

Cumulative-Phase-Alteration of Galactic-Light Passing Through the Cosmic-Microwave-Background: A New Mechanism for Some Observed Spectral-Shifts

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Currently, whole of the measured “cosmological-red-shift” is interpreted as due to the “metric-expansion-of-space”; so for the required “closer-density” of the universe, we need twenty times more mass-energy than the visible baryonic-matter contained in the universe. This paper proposes a new mechanism, which can account for good percentage of the red-shift in the extra-galactic-light, greatly reducing the requirement of dark matter-energy. Also, this mechanism can cause a new kind of blue-shift reported here, and their observational evidences. These spectral-shifts are proposed to result due to cumulative phase-alteration of extra-galactic-light because of vector-addition of: (i) electric-field of extra-galactic-light and (ii) that of the cosmic-microwave-background (CMB). Since the center-frequency of CMB is much lower than extra-galactic-light, the cumulative-phase-alteration results in *red*-shift, observed as an additional contributor to the measured “cosmological red-shift”; and since the center-frequency of CMB is higher than the radio-frequency-signals used to measure velocity of space-probes like: Pioneer-10, Pioneer-11, Galileo and Ulysses, the cumulative-phase-alteration resulted in blue-shift, leading to the interpretation of deceleration of these space-probes. While the galactic-light experiences the red-shift, and the ranging-signals of the space-probes experience *blue*-shift, they are comparable in magnitude, providing a supportive-evidence for the new mechanism proposed here. More confirmative-experiments for this new mechanism are also proposed.

1 Introduction

Currently, whole of the “cosmological red-shift” is interpreted in terms of “metric-expansion-of-space”, so for the required “closer-density” of the universe, we need twenty times more mass-energy than the visible baryonic-matter contained in the universe. This paper proposes a new mechanism, which can account for good percentage of the red-shift in the extra-galactic-light, greatly reducing the requirement of dark matter-energy. Prior to this, many scientists had proposed alternative-interpretations of “the cosmological red-shift”, but the alternatives proposed so far were rather speculative; for example, speculating about possible presence of iron-particles in the inter-galactic-space, or presence of atoms of gas, or electrons, or virtual-particles... etc. How can we say for sure that such particles are indeed there in the inter-galactic-space? Even if they are there, is the “cross-section” of their interactions sufficient? Whereas a mechanism proposed here is based on experimentally established facts, namely the presence of “cosmic-microwave-background” (CMB), we are sure that CMB is indeed present in the inter-galactic-space. And we know for sure that electric-field-vectors of light and CMB are sure to get added.

This mechanism predicts both kinds of spectral-shifts, *red*-shift as well as *blue*-shift. The solar-system-astrometric-anomalies [1, 2] are indicated here to arise due to the *blue*-shift caused by the cumulative-phase-alteration-mechanism

proposed here. These anomalies are actually providing supportive-evidences for the new mechanism proposed here.

Brief reminder of the “solar system astrometric anomalies” will be in order here: (a) Anomalous secular increase of the eccentricity of the orbit of the moon [3–7] (b) the fly-by-anomaly [8–10] (c) precession of Saturn [11–12], (d) secular variation of the gravitational-parameter GM (i.e. G times mass M of the Sun) [13–16] (e) secular variation of the Astronomical-Unit [17–23] and (f) the Pioneer anomaly. For description of Pioneers see: [24] for general review of Pioneer-anomaly see: [25]. Of course, the traditional constant part of the anomalous-acceleration does not show up in the motion of major bodies of the solar system [26–44]. For the attempts of finding explanations for the Pioneer-anomaly in terms of conventional physics see: [45–52].

In this new mechanism for the spectral-shift, proposed here, there is no loss of energy; energy lost by cosmic-photons get transferred to CMB; so, it is in agreement with the law of conservation of energy. More verification-experiments for this new mechanism are also proposed here, so it is a testable proposal.

Moreover, this proposal is not in conflict with the existing theories, because it does not claim that whole of the measured “cosmological red-shift” is due to this “cumulative-phase-alteration-mechanism”; some 5% of the red-shift must be really due to “metric-expansion-of-space”, reducing requirement of total-mass-of-the-universe to the observable

baryonic matter, making it sufficient for the required “closeness”. Thus this new mechanism is likely to resolve many of the problems of the current Standard Model of Cosmology.

2 Cumulative phase-alteration of the Extra-Galactic-Light passing through the Cosmic-Microwave-Background (CMB)

Let us imagine a horizontal arrow of three centimeter length representing instantaneous magnitude and direction of electric-field of the “extra-galactic-light”. Then add a small arrow of just five mm length at an angle minus thirty degrees, representing instantaneous magnitude and direction of the “cosmic-microwave-background”. We can see that the resultant vector has increased in magnitude, but lagged behind by a small angle θ . As the wave of extra-galactic-light travels in space, a new arrow representing CMB keeps on getting added to the previous resultant-vector. This kind of phase and amplitude-alterations continue for billions of years in the case of “extra-galactic-light”; producing a cumulative-effect. Since the speed of rotation of the vector representing CMB is much slower than that of light, the CMB-vector pulls-back the Light-vector resulting in reduction of cyclic-rotations. This process can be mathematically expressed as follows:

Electric field of pure light-wave can be expressed as:

$$\Psi(X, t) = A \exp i(\omega t - kX)$$

where ω represents the angular-frequency of light, and k the wave-number. Taking into consideration only the time-varying-part, at a point p :

$$\Psi(t) = A [\cos \omega t + i \sin \omega t] \quad (1)$$

When electric-fields of CMB get added to light, the resultant-sum can be expressed as:

$$\Psi(t) = A [N(t) \cos \omega t + i \hat{N}(t) \sin \omega t] \quad (2)$$

Where: $N(t)$ represents instantaneous magnitude of alteration caused by CMB, and $\hat{N}(t)$ represents its Hilbert-transform. When all the spectral-components of $N(t)$ are phase-shifted by +90 degrees, we get its Hilbert-transform $\hat{N}(t)$.

