Frequency Decrease of Light

D.H.W. Reffer*
ICPE, 313 Splai Unirii, Bucharest, Romania

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Abstract

This is a so slow phenomenon that its effect is undetectable in light emitted at distances as in our galaxy, but is significant in light coming from cosmological distances, hence the alias "Cosmological Degeneration/Decay of Light". On postulating the phenomenon's existence, its law comes uniquely—an unprecedented case in physics. As main consequences, it: solves *Digges-Olbers' paradox*, thus making possible cosmology with infinite universe; explains *Hubble-Humason's redshift* (or *cosmological redshift*), in agreement with *Hubble's constant's inconstancy*; explains *Penzias and Wilosn's* CMB; explains the unexplained non-uniformity in CMB; replaces the *Big-Bang theory/model/ scenario*. Two new predictions are made. Keywordsfrequency decrease solving Digges&Olbers paradox infinite universe replacing Big-Bang model background radiation absolutely resting frame Hubble constant inconstancy

1 Introduction

The existence of the phenomenon postulated herein was suggested by the following "photometric paradox" also called "dark night sky paradox".

Digges-Olbers' Photometric Paradox *In an infinite universe, uniformly full with sources of light, the nocturnal sky should be bright, not almost black as it is.*

Consequence *Any cosmology with infinite universe has been impossible because of this paradox.*

After the nature of light was discovered (Maxwell, 1864), the paradox should have suggested the existence of a phenomenon of decrease in frequency, but this did not happen. However, attempts to solve the problem by frequency decrease—called *tired-light* model—were made, but via some quantum mechanisms of collision with matter [2], i.e., not as a fundamental

*E-mail: dhwreffer@gmail.com

electromagnetic phenomenon (to be incorporated in Maxwell's electrodynamics).

Hubble and Humason (1929) [1] discovered the cosmological redshift that was—wrongly, but still currently accepted—hypothesized to be a Doppler effect, entailing a bunch of hypotheses referred to as the BBT[1] which, once known the phenomenon we are dealing with, and its law, are no longer necessary, since the observational facts intended to solve become predictions.

Though belonging to classical electromagnetism, this phenomenon, being extremely slow, is proved by cosmological facts of observation only, thus an adequate synonymous is CDL[2].

2 The phenomenon and its law

Digges-Olbers' paradox (above transcribed) is an incentive to postulate the existence of a fundamental electromagnetic phenomenon, hence having to be incorporated in the classical/Maxwell electrodynamics. As demonstrated below, the law governing the phenomenon derives uniquely from the postulate of the phenomenon's existence—an unprecedented case in physics.

Postulate of Frequency decrease or CDL *The frequency of electromagnetic waves slowly decreases during their travel in free space, tending to zero as the distance tends to infinity,*

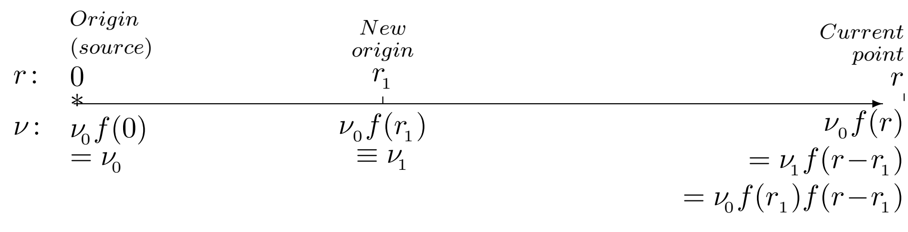
$$\nu = \nu_0 f(r)\,, \quad f(0) = 1\,, \quad \lim_{r\to\infty} f(r) = 0\,, \tag{1}$$

f being *positive, strictly decreasing, and continuous together with all its derivatives in the interval* $(0, \infty)$.

Mathematical observation *The law* $\nu_0 f(r)$ *must permit taking any point of the trajectory as origin, and the corresponding frequency as the initial value—just as if that point were the source (or emitter)*; that is, taking a new origin at $r_1 < r$ at which the frequency is ν_1, one must have

$$\nu = \nu_0 f(r) = \nu_1 f(r - r_1) = \nu_0 f(r_1) f(r - r_1)\,, \tag{2}$$

or graphically,



[1]BBT stands for *Big-Bang Theory/Model/Scenario.*

[2]CDL stands for *Cosmological Degeneration/Decay of Light.*

This natural observation filters uniquely the function $f(r)$, as demonstrated below.
Theorem *The law of frequency decrease stated by the above homonymous postulate is*

$$\nu = \nu_0 e^{-\mathcal{H}r/c}, \tag{3}$$

where c is the speed of light in vacuum, and $\mathcal{H}$ is a positive constant.

