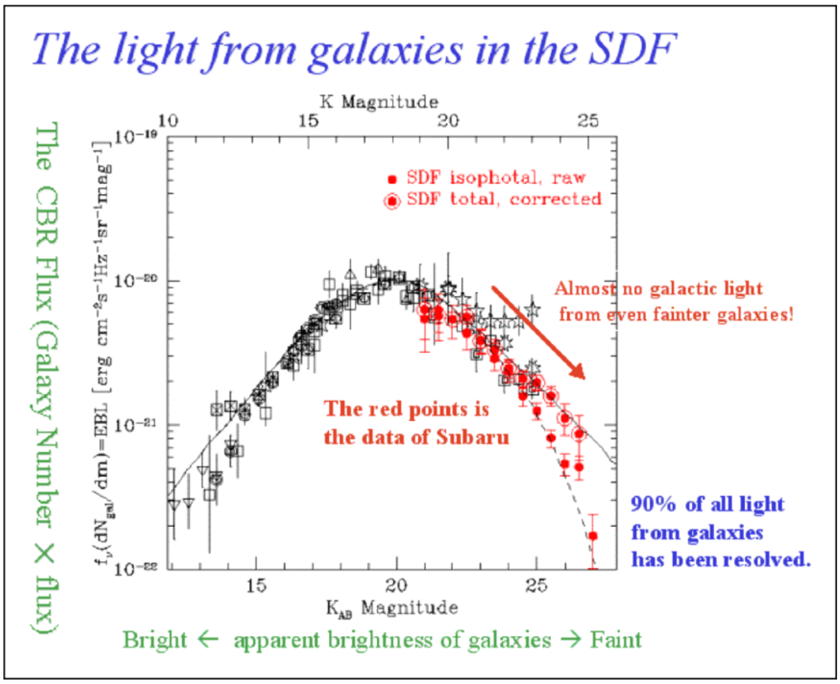


Fig. 2: https://subarutelescope.org/Pressrelease/2001/04/30/Fig2_e.gif

Please keep in mind that *CBR flux* (CBR = Cosmic Background Radiation originating from extragalactic sources excluding the CMB = Cosmic Microwave Background, which originates from the big bang) is not *galaxy count*, although strongly related, and *magnitude* is not *distance*, but also strongly related.

Similar images are contained in a publication by Simon P. Driver[8], in figures 1, 2, and A1-A6.

Actual *counts* in the SDF

The URL http://soaps.nao.ac.jp/SDF/v1/index.html leads to catalogs containing *magnitudes* of all objects in the SDF. Next files were downloaded and analysed:

1. http://soaps.nao.ac.jp/SDF/v1/B/sdf_v1_B.cat.gz
2. http://soaps.nao.ac.jp/SDF/v1/V/sdf_v1_V.cat.gz
3. http://soaps.nao.ac.jp/SDF/v1/Rc/sdf_v1_Rc.cat.gz
4. http://soaps.nao.ac.jp/SDF/v1/ip/sdf_v1_ip.cat.gz
5. http://soaps.nao.ac.jp/SDF/v1/zp/sdf_v1_zp.cat.gz
6. http://soaps.nao.ac.jp/SDF/v1/816/sdf_v1_816.cat.gz
7. http://soaps.nao.ac.jp/SDF/v1/921/sdf_v1_921.cat.gz

For each object an *objectId* was assigned based on its x and y position as given in the catalog. Per *objectId* the average of all MAG_BEST values found was used. This yielded next histogram of actual *counts* per *magnitude*.

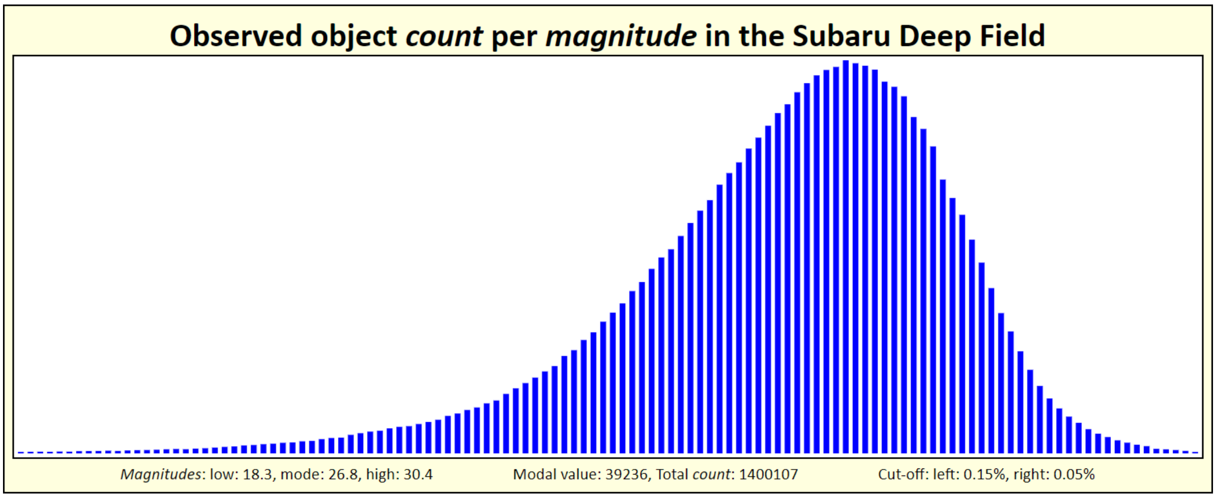


Fig. 3: Object count per magnitude in the Subaru Deep Field

The existance of the maximum in the *galaxy count* per *magnitude* is in accordance with a 3-spherical geometry of the universe.

Since *magnitude* is not proportional to *distance*, it must be converted in order to compare reality to the theoretical curves as shown in figure 1. The inverse of next fuction was used:

$$\mu_{ar} = m - M = -5\log_{100}\left(e^{\mathrm{f}_0 \arcsin\rho} \cdot \sqrt{\frac{1-\rho}{1+\rho}} \cdot \frac{A_{10\mathrm{pc}}}{\{A_E|A_{3S}\}}\right) \quad [1]$$

where μ_{ar} is what I call the *attenuated relativistic distance modulus*, f_0 is some *attenuation coefficient* that must be determined by trial and error and selecting the value giving the most plausible result, and ρ the dimensionless *distance* scaled to D_H. The $\arcsin\rho$ results from integrating the *Lorentz contraction* which increases the distant *density*, and $\sqrt{(1-\rho)/(1+\rho)}$ takes care of dimming by *time dilation* (and relativistic *Doppler effect*[9]). The spherical *surface areas* are[a]: $A_{3S} = D_H^2 \cdot \frac{4}{\pi}\sin^2 \pi\rho$ and $A_E = D_H^2 \cdot 4\pi\rho^2$. Since in this context 10 pc is a very small distance, $A_{10\mathrm{pc}}$ was calculated using Euclidean geometry in both cases. In 3-spherical geometry, equation [1] has a maximum near $\rho \approx 0.9$, so it cannot properly be inverted. For each *magnitude*, the smallest of the possible *distances* was chosen, yielding a cut-off at this point and an estimated error $\lesssim 10\%$. More on this equation is explained in paragraph ***Object intensity*** on page 11.

Next image shows the resulting *galaxy count* per *distance interval* of $D_H/100$, assuming an *absolute magnitude* of $M_G = -18$ (in accordance with several publications) and an *attenuation coefficient* $\mathrm{f}_0 = -5.5$. The latter was chosen in order to position the 3-spherical modal value very near $D_H/2$.

[a] Corrected $A_E = D_H^2 \cdot 4\pi r^2$ to $A_E = D_H^2 \cdot 4\pi\rho^2$ on 2019-07-29

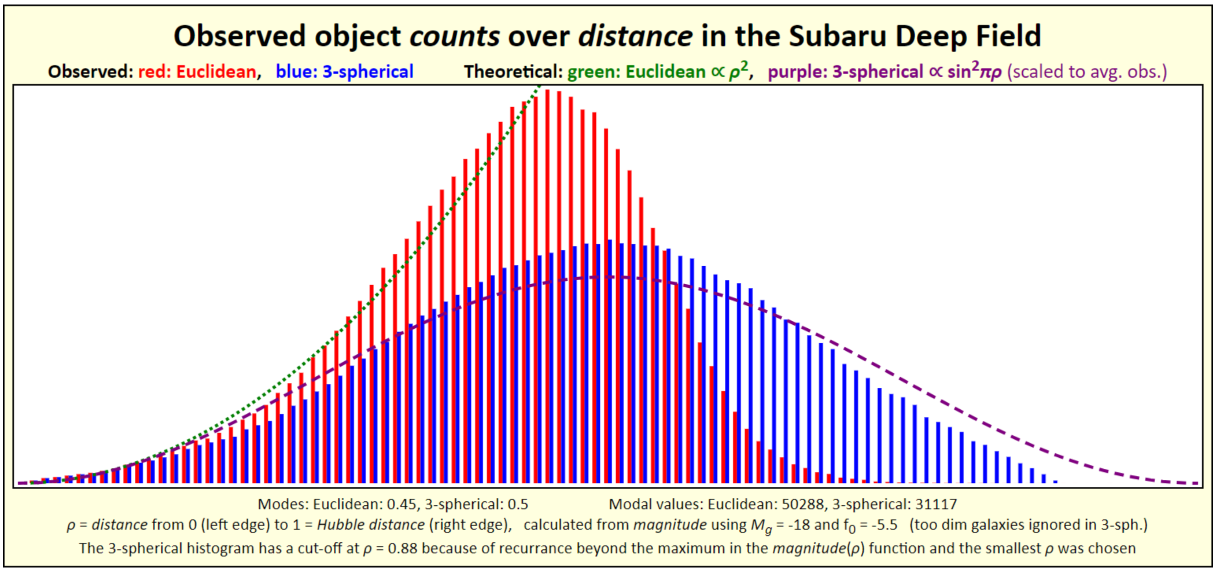


Fig. 4: Object count per $D_H/100$ distance interval in the Subaru Deep Field

The *galaxy count* per *distance* of the SDF confirms a 3-spherical geometry of the universe.