As a communications-engineer we use band-pass-filter to remove out-of-band noise. This author has also developed a noise-cancelling-technique, to reduce the effect of even in-band-noise by up-to 10 dB. But in the extra-galactic-space there are no band-pass-filters, so the phase-alterations caused by CMB keep on getting accumulated. After billions of years, when this light reaches our planet earth there is a cumulative-phase-alteration in the extra-galactic-light, observed as a part of “the cosmological red-shift”. Since the center-frequency of CMB is much lower than extra-galactic-light, the cumulative-phase-alteration results in red-shift; and since the center-frequency of CMB is higher than the radio-frequency-signals (2110 MHz for the uplink from Earth and 2292 MHz for the

downlink to Earth) used to measure velocity of Pioneer-10, Pioneer-11, Galileo and Ulysses space-probes, the cumulative-phase-alteration resulted in blue-shift, leading to the interpretation of deceleration of these space-probes. C. Johan Masreliez [53] has presented a “cosmological explanation for the Pioneer-anomaly”, in terms of expansion of space, whereas here it is proposed that the expansion-of-space appears mostly due to the “cumulative-phase-alteration” of light due to CMB. This shows that there is a co-relation between the magnitudes of anomalous-accelerations of the Pioneer-10-11 space-probes and the “cosmological red-shift”. Although, one of the shifts is red-shift, and the other is blue-shift, their magnitudes, in terms of decelerations, are strikingly the same; as described in detail in the next paragraph:

We can express the cosmological red-shift z_c in terms of de-acceleration experienced by the photon, as follows [54–55]: For z_c smaller than one:

$$z_c = \frac{f_0 - f}{f} = \frac{H_0 D}{c}$$

i.e.

$$\frac{h\Delta f}{hf} = \frac{H_0 D}{c}$$

i.e.

$$h\Delta f = \frac{hf}{c^2} (H_0 c) D \quad (3)$$

That is, the loss in energy of the photon is equal to its mass (hf/c^2) times the acceleration $a = H_0 c$, times the distance D travelled by it. Where: H_0 is Hubble-parameter. And the value of constant acceleration a is:

$$a = H_0 c, \quad a = 6.87 \times 10^{-10} \text{ m/s}^2.$$

And now, we will see that the accelerations experienced by the Pioneer-10, Pioneer-11, Galileo and Ulysses space-probes do match strikingly with the expression (3):

Carefully observed values of de-accelerations [27]:

For Pioneer-10:

$$a = (8.09 \pm 0.2) \times 10^{-10} \text{ m/s}^2 = H_0 c \pm \text{local-effect.}$$

For Pioneer-11:

$$a = (8.56 \pm 0.15) \times 10^{-10} \text{ m/s}^2 = H_0 c \pm \text{local-effect.}$$

For Ulysses:

$$a = (12 \pm 3) \times 10^{-10} \text{ m/s}^2 = H_0 c \pm \text{local-effect.}$$

For Galileo:

$$a = (8 \pm 3) \times 10^{-10} \text{ m/s}^2 = H_0 c \pm \text{local-effect.}$$

And: as we already derived earlier, for the “cosmologically-red-shifted-photon”, $a = 6.87 \times 10^{-10} \text{ m/s}^2 = H_0 c$.

The “critical acceleration” of modified Newtonian dynamics MOND: $a_0 = H_0 c$. The rate of “accelerated-expansion” of the universe: $a_{exp} = H_0 c$.

Perfect matching of values of decelerations of all the four space-probes is itself an interesting observation; and its matching with the deceleration of cosmologically-red-

shifting-photons can not be ignored by a scientific mind as a coincidence.

There is one more interesting thing about the value of this deceleration as first noticed by Milgrom, that: with this value of deceleration, an object moving with the speed of light would come to rest exactly after the time T_0 which is the age of the universe.

The attempt proposed by this author refers only to the constant part of the PA. It should be acknowledged that also a time-varying part has been discovered as well.

3 Possible verification-experiments

Vector-addition of light and CMB can be simulated using computers. The vector to be added to light-vector can be derived from the actual CMB received. Every time new and new CMB-vector can be added to the resultant vector of previous addition.

Secondly, we know that there is certain amount of isotropy in the CMB. Microwaves coming from some directions are more powerful than others. So, we can look for any co-relation between the strength of CMB from a given direction and value of cosmological-red-shift.

Thirdly, we can establish a reverberating-satellite-link, in which we can first transmit a highly-stable frequency to geosynchronous-satellite; receive the signal back; re-transmit the CMB-noise-corrupted-signal back to satellite, and continue such repetitions for an year or longer and compare the frequency of the signal with the original source.

4 Conclusion

After getting the results of verification-experiments, the new mechanism proposed here namely: "Cumulative Phase-Alteration of the Extra-Galactic-Light passing through Cosmic-Microwave-Background (CMB)" it seems possible to explain: not only the large percentage of "cosmological red-shift", but also the Pioneer-anomaly. Quantitative analysis may leave 5% of the measured value of the "cosmological red-shift" for the standard explanation in terms of "metric-expansion-of-space", reducing the requirement of total-mass of the universe to the already-observable baryonic matter; thus it is likely to resolve many of the problems of current standard-model-cosmology. This author also proposes to investigate if this new mechanism of spectral-shifts will be able to accommodate some of the solar-system-astrometric-anomalies.

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