We propose $\mathcal{H}$ to bare the name of the *earliest (value of) Hubble's constant*, since it is just the name says, as to be seen now.

Demonstration Transcribe from Eq. (2) $\nu_0 f(r) = \nu_0 f(r_1) f(r - r_1)$, differentiate both sides, and write the ratio of the two equations,

$$\frac{f'(r)}{f(r)} = \frac{f'(r - r_1)}{f(r - r_1)},$$

whence, as r_1 is arbitrary, these ratios are constant $f'(r)/f(r) = c_1$, whence $f(r) = c_2 \exp(c_1 r)$, hence $\nu = \nu_0 c_2 \exp(c_1 r)$, whence, as ν at $r = 0$ is ν_0, obtain $c_2 = 1$, thus $\nu = \nu_0 \exp(c_1 r)$; since, by postulate, ν decreases, c_1 is negative, and it is preferable to take it in the form $c_1 = -\mathcal{H}/c$, hence just the law (3). QED

Of course, one can replace $r = ct$ in (3), but the resulting form hides the physical sense, namely, it is space that acts upon light, not time. As already mentioned, the effects of this phenomenon are significant for very large/cosmological distances only, and therefore one can also refer to it as the CDL, an expressive alias.

3 Explaining the effects related to Big-Bang

Each subsection below is a test of the law (3) and has two components: problem, followed by solution, including the one in the BBT.

3.1 Solving Digges-Olbers paradox

Solving the Digges-Olbers paradox has been just the motive of finding out the phenomenon this article is dealing with. According to law (3) the frequencies of light coming from enough large distance decreased/decayed below the threshold of visibility, i.e., an observer is not reached by light from the whole universe, but only from a (large) vicinity.

In the BBT the problem is solved by postulating/hypothesizing the universe to be finite.

3.2 Explaining the Hubble-Humason redshift

As already mentioned in Section 1, Hubble and Humason discovered (1929) [1] a redshift in light coming from distant galaxies—hence the name of *Hubble-Humason's cosmological redshift*—according to the formula

$$\frac{\lambda-\lambda_0}{\lambda_0}=\frac{H}{c}r \qquad \texttt{(Hubble formula)}, \tag{4}$$

where H is the *Hubble constant*, which later proved not to be a constant.

The law (3) leads to Eq. (4) as an approximation, as follows. Expressing $(\lambda-\lambda_0)/\lambda_0$ in terms of frequency, via $\lambda\nu = c$, i.e., $(\lambda-\lambda_0)/\lambda_0 = (\nu_0-\nu)/\nu = \nu_0/\nu - 1$, and replacing ν according to (3), yield

$$\frac{\lambda-\lambda_0}{\lambda_0}=e^{\mathcal{H}r/c}-1 \quad \texttt{(exact formula for Hubble-Humason redshift)}, \tag{5}$$

instead of the above Hubble formula, (4); expanding the exponential in a power series and neglecting the powers higher than 1,

$$\frac{\lambda-\lambda_0}{\lambda_0}\approx\frac{\mathcal{H}}{c}r, \tag{6}$$

for $\mathcal{H}r/c \ll 1$, that is, for

$$r \ll c/\mathcal{H} \qquad \texttt{(condition for}(6)\texttt{)}. \tag{7}$$

Hence, indeed, the approximation (6) coincides experimentally with (4), *if the condition (7) is satisfied*. In other words, Hubble's formula (4) is an approximation of that exact (5) derived from the law (3).

In the BBT the Hubble-Humason/cosmological redshift is explained by hypothesizing/postulating it to be a Doppler effect, what entailed the entire bunch of hypotheses making up the scenario itself—this (wrong) hypothesis has been the basis of the Big-Bang idea in cosmology.

One should read quotations showing Hubble and Tolman's [3] quandary on the cause of the cosmological redshift: "... recession or some other cause for the red-shift." "observations ... are not yet sufficient to permit a decision between recessional or other causes for the red-shift." "Nevertheless, the possibility that the red-shift may be due to some other cause ... should not be prematurely neglected;" "... both the present writers wish to express an open mind ... and ... continue to use the phrase "apparent" velocity of recession. They both incline to the opinion, however, that if the red-shift is not due to recessional motion, its explanation will probably involve some quite new physical principles." This ending sentence should be reread ("some quite new physical principles").