It is evident that 3-spherical geometry yields a far better correspondance to the observed values than Euclidean geometry. In a homogeneous universe the latter should yield a *count* that is ever quadratically increasing with the *distance*, which it obviously does not. Instead it drops beyond $\rho = 0.45$ and it becomes practically zero at say $\rho = 0.75$.

A closer inspection of the image made me create next image, which includes a normal distribution curve. It gives an even better correspondance, so the 3-spherical *galaxy count* per *distance* seems to be normally distributed!

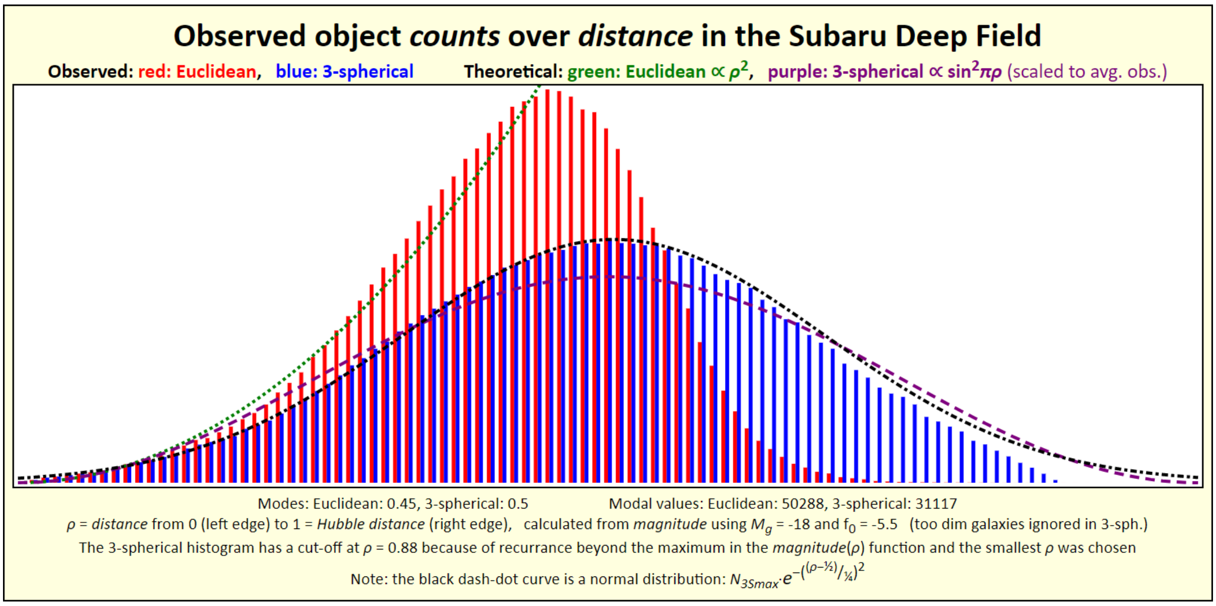


Fig. 5: Object count per $D_H/100$ distance interval in the Subaru Deep Field seems Gaussian

Since *distance* in the universe also is a measure of *time*, it might indicate the big bang itself was normally distributed over *time*. As a singularity in zero *time* it would then have been the *Dirac delta function*, which in fact is a degenerated normal distribution.

L'universo è bello.
The universe is a bell curve…

2020-06-25: I now think the sine is just superimposed by its first harmonic which might find its origin in the universe having started with a big KAH-BOOM instead of a big BANG.

<u>*Homogeneity* in the SDF</u>

The *homogeneity* of the universe (at least in the SDF) is shown in the two images below. They show the *galaxy density* over *distance*, i.e. the SDF *galaxy count* per *volume* for both geometries. This *volume* of course is the product of the *shell thickness* $= D_H/100$ and the 3-spherical or Euclidean *surface area* of the ball around us at each *distance*.

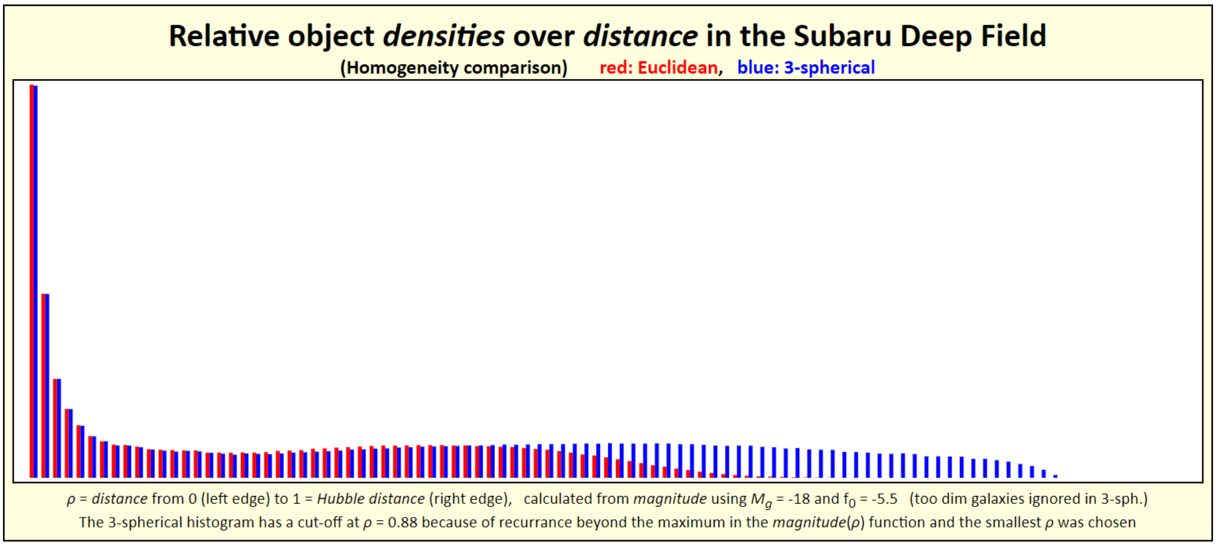


Fig. 6: Object density over distance, scaled to its maximum value

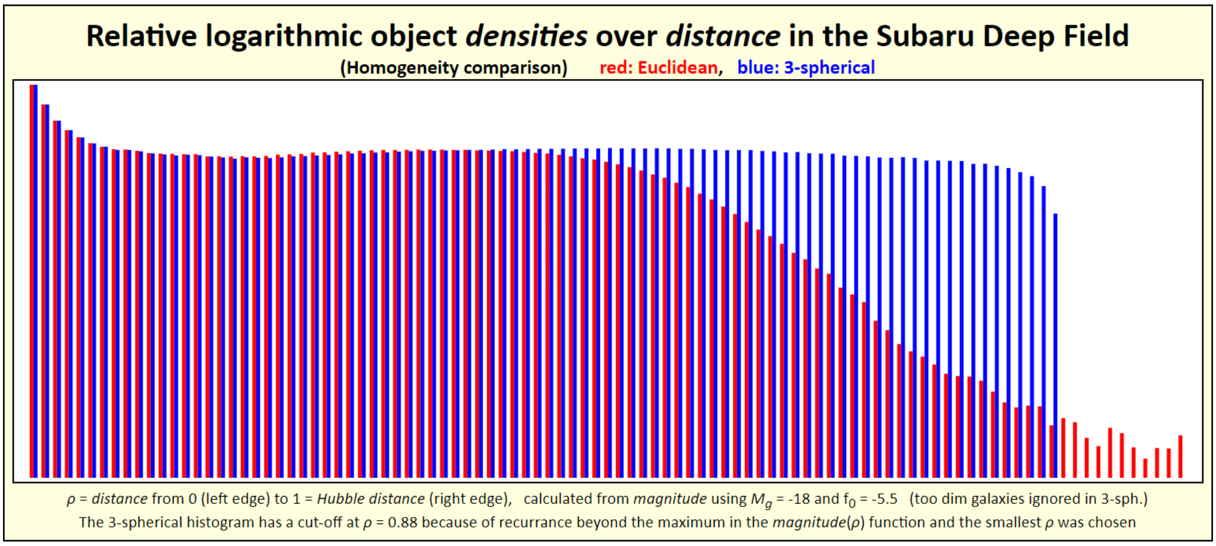


Fig. 7: Logarithm of object density (plus one) over distance, scaled to its maximum value

Once again it seems evident that 3-spherical geometry yields a far more homogeneous universe than Euclidean. The 3-spherical cut-off at $\rho \approx 0.88$ is already explained above. Euclidean geometry does not yield such a cut-off.

The *galaxy density* over *distance* distribution of the SDF confirms a 3-spherical geometry of the universe.

<u>Galaxy *sizes* in the SDF</u>

The SDF catalogs also contain the *apparent sizes* of the galaxies, from which their *absolute sizes* can be derived for both geometries. It yields the following image.

