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Not-So-Alternative Cosmology

Hints on CMB temperature anisotropies in 4-Sphere

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ABSTRACT AND INTRODUCTION

This paper speaks of the measurement of the *CMB* [*] from the point of view of a non-standard model. Named to as 4-Sphere, the latter is described in [viXra:2209.0098].

The *CMB* is the result of the expansion of the Radiation Era relic. The consequence of this is in its homogeneity and isotropy even among distant points of the Universe.

We can find small difference of its property, say *CMB* anisotropies [1], for various reasons. The most important concerns the discontinuities in the primordial plasma concentration, with production of gravity and pressure gradients of local character coming from the Inflationary Era. Physicists think these are the origin of galaxies and galaxy clusters.

Given the extreme complexity of the matter we will not adapt the Cosmological Perturbation of ΛCDM to 4-Sphere, but we will limit ourselves to a qualitative description of an adiabatic expansion of radiation pressure gradients interacting with the plasma and culminating in an isochoric scenario. We will show that all this is compatible with the “bottom-up” growth of the galactic structures we observe now.

A snapshot at Last Scattering of this situation is transmitted to us through the anisotropy of the *CMB*.

We will see how the *CMB* dipole, measured by an observer in peculiar motion, is coherent with the 4-Sphere geometry.

But the discussion is mainly about the temperature anisotropy due to cosmological perturbations. From this it follows that, with a directional antenna, what we measure is the interference of the overlapping radiation from two opposite directions: Maybe it could arise from the same cosmological perturbation.

So, identification of standing waves could address new research into the fourth dimension of space.

[*] - [Astrophysical Journal v.339, p.632] - Measurements of the Cosmic Microwave Background Radiation Temperature at 90 GHz

CMB ANISOTROPY FROM A PECULIAR MOTION

Without necessarily referring to a particular cosmological model, we say that any model that respects the expansion described above, taking a snapshot of the Universe, expects an observer O_1 to see the CMB as coming from a homogeneous spherical radiation source of which the observer is in the center O. Incidentally, for all cosmological models, including the static ones, the CMB is a disordered radiation and part (where expansion is not considered) of the above representation should apply in any case.

Now, we consider a celestial body with a peculiar motion (namely: that it is in motion with respect to the expanding frame of the CMB) as equivalent to another observer O_2, this time in motion, in the instant in which he meets O_1 and crosses the center of the sphere.

The question that arises is: Does O_2 measure in O the same Radiation Intensity as O_1 or not? Or said in another way: Can a celestial body, for the sole fact that it has a peculiar motion. measure a temperature anisotropy of the CMB surrounding it?

We are not interested in knowing the distribution of energy on the surface of the sphere. For our purpose we can simply study the behavior of the radiation lying in a generic plane passing through O. Then with $\beta = v/c$, the frequency ν' due to the Oblique Doppler Effects is:

$$\nu' = \frac{\nu(1-\beta^2)^{1/2}}{1-\beta\cos\theta}$$

and for $\beta \neq 0$ we can get the indefinite integral, with the substitution $u = \tan(\theta/2)$, starting from:

$$\frac{(1-\beta^2)^{1/2}}{\beta}\int\frac{1}{1/\beta-\cos\theta}\,d\theta$$

The definite integral, in the open interval $(-\pi, \pi)$ is $2\pi\beta(1-\beta^2)^{-1/2}$ and we get $\nu' = \nu$ for mean values of frequency. In other words, Redshift and Blueshift compensate each other in the mean energy of the disordered radiation. (If this is true for a generic circumference then it is true for the whole surface of the sphere).

Then $O_1$and O_2 measure the same mean temperature of CMB and this result also confirms what was said in [viXra:2209.0098] about the total absence of Radiation Friction by the CMB on a celestial body with any peculiar speed.

But the above sphere is generic. What happens if we identify it with the observable Universe [*], and use a directional antenna to measure the CMB in one RA and Dec direction of the sky?

As a first consideration we should be able to measure the motion of the observatory with respect to the frame of the CMB (approximately the center of mass of the orbiting Local Group) and from this, knowing the motions of stars and galaxies near us, we could calculate their peculiar velocities.

But this is not the only interesting aspect.

[*] - The Radius of the Observable Universe depends on the cosmological model. For *ΛCDM* we consider the Hubble Radius. Here instead, we consider the 4_Sphere's one, that is, the border with the Relativistic Elsewhere zone. This quantity is important because it is linked to the Principle of Locality which in turn regulates the relationship between cause and effect.

CMB ANISOTROPY AS DIPOLES WHICH DIFFER SIGNIFICANTLY FROM EACH OTHER ACCORDING TO THE DIRECTION

Fluctuations in the primordial plasma gave rise to the formation of galaxies and their distribution in space can be associated with local gravity and pressure gradients created in the primordial plasma and started to collapse soon after the Recombination Era. For the discussion, the representation of the Universe from the chosen cosmological model is decisive.

For example, in *ΛCDM*, the Last Scattering surface belongs to the measurable Universe, while in the 4-Sphere the Elsewhere zone of Special Relativity begins beyond the distance corresponding to 1 radian and our observations stop there; the ray of light, which travels the most recent circle and reaches us after a rotation of 2π radians, had an age of 25 million years from Big Bang when started.