3.3 Why Hubble's constant has not behaved as a constant

As just noted, Hubble's formula (4) is experimentally valid as long as the condition (7) is accomplished.
As observations advanced to more and more distant galaxies, the linear Eq. (4) became unsatisfactory, which made observers determine smaller and smaller values for H to satisfy (unawares) the condition (7), and the process continued up to the edge of visible universe. It is now clear why $\mathcal{H}$ in (6), i.e., in (3), is (as above called) the *earliest* value of Hubble's constant: the subsequent values were forced, to use the same linear law (4) in the absence of that exact (5).
The value of the (pseudo)constant H has been debated for all 89 of the intervening years: as observations reached more distances, smaller values have been assigned to H, ranging from above $550\,(km/s)/Mpc$ to below 50 ($1\,Mpc = 3.08568025 \times 10^{22}\,m$). This is why the syntagmas *Hubble's constant's inconstancy* and *Hubble's (pseudo)constant* are used herein.

3.4 Evaluating the known $10^{26}\,m$ edge of visible universe

Clearly, according to law (3), for any source of light there exists a distance beyond which its highest emitted frequency decays (on travel) below infrared, i.e., becomes microwave and even more degenerated, up to undetectability. In general, a source of visible spectrum of light also emits the neighboring bands—infrared and ultraviolet—by means of which the source can also be seen using adequate instruments. Naturally, *the visible universe edge*, r_{edge}, is the distance from which the whole ultraviolet band decays in frequency up to below infrared. In other words, r_{edge} is the shortest distance from which the whole spectrum infrared–visible–ultraviolet reaches the observer as cosmic microwave background radiation. The distance from which a wave comes is

$$r = \frac{c}{\mathcal{H}} \ln \frac{\nu_0}{\nu} = \frac{c}{\mathcal{H}} \ln \frac{\lambda}{\lambda_0} \,, \tag{8}$$

and to evaluate $r = r_{edge}$ we must take $\lambda_0 = 10\,nm$ (initial wavelength), and $\lambda = 1\,mm$ (received wavelength), while for $\mathcal{H}$ we take $550\,(km/s)/Mpc \approx 1.78 \times 10^{-17}\,s^{-1}$, thus finding $r_{edge} \approx 1.94 \times 10^{26}\,m$, a value too large, which makes us expect a greater value for $\mathcal{H}$, about $800\,(km/s)/Mpc \approx 2.60 \times 10^{-17}\,s^{-1}$. In other words, even at his first observations Hubble reached distances too large for the linearity of Eq. (4) without resorting to an H greater than the true $\mathcal{H}$.

Note that sources beyond r_{edge} emitting X-rays can also be seen in the infrared-visible-ultraviolet range; also, γ-ray bursts having taken place at even greater distances, can be seen in this range of frequencies. These sources appear as non uniformities in CMB[3], which were observed but cur-

[3]CMB stands for *Cosmic Microwave Background.*

rently unexplained (hence one more hypothesis is expected! in the BBT—which in fact gives rise to more and heavier questions than it answers).

Currently the edge the visible universe has been evaluated observationally, as the BBT does not answer.

3.5 Explaining the CMB

This radiation was discovered by Penzias and Wilson (1965) [5] and is also called *relic radiation*, as interpreted/hypothesized in the big-bang scenario. The CMB, whose origin is not within the edge of the visible universe, is, on average, isotropic, as the universe is, and its intensity distribution looks like that of a black-body radiation at 2.725 K temperature.

The existence of CMB is an immediate consequence: light from sources at enough large distances (beyond *the edge of the visible universe*) does arrive with frequencies fallen below the infrared range—microwave and radio radiations—and must be isotropic, according to the *cosmological principle* (*"at cosmological scales, the masses and sources of light and particles are uniformly distributed"*, analogously to the molecules of a gas at thermodynamic equilibrium; the view arisen herein agrees with today's thermodynamical picture of the CMB, but the cause differs altogether).