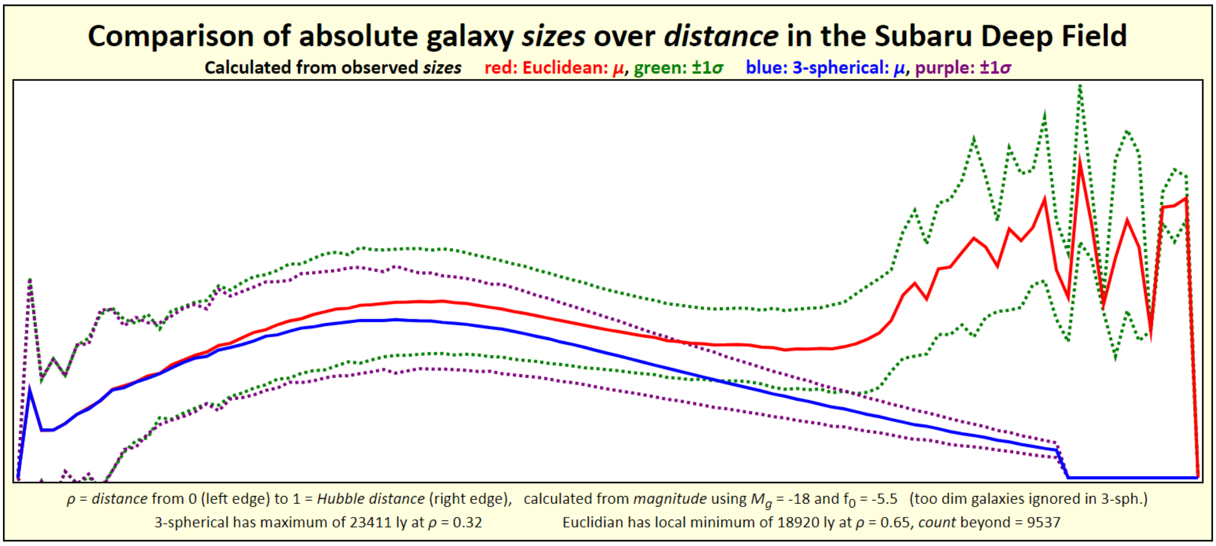


Fig. 8: Average galaxy sizes in the Subaru Deep Field for both geometries, dotted lines are $\mu \pm 1\sigma$

The apparent chaos for distant galaxies using Euclidean geometry is probably a result of the smaller observed galaxy count overthere, i.e. a relatively small *sample size*.

The decline of the nearby galaxy sizes probably results from how the SDF was selected. It was to contain as few as possible known objects (and of course an absolute minimum of objects in our Milky Way galaxy). This obviously yielded a patch of sky without large relatively nearby galaxies. This means at smaller distances the sample is neither aselect nor representative for the universe as a whole.

The Euclidean curve seems implausible since it shows a significant incline of the *galaxy size* towards the *Hubble distance*, where the galaxies would still be very young. It contradicts the plausibility of young galaxies being relatively small. However, http://henk-reints.nl/astro/HR-distant-proper-age.pdf shows that distant objects are not young at all, in spite of the *light travel time*.

Apparently, there has been a steady *growth* of the average *galaxy sizes* since the very beginning. Edwin Hubble discovered the radial expansion, i.e. in the line of sight, the above most probably reveals the transverse (intragalactic) expansion of the universe.

For 3-spherical geometry, the line can be extrapolated to nearly zero at the *Hubble distance*, i.e. at the moment of the big bang. This obviously contradicts Alan Guth's inflationary universe.

The *galaxy size* over *distance* distribution in the SDF seems to confirm a 3-spherical geometry of the universe, and in this 3-spherical geometry it reveals a perfectly linear transverse expansion of the universe.

Altogether, the Subaru Deep Field strongly suggests the universe has a 3-spherical geometry.

Quasar data observed by the Sloan Digital Sky Survey

The Sloan Digital Sky Survey has released the data of quasar observations[10]. The https://data.sdss.org/sas/dr14/eboss/qso/DR14Q/DR14Q_v4_4.fits file[11] contains the current final data. It contains 526 357 quasars in nearly 23% of the full sky[10]. Both *magnitudes* and *redshifts* are available.

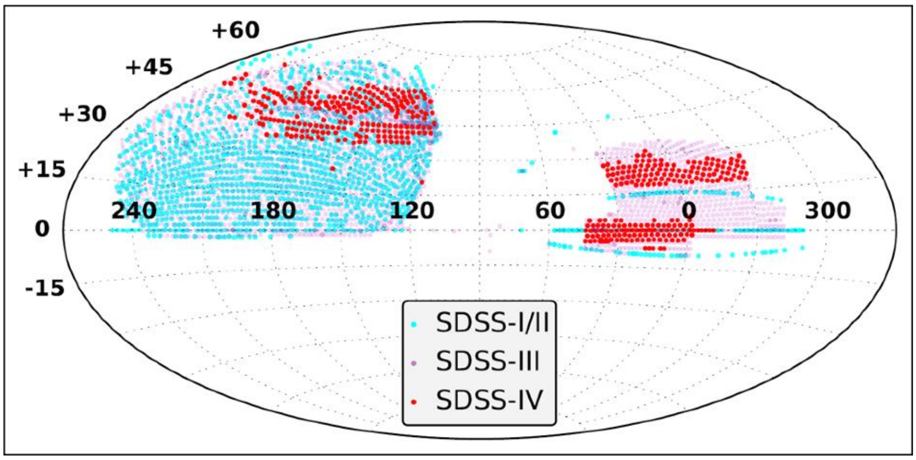


Fig. 9: Part of the sky covered by DR14Q, image by I. Pâris et al.[10]

Quasar *count* per *magnitude*

For the analysis of *quasar magnitudes*, the average of the 5 PSFMAG values was used. 525 607 of the quasars in the data file have a valid *magnitude* ≥ 15. It yields next image.

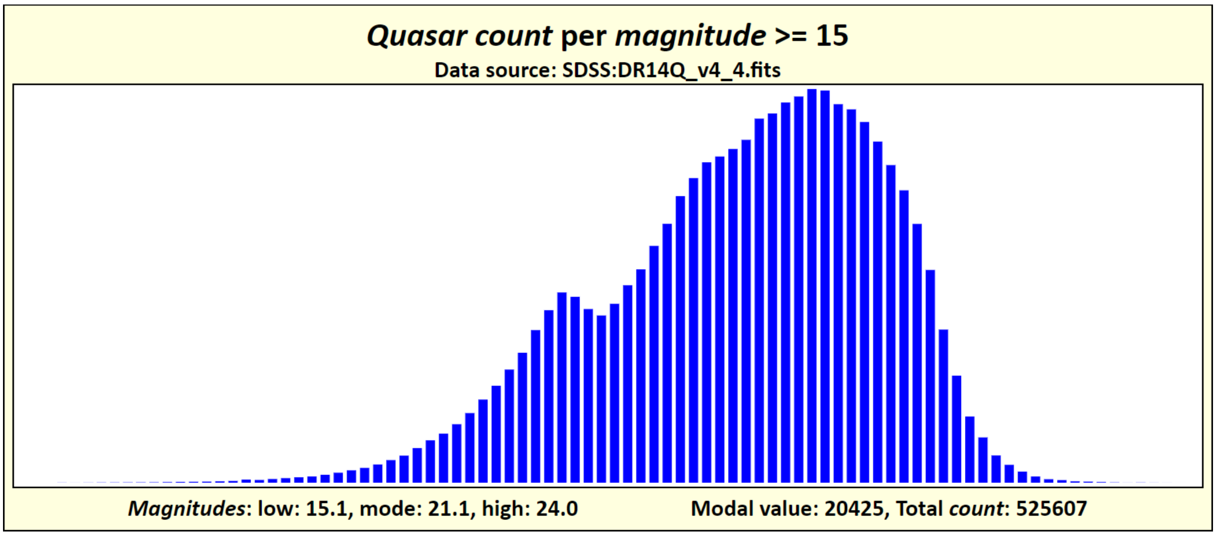


Fig. 10: Quasar count per magnitude

This is very similar to the object *count* per *magnitude* in the Subaru Deep Field as already shown. This image is in correspondance with what has been published by I. Pâris et al.[10] I can only guess about the cause of the "hiccough" around magnitude 19.2, but, as Newton wrote, hypothefes non fingo, *I do not feign hypotheses*, *I don't contrive concoctions* (such as *superluminality*, horizon problem, unobservable part of the universe, light not having enough *time* to reach us, dark matter, dark *energy*, inflationary universe, etc...).

Conversion from *magnitude* to *distance* like for the SDF yields the image below. The average *absolute quasar magnitude* was determined as $M_Q = -24.3$, which, together with the same *attenuation coefficient* $\mathrm{f}_0 = -5.5$ as was used for the SDF, yields the 3-spherical modal value very near $D_H/2$, and therefore can be considered a very plausible estimate.

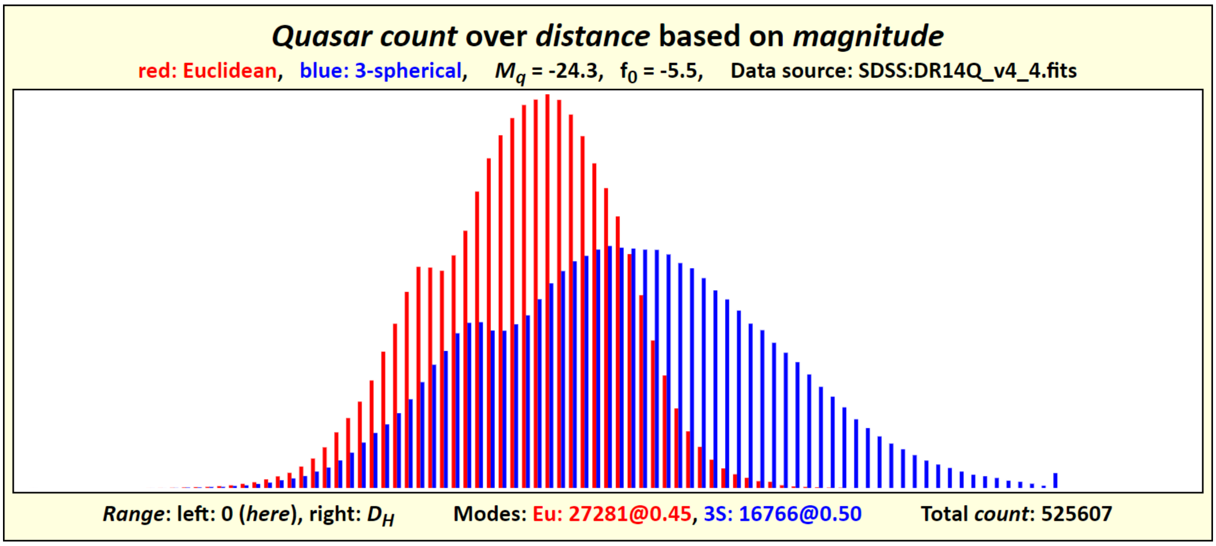


Fig. 11: Quasar count over distance based on magnitude

It obviously has the same cut-off at $\rho \approx 0.9$ as the SDF. The small peak at that distance must have to do with this cut-off.

The *quasar count* per *magnitude* also confirms a 3 spherical geometry of the universe.

Redshift analysis

The *quasar redshift* yields its *velocity* in the Hubble flow as follows.

Relativistic Doppler: $$\beta = \frac{(z+1)^2-1}{(z+1)^2+1} \qquad [2]$$

Dimensionless distance according to the Hubble-Lemaitre law:

$$\rho \equiv \frac{r}{D_H} = \beta \qquad [3]$$

which is in accordance with the non-existance of any horizon or unobservable part of the universe since *superluminality* should always be rejected whatsoever.

Then the dimensionless time since big bang equals:

$$\tau = 1 - \rho \qquad [4]$$

Next image shows $N_Q(\rho(z), \Delta\rho)$, the *quasar count* per *distance* interval at each *redshift*-based *distance*.

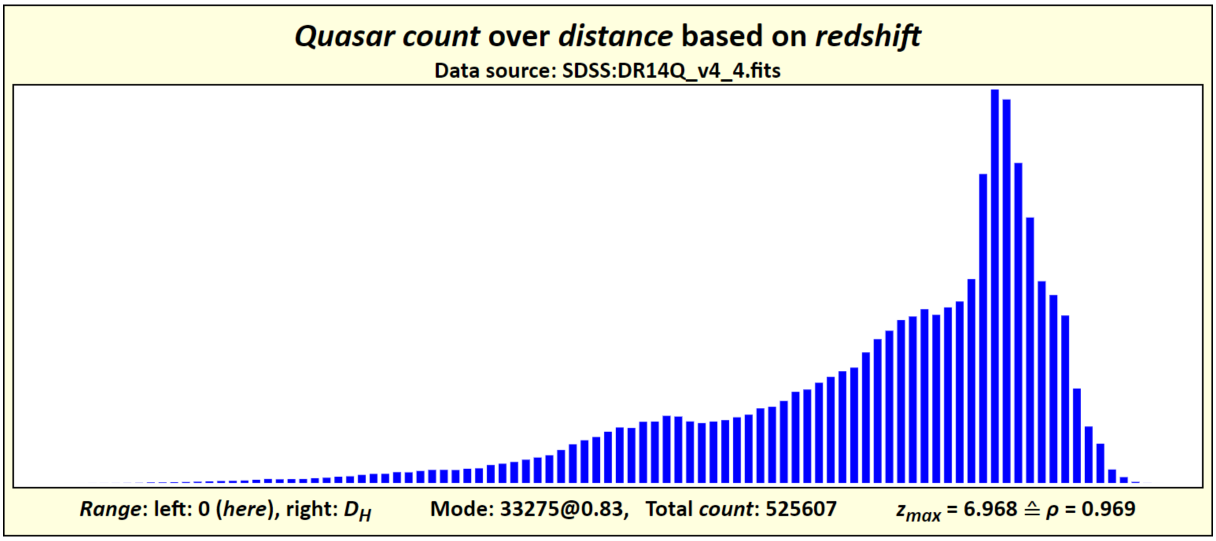


Fig. 12: Quasar count versus redshift-based distance in SDSS:DR14Q v4.4

As can be seen, the quasar distribution over *distance* based on *redshift* differs significantly from the *magnitude*-based distribution. Paragraph ***Magnitude vs. redshift*** on page 10 explains this.

By dividing these counts by the corresponding *shell volume* (*surface area* of the ball times the *distance* interval) we obtain the *quasar density* per *distance*.

$$\Omega_Q = \frac{N_Q(\rho(z),\Delta\rho)}{\{A_E|A_{3S}\}\cdot\Delta\rho} \quad [5]$$

Next images show the result for both geometries. They are mirrored, so from left to right they show the *quasar density* over *time* since the big bang, and from right to left it is over *distance* (the right edge is '*here*'). They include a dashed line which corresponds to the *reciprocal volume* of the universe itself if it would be exactly linearly expanding all the *time*, so it's a *scale factor* based on the quasar density divided by τ^3.

In the image for the Euclidian geometry, it does not matter how τ^{-3} is scaled, there is no match at all.

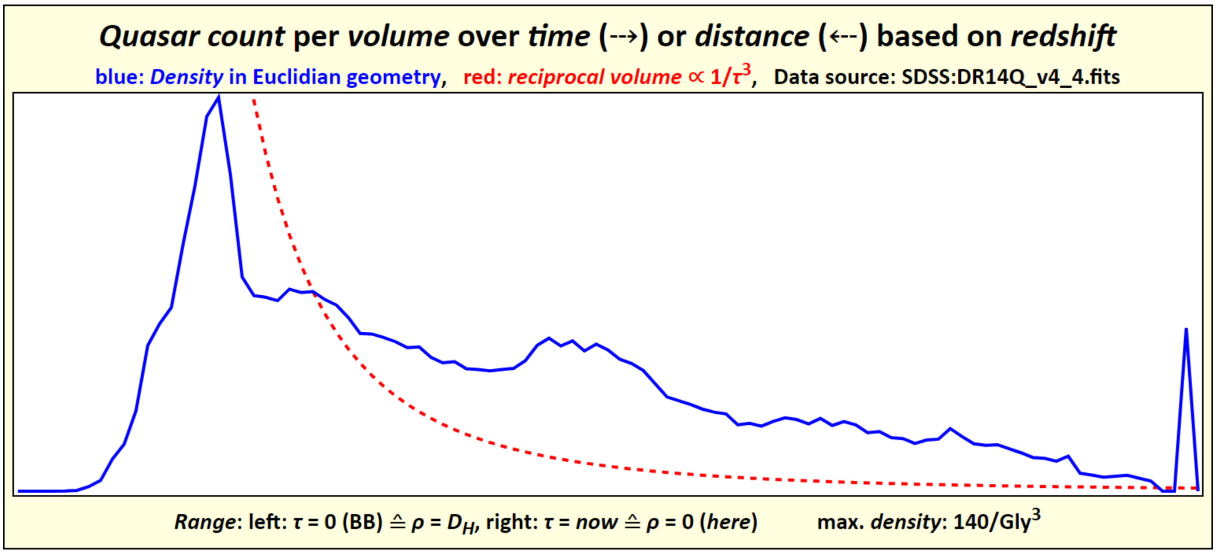


Fig. 13: Quasar density over time in Euclidean geometry

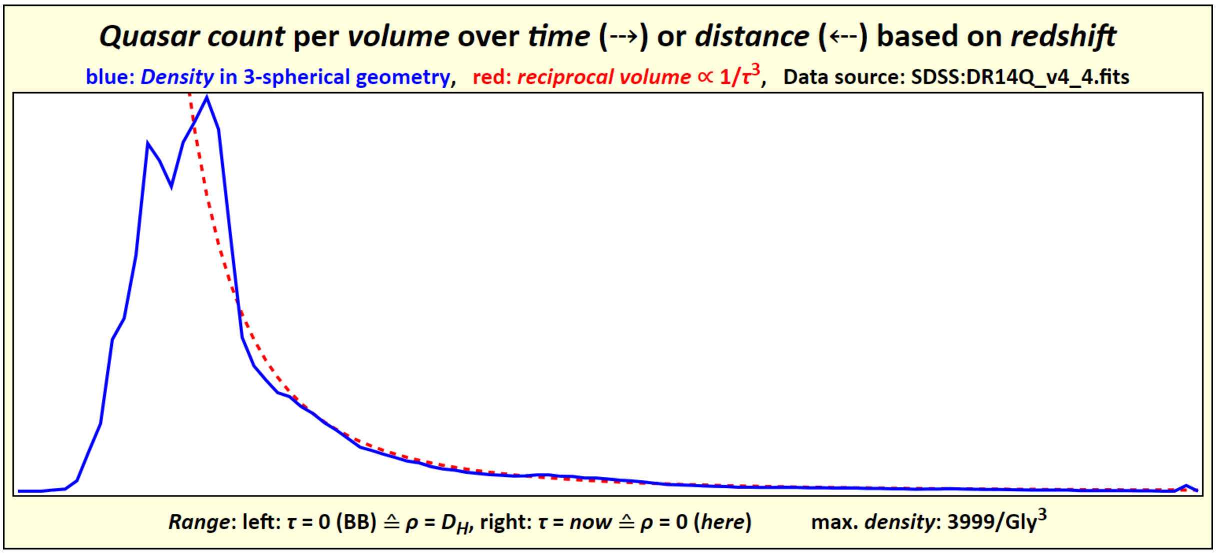


Fig. 14: Quasar density over time in 3-spherical geometry

But in the image using 3-spherical geometry 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 totally <u>linear</u> *expansion* of the universe.