3.6 Explaining the slight non-uniformity in CMB

By reason of importance for cosmology and physics in general—especially for the fact that *the CMB is an absolutely resting reference frame*—close theoretical and observational studies have been carried out. COBE (COsmic Background Explorer) satellite discovered (1992) [6] slight non-uniformities, randomly distributed, in the CMB. WMAP (Wilkinson Microwave Anisotropy Probe) mission has examined the CMB in finer detail, with greater sensitivity, and a full sky map has resulted [7], as well as that the CMB ranges—in terms of temperature—between 2.7251 and 2.7249 K.

Obviously, the CMB coming from sources beyond, but relatively near, the visible edge, are received individually, as spots on the compact background, i.e., those sources are seen by means of radiation below the infrared range (microwave and radio). The CMB becomes compact, i.e., indiscernible sources, as distances tend to infinity (and frequencies to zero).

4 Predicting two new effects

4.1 The lower the frequency the less the non-uniformities in CMB

Obviously, the CMB coming from sources beyond, but relatively near, the visible edge, are received individually, as spots on the compact background, i.e., those sources are seen by means of radiation below the infrared range (microwave and radio). The CMB becomes compact, i.e., indiscernible sources, as distances tend to infinity (and frequencies to zero). Hence the maximum anisotropy appears *in infrared*—just as seen on the WMAP map—which the BBT fails to predict.

We now use the notion of the visible universe edge, r_{edge}. Clearly, the highest frequency of the CMB, *long infrared*, comes from the closest—just beyond r_{edge}—sources only. Therefore, the sources are seen *(almost) individually* through (long) infrared originating from visible light, hence the greatest non-uniformity appears in (long) infrared. On the contrary, frequencies lower than long infrared originate both from the nearest and farther sources, i.e., from more numerous sources (yielding greater angular density), hence *the non-uniformity is less than in infrared.* Three WMAP type maps would be relevant: in infrared; in microwaves; and in radio frequency. The evenness is thus expected to increase gradually, beginning with the map in infrared.

4.2 Light from sources beyond the visible universe's edge

Note that sources beyond r_{edge} emitting X-rays can also be seen in the infrared-visible-ultraviolet range. Also, γ-ray bursts having taken place at even greater distances, can be seen in this range of frequencies.

4.3 Absolutely resting reference frame does exist

At any point in space, light comes degenerated to any value of frequency, from sources correspondingly distant, in particular as CMB, and is homogeneous and isotropic, as the distribution of sources are in the universe (according to the *cosmological principle* worded in Subsection 3.5); the point under consideration lies in the absolutely resting reference frame; if the point is moving, then this background of radiation becomes anisotropic because of the Doppler effect (so Doppler's effect is the basis for a kind of an absolute GSM&speedometer through the universe).

5 Discussion

Note that the six effects in Section 3 are explained artificially in the BBT, each by one more hypothesis, while using the CDL they are explained naturally, with no hypothesis. Note also how all scientists refrained from postulating the cosmological redshift to be caused by a fundamental electromagnetic phenomenon, regarding Maxwell's electrodynamics as taboo. One should now reread the ending paragraph of Section 3.2.

Maybe the BBT is the most naive and hilarious theory in the history of Physics, Cosmology, Philosophy, and all the sciences, including the ancient times. It is a big shame of the precedent, 20th, century.

A rhetorical question arises: who, or better said, what kind of mind, can any longer accept the BBT, instead of a turnabout towards the CDL?

The Big-Bang story is the structure of a science fiction novel for teenagers.

"Cosmologists are always wrong, but never in doubt." (Robert P. Kirshner).

The fact should be mentioned that GTR does not stand on BBT, i.e., it does not stagger on removing from it the universe expansion (the positive—repulsive—term in the gravitational field's equation), it only having to shift to its state before the cosmological redshift discovery (Hubble-Humason 1929). The real problem of GTR is the tough question [8] on *Perihelion advance*.

5.1 On authorship upon the law (3)

While the phenomenon of CDL, or more exactly named by the title of this article, is clearly newly put forward by the undersigned (having difficulties in making the scientific community accept its existence), an exponential like the above law (3) was encountered for the Hubble-Humason's redshift but **as a Doppler effect** (not as a CDL effect), and as a hypothesis, **not mathematically deduced**. An interesting example is the article [4] in which Geller and Peebles pleaded **against the exponential law**, which they took with **no demonstration** from opposers, and analyzed it polemically in relation to the **cosmological redshift as a Doppler effect**.

References

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