The *quasar density* over *time* confirms that the universe has a 3-spherical geometry and that it is expanding at a very constant *rate* without any *acceleration*.

Because the 3-sphere has its antipodal point at exactly the *Hubble distance*, which itself is the largest possible *distance* in the universe (half its *circumference*) growing at the *speed of light*, its expansion (i.e. the growth of its half *circumference*) can obviously only be exactly linear, since it occurs at the *speed of light* and nothing else.

Altogether, the SDSS DR14Q data strongly suggest the universe has a 3-spherical geometry and an absolutely linear *expansion*.

<u>Magnitude</u>* <u>vs.</u> *<u>redshift</u>

The difference between the *magnitude*-based *distance* and the *redshift*-based one can be explained as follows.

Magnitude directly relates to *intensity*, which actually equals the average individual photon *energy* times the *photon flux* (*number of photons* per *time* per *surface area*). And the *distance - magnitude* relation does not include the *speed of light*, so it is "timeless". Therefore it is only relevant how we measure it right <u>now</u>, independent of any expansion of the universe between emission and observation of the light, so it should be related to the <u>current</u> total *surface area* of a sphere around the light source, which then apparently resides at its very centre.

Redshift however directly relates to only the *frequency* or *energy* of the individual photons, but not to the *photon flux*. This causes a different location of the maximum, which is more or less similar to the relation between the *power* P and the *torque* T of an engine as a function of its *angular velocity* ω. The equation $P = T \cdot \omega$ also causes a shift of the maximum, i.e. the maximum *power* occurs at a higher *RPM* than the maximum *torque*.

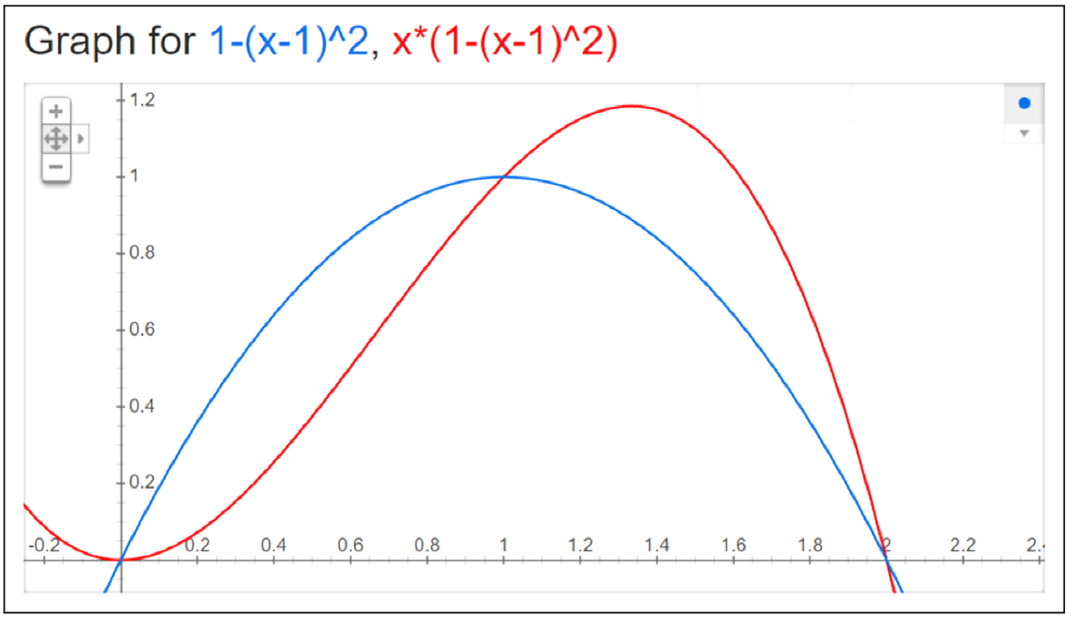


Fig. 15: Power (red) and (pro forma) torque (blue) related to an engine's RPM (arbitrary units)
(graph made with Google)

Object *intensity*

The components of equation [1] are explained below. First of all, the inverse-square law or its 3-spherical equivalent (inverse-squared-sine) yield the unattenuated *intensity* factor at a *distance*:

$$\frac{A_{10\mathrm{pc}}}{\{A_E(\rho)|A_{3S}(\rho)\}} \qquad [6]$$

It yields next image (red = Euclidean, blue = 3-spherical):

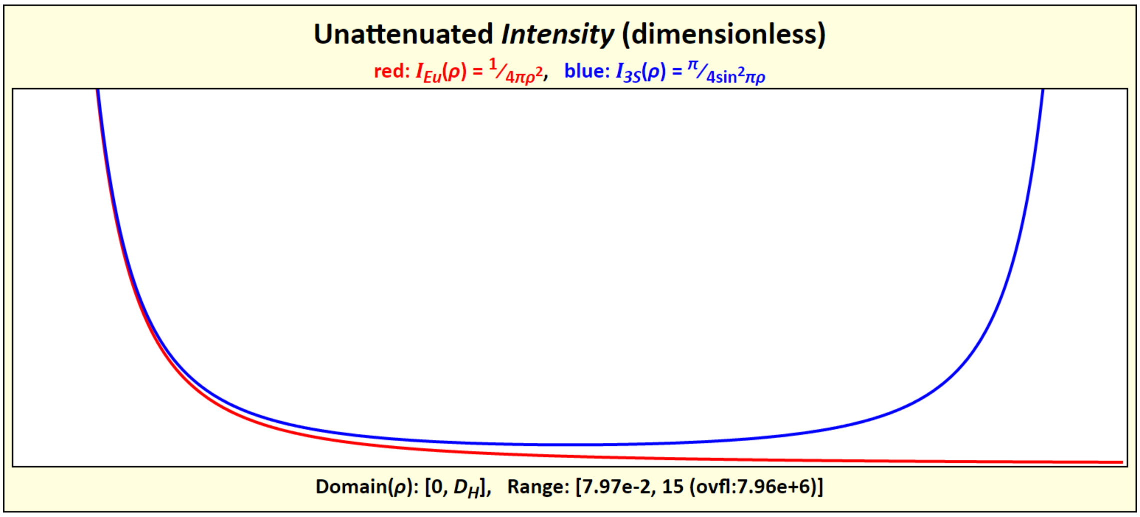


Fig. 16: Unattenuated intensity over distance for both geometries

As should be obvious, in a 3-spherical geometry the *intensity* inclines with growing *distance* beyond the equator at half the *Hubble distance*, making distant objects brighter than in a Euclidean universe.
It is plausible that due to this effect, together with the existing idée fixe of a Euclidean (flat) universe, the *accelerated expansion* of the universe was discovered[12], which now - with all respect - seems more a mistake than a discovery... Probably this also is the underlying effect of a recent publication[13] in Nature Astronomy[14] by G. Risaliti & E. Lusso.

Attenuation

Usually this is called *galactic extinction*, but I prefer the term *attenuation*. Relativistic *time dilation* because of the *Hubble velocity*, which in its dimensionless form equals the *distance*, causes *weakening* of light[9] with a factor of:

$$\sqrt{\frac{1-\rho}{1+\rho}} \qquad [7]$$

Finally, there is exponential *dimming* by the intergalactic medium, but due to relativistic *Lorentz contraction* because of the *Hubble velocity* which must be integrated, the exponent contains an arc sine:

$$e^{\mathrm{f}_0 \arcsin\rho} \qquad [8]$$

where f_0 is an *attenation coefficient*. Altogether this results in next image, with a chosen value of $\mathrm{f}_0 = -3$ in order to clearly reveal what happens to light that's coming from very near the *Hubble distance*. There is a <u>very</u> steep incline of the *intensity*! Please realise that the source of the CMB resides just there.

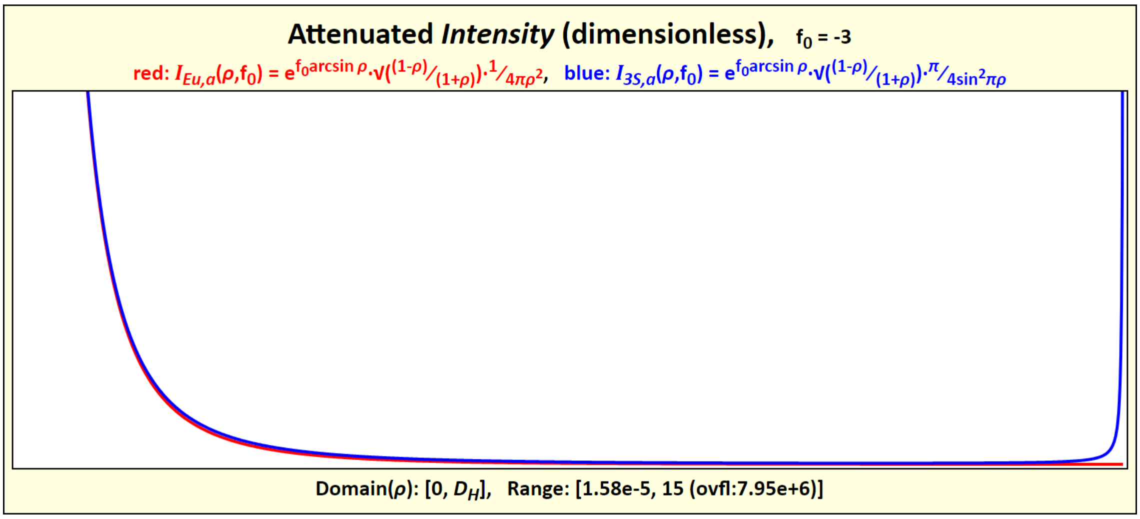


Fig. 17: Attenuated intensity over distance for both geometries

The simple fact that we actually <u>do</u> observe the (very isotropic) CMB at all confirms that the universe has a 3-spherical geometry.

Please note that due this *attenuation* the quite large difference between both geometries beyond the equator has nearly disappeared, except very near the *Hubble distance* where the CMB source is located.

The conversion to a *distance modulus* using $-5\log_{100}(\textit{intensityRatio})$ is obvious. With $\mathrm{f}_0 = -5.5$ as was used for the *magnitude* to *distance* conversions in the SDF it yields next image, which also shows the aforementioned maximum in the 3-spherical curve at $\rho \approx 0.88$, which causes the cut-off in the histograms:

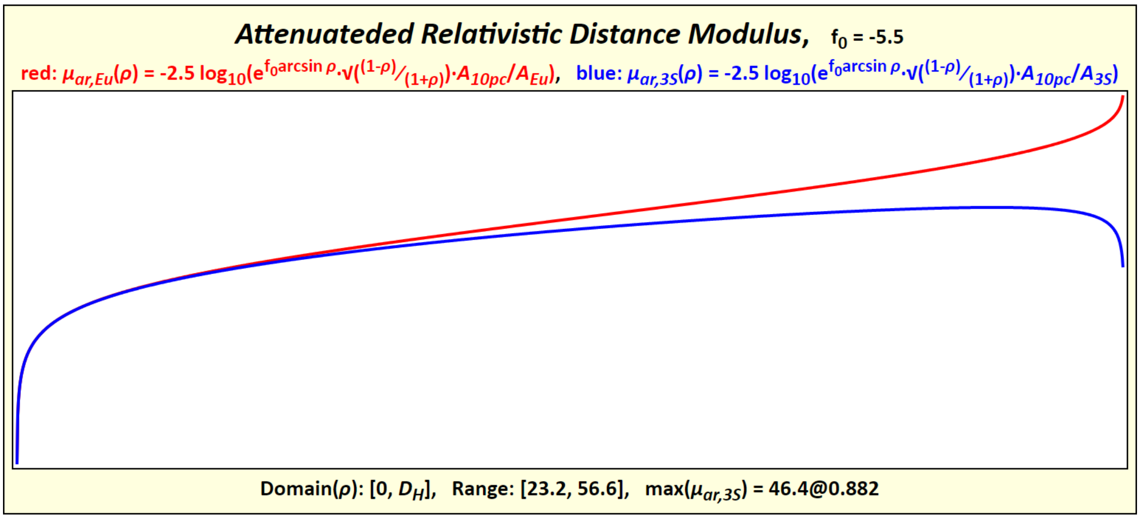


Fig. 18: Distance modulus for both geometries

As long as a Euclidean geometry of the universe is presumed, the *magnitude difference* shown by this image gives way to the presumption of an *accelerated expansion* of the universe, which, as already mentioned, seems a mistake. According to the above analysis of *quasar redshifts* the universe has been expanding as linearly as possible ever since the very beginning. This would imply that the assumption of *dark energy* is incorrect.

G. Risaliti & E. Lusso[13] published next image. Difference is the horizontal axis (above it's *distance*, below it's *redshift*).

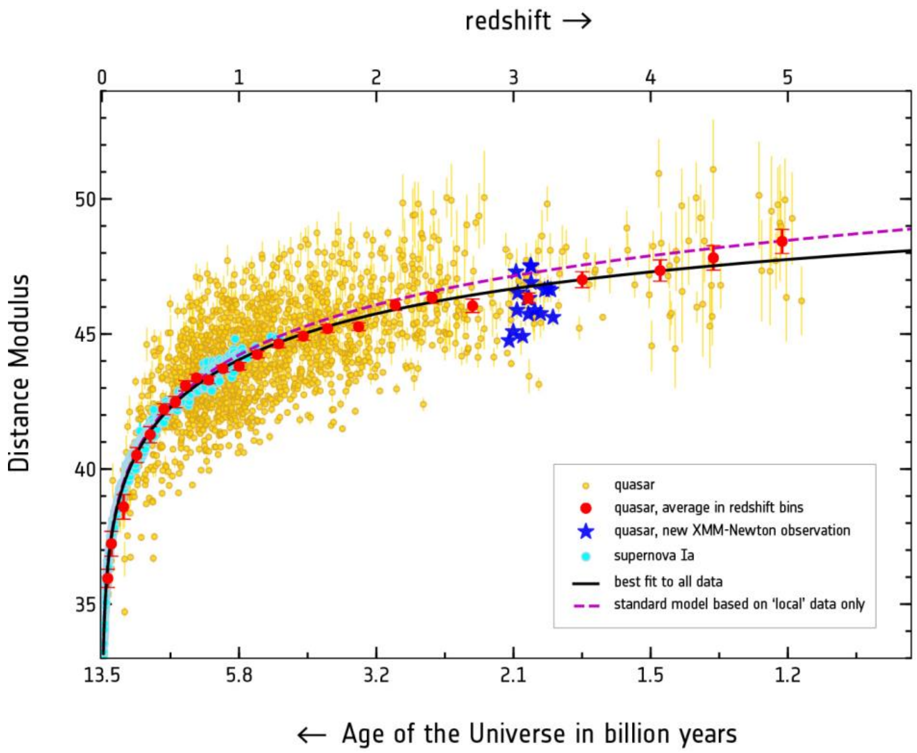


Fig. 19: Distance modulus versus redshift by Risaliti & Lusso
http://www.esa.int/Our_Activities/Space_Science/Active_galaxies_point_to_new_physics_of_cosmic_expansion.

Conversion of *Fig. 18* above from *distance* to *redshift*, and from *distance modulus* to *apparent magnitude*, using $M_Q = -24.3$ and $f_0 = -5.5$ as were used above to place the modal *count* over *distance* at $D_H/2$ (and $f_0 = -5.5$ was used for the SDF as well), and combining it with the observed quasar *magnitudes* per *redshift* as in the DR14Q database, yields next image. Per *redshift* interval, the *mode* as well as the *mean value* and *standard deviation* of the corresponding *magnitudes* were determined.

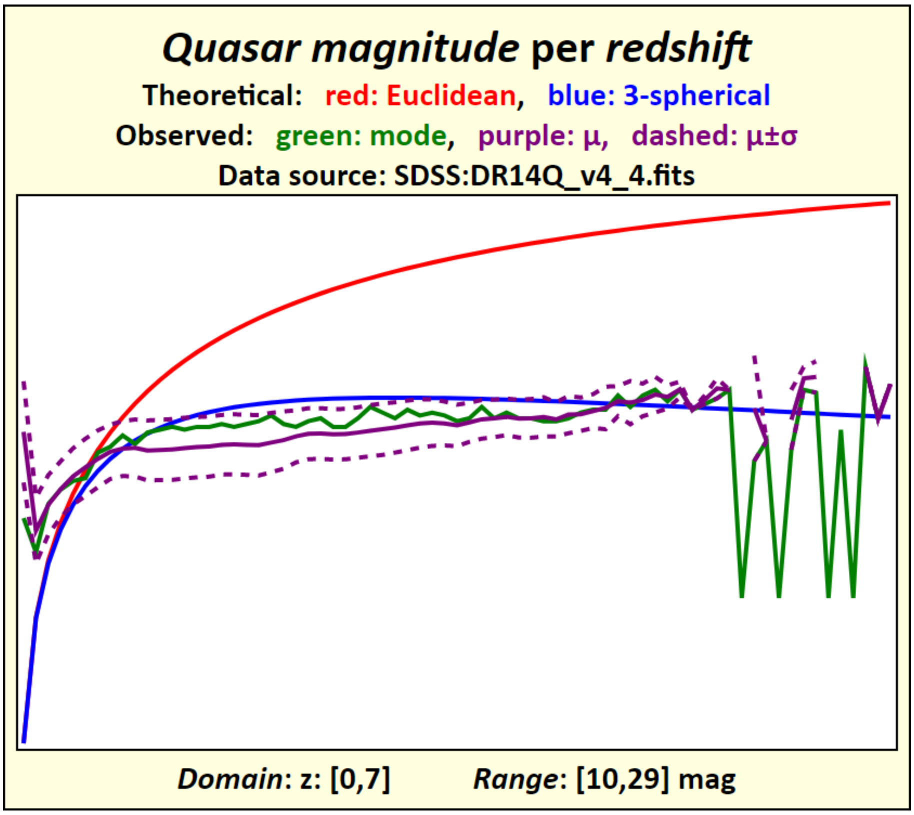


Fig. 20: Theoretical and observed apparent quasar magnitude versus redshift

Please draw your own conclusion.

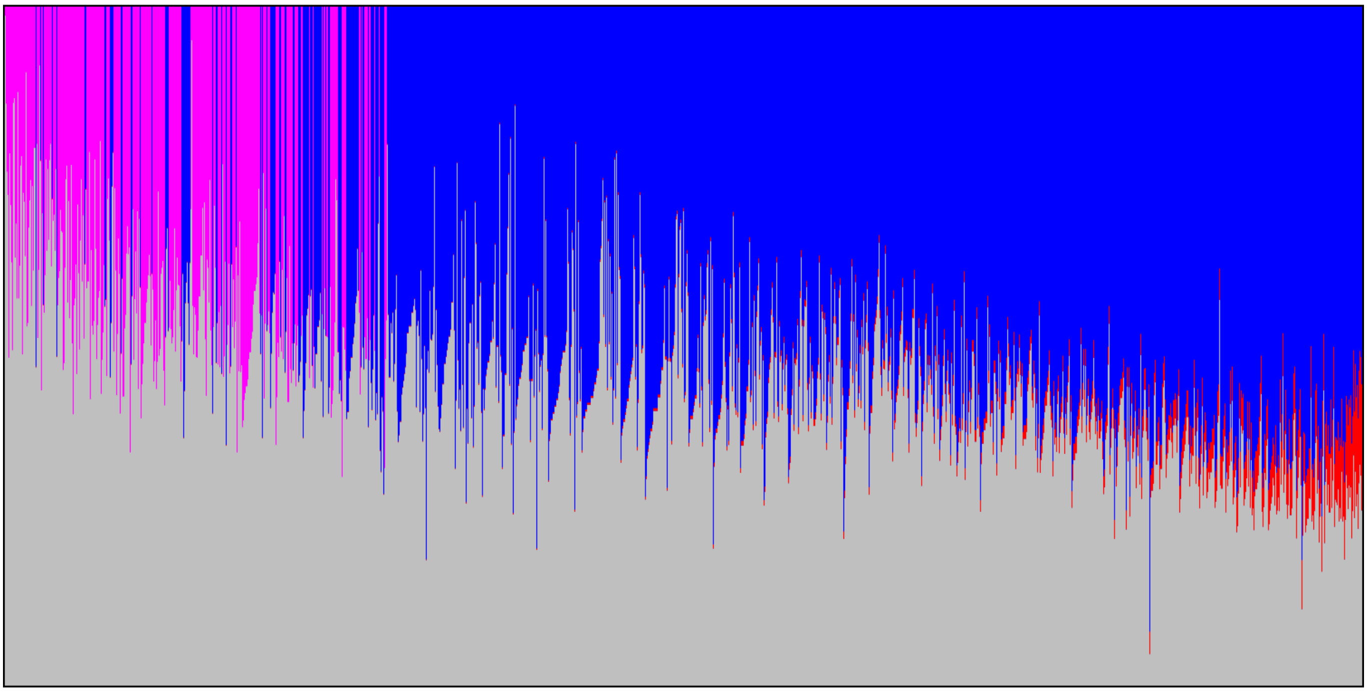
Type-Ia supernovae

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 encountered has $z = 1.199 \triangleq \rho = 0.6573$, which makes it not a really distant object. And this *sample size* of 1499 is ~ 350 times smaller than the DR14Q quasar database. This *distance* limitation as well as this relatively small sample makes the supernovae not very representative for the entire universe.

Calculation of the *absolute magnitude* per supernova based on its *distance* according to its *redshift*, using equation [1], which takes average intergalactic *attenuation* as well as relativistic effects into account, yields the image below. It is a "hanging bar chart" of negative values with the smallest (closest to zero) in front of the other, ordered from left to right by *redshift*.

Type Ia supernovae -- estimated absolute magnitudes ordered by redshift

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



μ_{3Sph} = -19.03, σ_{3Sph} = 1.26, $\min_{3Sph}$ = -23.15, $\max_{3Sph}$ = -13.78
μ_{Eucl} = -19.18, σ_{Eucl} = 1.42, $\min_{Eucl}$ = -23.48, $\max_{Eucl}$ = -13.78
Attenuation coefficent f_0 = -5.50
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)

Fig. 21: Absolute magnitudes of supernova according to both geometries

The average *absolute magnitude* found is -19, which nearly matches the "official" value.

At the right, the Euclidean calculations start to yield too bright supernovae. Due to the thought of a flat universe this has been interpreted as accelerated *expansion* thereof, for which the 2011 Nobel Prize was awarded. It's no use crying over spilled milk. The *quasar redshifts* indicate a perfectly linear *expansion* of the universe. The *quasar count* exceeds the *supernovae count* by a factor of ~ 350, which makes it a far better sample. Moreover, the quasars are found over practically the entire *Hubble distance*, whilst the farthest supernova is at merely $\rho \approx \frac{2}{3} D_H$.

Count per *magnitude*

The counts of supernovae per *apparent magnitude* interval is as follows.

```
Type Ia Supernovae Count per Magnitude (total m-range divided into 25 equal intervals)
=======================================================================================
magn    count
-----   -----   |--------------------------------------------------
12.40   1       |
12.90   1       |
13.41   0       |
13.91   5       |#
14.42   11      |###
14.92   20      |######
15.42   31      |#########
15.93   39      |###########
16.43   84      |########################
16.94   93      |###########################
17.44   95      |############################
17.94   75      |######################
18.45   81      |########################
18.95   81      |########################
19.46   80      |#######################
19.96   65      |###################
20.46   59      |#################
20.97   110     |################################
21.47   133     |#######################################
21.98   172     |##################################################
22.48   142     |#########################################
22.98   68      |####################
23.49   27      |########
23.99   14      |####
24.50   9       |###
25.00   3       |#
-----   -----   |--------------------------------------------------
```

This histogram is more capricious than the above SDF and SDSS:DR14Q histograms, since it is of a far smaller and therefore less representative sample. Nevertheless it is similar to them. I did not convert these *magnitudes* to actual *distances* since that would yield an obvious result. The general shape of this histogram, which, like the other ones, shows a prominent maximum, definitely does not contradict a 3-spherical geometry of the universe.

Apparent magnitude per *redshift* interval

After dividing the total *redshift* range of the supernovae into 50 intervals, the average *apparent magnitude* per *redshift* interval comes out as follows (cf. fig. 20 above, which is very similar). It is far more in agreement with a 3-spherical than with a Euclidean geometry. The same value of $f_0 = -5.5$ was used as for the SDF and SDSS:DR14Q.

```
Type Ia Supernovae Magnitude per Redshift (total z-range divided into 50 equal intervals)
=========================================================================================
Obs.            Theor. Magn.    Obs. Magn.
z       rho     3sph    Eucl    mu      smooth  sigma   min     max     count   | E: Euclidian, 3: 3-spherical, ·: Observed, •: Smoothed
-----   ----    -----   -----   -----   ------  -----   -----   -----   -----   |-------------------------------------------------------
0.002   0.00    NaN     NaN     16.62   17.61   1.17    12.40   21.10   229     |          ·      •
0.026   0.03    16.08   16.08   17.57   18.10   0.91    15.50   21.10   224     |       E         ·  •
0.050   0.05    17.65   17.66   18.74   18.67   1.08    15.40   22.50   96      |                 E      •
0.074   0.07    18.62   18.64   19.46   19.26   1.22    16.60   23.00   87      |                        E   •·
0.098   0.09    19.34   19.37   20.07   19.91   1.11    18.30   23.10   94      |                            3E  •·
0.122   0.11    19.92   19.97   20.61   20.46   1.04    18.00   22.70   74      |                                3E  •·
0.146   0.14    20.41   20.48   20.87   20.88   0.90    19.00   23.00   61      |                                    E  •
0.170   0.16    20.84   20.93   21.30   21.23   0.88    19.00   23.00   77      |                                      3E •·
0.194   0.18    21.22   21.33   21.84   21.51   0.74    19.80   23.50   64      |                                         3E• ·
0.218   0.19    21.55   21.69   21.64   21.70   0.65    20.20   23.10   51      |                                           3•
0.242   0.21    21.86   22.02   21.82   21.84   0.66    20.20   23.50   62      |                                             •E
0.266   0.23    22.14   22.33   22.00   21.95   0.52    21.10   23.40   45      |                                              •3E
0.290   0.25    22.40   22.62   22.10   22.04   0.51    20.80   23.20   42      |                                              •· 3E
0.314   0.27    22.63   22.89   22.10   22.14   0.64    20.60   23.70   38      |                                               •  3 E
0.337   0.28    22.86   23.15   22.14   22.24   0.81    19.20   23.50   27      |                                               ·•   3 E
0.361   0.30    23.06   23.39   22.39   22.36   0.43    21.70   23.30   18      |                                                 •   3 E
0.385   0.31    23.25   23.62   22.53   22.47   0.40    21.60   23.30   23      |                                                 •·    3 E
0.409   0.33    23.43   23.84   22.50   22.57   0.42    21.80   23.50   25      |                                                 ·•     3 E
0.433   0.35    23.60   24.05   22.85   22.66   0.80    22.00   25.00   11      |                                                   •·    3  E
0.457   0.36    23.76   24.25   22.68   22.72   0.56    21.80   23.70   19      |                                                   •      3  E
0.481   0.37    23.92   24.44   22.77   22.79   0.50    22.00   24.00   21      |                                                   •       3  E
0.505   0.39    24.06   24.62   22.64   22.84   0.39    22.10   23.40   16      |                                                  · •       3   E
0.529   0.40    24.19   24.80   23.11   22.93   0.63    22.40   24.50   11      |                                                    • ·      3   E
0.553   0.41    24.32   24.97   23.10   22.99   0.56    22.50   24.10   11      |                                                     •        3   E
0.577   0.43    24.44   25.14   22.83   23.05   0.57    21.30   23.80   15      |                                                    ·•        3    E
0.601   0.44    24.56   25.30   23.30   23.18   0.67    22.60   24.50   8       |                                                      •·       3    E
0.625   0.45    24.67   25.45   23.00   23.26   0.52    22.10   23.80   7       |                                                     · •        3    E
0.649   0.46    24.77   25.60   23.49   23.39   0.59    22.60   24.80   9       |                                                       •·        3    E
0.672   0.47    24.87   25.74   23.83   23.49   0.63    23.20   24.70   3       |                                                        • ·      3     E
0.696   0.48    24.97   25.88   23.30   23.51   0.17    23.00   23.40   4       |                                                       ·•         3     E
0.720   0.49    25.06   26.02   23.70   23.54   0.00    23.70   23.70   1       |                                                        •·         3     E
0.744   0.51    25.14   26.15   23.40   23.55   0.10    23.30   23.50   2       |                                                       · •         3      E
0.768   0.52    25.23   26.28   23.63   23.61   0.33    23.40   24.10   3       |                                                         •          3      E
0.792   0.53    25.31   26.40   23.30   23.71   0.28    22.90   23.50   3       |                                                       ·  •         3      E
0.816   0.53    25.38   26.52   24.20   23.84   0.00    24.20   24.20   1       |                                                          •  ·       3      E
0.840   0.54    25.45   26.64   23.95   23.96   0.15    23.80   24.10   2       |                                                           •         3       E
0.864   0.55    25.52   26.75   24.20   24.04   0.00    24.20   24.20   1       |                                                            •·        3       E
0.888   0.56    25.59   26.86   NaN     24.08   NaN     NaN     NaN     0       |                                                            •         3        E
0.912   0.57    25.65   26.97   24.20   24.06   0.10    24.10   24.30   2       |                                                            •·         3       E
0.936   0.58    25.71   27.08   23.80   24.11   0.20    23.60   24.00   2       |                                                          · •          3        E
0.960   0.59    25.77   27.18   NaN     24.28   NaN     NaN     NaN     0       |                                                             •         3         E
0.984   0.59    25.83   27.28   NaN     24.44   NaN     NaN     NaN     0       |                                                              •         3        E
1.008   0.60    25.88   27.38   25.00   24.59   0.00    25.00   25.00   1       |                                                               •  ·     3         E
1.031   0.61    25.93   27.48   24.45   24.61   0.35    24.10   24.80   2       |                                                               ·•       3          E
1.055   0.62    25.98   27.57   24.27   24.61   0.21    24.00   24.50   3       |                                                             ·  •        3         E
1.079   0.62    26.03   27.66   24.85   24.66   0.15    24.70   25.00   2       |                                                                •·       3          E
1.103   0.63    26.07   27.75   NaN     24.69   NaN     NaN     NaN     0       |                                                                •        3           E
1.127   0.64    26.12   27.84   24.90   24.76   0.00    24.90   24.90   1       |                                                                 •        3          E
1.151   0.64    26.16   27.92   NaN     24.76   NaN     NaN     NaN     0       |                                                                 •        3           E
1.175   0.65    26.20   28.01   NaN     24.66   NaN     NaN     NaN     0       |                                                                •         3           E
1.199   0.66    26.24   28.09   24.50   24.58   0.00    24.50   24.50   1       |                                                               •          3            E
--------        -----   -----   -----   ------  -----   -----   -----   -----
Min|tot:        16.08   16.08   16.62   17.61   0.00    12.40   21.10   1499
Max:            26.24   28.09   25.00   24.76   1.22    25.00   25.00
Absolute magnitude used for 3sph and Eucl: -19.3 (according to https://en.wikipedia.org/wiki/Type_Ia_supernova as of 2019-03-10)
Attenuation coefficient f0: -5.5 (same as for SDF and SDSS:DRQ14)
```

Since the DR14Q data reveal an absolutely linear expansion of the universe, I'm not convinced the mismatch between the measured values above and even the 3-spherical graph indicates accelerated expansion. I think it must have to do with the chosen *attenuation coefficient* of -5.5.

Hubble Ultra Deep Field

Below is the magnitude histogram of the Hubble Ultra Deep Field.

```
# Hubble Ultra Deep Field object counts per magnitude
# ===================================================
# Catalog downloaded via: https://heasarc.gsfc.nasa.gov/W3Browse/hst/hubbleudf.html
# Excluded objects with an id >= 20000, as well as objects with at least one magnitude value (B,V,I,Z) >= 50.
# The catalog does not contain any redshift values.
# Magnitude below is the average of the B, V, I, and Z magnitudes.

# Analysis done by Henk Reints, 2019-05-12, http://henk-reints.nl
# Compare the histogram below to those of the SDF and SDSS:DR14Q.

Magn    Count   Histogram (magnitude range condensed to 50 intervals)
----    -----   -----------------------------------------------------
19.09:  3       |
19.39:  2       |
19.68:  0       |
19.98:  2       |
20.28:  2       |
20.57:  0       |
20.87:  6       |+
21.16:  7       |+
21.46:  2       |
21.76:  11      |++
22.05:  8       |+
22.35:  10      |++
22.64:  9       |+
22.94:  14      |++
23.24:  16      |++
23.53:  25      |++++
23.83:  30      |+++++
24.13:  40      |++++++
24.42:  46      |+++++++
24.72:  64      |++++++++++
25.01:  69      |+++++++++++
25.31:  104     |++++++++++++++++
25.61:  91      |++++++++++++++
25.90:  132     |++++++++++++++++++++
26.20:  142     |++++++++++++++++++++++
26.49:  175     |+++++++++++++++++++++++++++
26.79:  190     |+++++++++++++++++++++++++++++
27.09:  250     |+++++++++++++++++++++++++++++++++++++++
27.38:  257     |++++++++++++++++++++++++++++++++++++++++
27.68:  292     |+++++++++++++++++++++++++++++++++++++++++++++
27.98:  347     |++++++++++++++++++++++++++++++++++++++++++++++++++++++
28.27:  408     |+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
28.57:  450     |+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
28.86:  501     |+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
29.16:  524     |+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
29.46:  607     |++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
29.75:  648     |++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
30.05:  539     |+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
30.34:  648     |++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
30.64:  622     |++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
30.94:  494     |++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
31.23:  419     |+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
31.53:  316     |+++++++++++++++++++++++++++++++++++++++++++++++++
31.82:  182     |++++++++++++++++++++++++++++
32.12:  111     |+++++++++++++++++
32.42:  56      |+++++++++
32.71:  31      |+++++
33.01:  10      |++
33.31:  4       |+
33.60:  1       |
33.90:  1       |
Total count: 8918
```

It is obviously equivalent to the already shown *magnitude* histograms, so the HUDF confirms a 3-spherical geometry as well. The catalog does not contain *redshift* values.

Conclusions

1. Both the observed Subaru Deep Field data and the observed SDSS quasar data cannot lead to another conclusion than that

   THE UNIVERSE IS A PERFECTLY LINEARLY EXPANDING 3-SPHERE.

   Ex obſervatis phænomenis immediate deductum eſt.

   It has directly been deduced from observed phenomena.

   Hypotheſes non fingo, *I do not feign hypotheses.*

2. The 3-sphere's *half circumference* equals the *Hubble distance*. Therefore its *hyperradius* grows at c/π, so it cannot ever be the same as Minkowski's ict dimension, which obviously grows at c.
3. The CMB source must reside around the antipodal point.
4. Both the observation-based rejection of the *horizon problem* because *superluminality* cannot ever exist, and the observation-based 3-spherical geometry of the universe which fully contradicts the *flatness problem*, severely undermine Alan Guth's Inflationary Universe[15] by falsifying both its premises. It is purely hypothetical anyway, i.e. not actually deduced from any observations, and it would require *superluminality* which should be firmly rejected.
5. The universe is far smaller than assumed by standard cosmology. No two objects can have a greater mutual *distance* than the *Hubble distance*, not even by a *Planck length*.
6. FLRW geometry was not used at all and it seems not applicable to the universe. By using only the *relativistic Doppler effect* to obtain the *distance*, a nearly perfect match is achieved for the 3-spherical geometry.
7. This nearly perfect proportionality to t^{-3} of the *quasar density* over *time* based on observed quasar *redshifts*, implies the *expansion* is not accelerating at all, it appears as linear as can be. Then there exists no reason at all for the assumption of any hypothetical *dark energy*.
8. The 2011 Nobel Prize in Physics was awarded for the discovery of the non-existing *accelerated expansion* of the universe...

About me

I am a Dutch graduated physicist (Eindhoven University of Technology, 1984). After I graduated, I obtained a job in automation where I stayed ever since. But the universe kept fascinating me and I never felt comfortable with many exotic assumptions made in cosmology. The *horizon problem* and the presumed *flatness of the universe* are just a few of them. Please find me on the internet at http://henk-reints.nl and read more of my ideas concerning the universe.

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