The Cosmic Background Radiation is born with the Last Scattering and makes more than one turn of the Universe before reaching us, entering the observable Universe about 8.8 billion years ago. When it is born, the first halo of gas has not yet formed and, by construction of the model, until it enters our relativistic Light cone, it has not encountered anything: no galaxies, no stars, nothing (remarks made in [viXra:2209.0098] on the radial dimension of the hypersphere hypothesize how this is possible).

But then, what do we measure when we point our directional antenna to observe the *CMB*?

The disordered relic of the Radiation Era was released in all directions, so also a density disturbance of the plasma was dispersed, even if unevenly as temperature anisotropies, likewise.

When we affirm that a *CMB* dipole is due to a peculiar motion we are also saying that, if we were at rest with respect to the Galactic Recession frame, we would always measure the same anisotropy for all pairs of opposite sky directions.

In our geometric context, every expanding Great Circle traveled by the *CMB* does not originate in the center of the hypersphere but continues its trajectory by detaching itself from a point of the surface at the time of Last Scattering. We must therefore try to explain the presence of these dipoles which vary significantly according to the direction. The question is: Are we able to trace back, to the same Early Universe's position, the anisotropies observed in two opposite directions of the sky?

Our answer must be consistent with the assumption that Last Scattering occurred when the Universe was not expanding, and the pressure wave traveled in both directions an arc of 4-Sphere Great Circle, before dying down due to the Thompson effect. But we are talking about perturbations that correspond to large galaxies and clusters and the probability to meet more than one of them, in that arc, is very small. We can then think of not more than a single wave traveling through the arc.

Therefore, there are two opposite directions from which a certain perturbation comes from, and we measure not the intensity of the latter, but the interference of its radiation, managing to isolate it with a suitable antenna. Thus, the anisotropy is the same for each pair of opposite directions, and the dipole is due to the peculiar motion of the observer.

The conclusion is coherent with the 4-Sphere geometry and its conjecture. Moreover, the wavelengths we measure for the *CMB* are a few centimeters and it would be interesting to have a directional antenna capable of detecting the standing wave once the effect of movement has been eliminated.

The presence of standing waves, indeed, would be confirmation that we are receiving the same cosmological perturbation from two opposite directions, hence it would be a strong sign of the existence of the fourth dimension of space.

THE 4-SPHERE ISOCHORIC SCENARIO

Standard cosmology foresees that cosmological perturbations do come from (due to quantum fluctuations before inflation) the period preceding the Inflationary Hot Big Bang Era.

"... the rather simple idea that the observed structure in our universe has resulted from the gravitational amplification of weak primordial fluctuations seems to work remarkably well. These small perturbations grew slowly over time until they were strong enough to separate from the background expansion, turn around, and collapse into gravitationally bound systems like galaxies and galaxy clusters."

(Christos G. Tsagas)

As for the Standard model, 4-Sphere foresees an expansion (although not in the presence of Dark Matter). But our model, on its own, also foresees a period of isochoric transformations. At that time the radiation made one revolution every 4.5 million years. Thompson scattering being able to occur everywhere, 4-Sphere has not a *Horizon* Problem.

Because of its extreme complexity, here we do not intend to develop the existing theory of Cosmological Perturbation introduced in [*], but simply to rely on the geometry of the hypersphere.

The consequence is giving up a quantitative analysis of the phenomenon.

In this simplification as stated above, the primordial fluctuation of the radiation was unevenly dispersed in all direction, losing its energy over time, as result of expansion. Thus, that local gradients of pressure radiation due to the interference of multiple photons survived during Nucleosynthesis and further, beyond Recombination and till now.

For 4-Sphere, the expansion, as $r = ct$ driven by radiation, follows the Inflation Era by continuing the cooling phase. At the end of nucleosynthesis, the electrons constitute the hottest part of the plasma, and the heat is exchanged with the radiation via Thompson scattering. The latter effect slows down the photon and before reaching the density equilibrium between matter and radiation the expansion ceases altogether. The Timeline of events may not coincide with that of the Big Bang as the rate of expansion is different, but this occurs at a hypothesized $r_{4-Sphere} = 720{,}000\ ly$.

Assuming a today baryon density equal to $3 * 10^{-28}\ Kg\ m^{-3}$, with a radius at that time of $720.000\ ly$ and a hypothetical temperature of $52.000\ K,$ we compute a baryonic density of $2 * 10^{-15}\ Kg\ m^{-3}$ vs. a radiation density of $6 * 10^{-14}\ Kg\ m^{-3}$. Still at the same temperature, the characteristic plasma Debye length for electrons could be $\lambda_{\mathrm{De}} = 1.65\ cm$.

With the 4-Sphere model, the equilibrium between matter and radiation will not be reached before the Recombination.

Inside the overlying thermal random motion, density and pressure gradients are accompanied by small electrical positive charge gradients because electrons continue to be scattered away.

Then, the collapse of ions is resisted even in the absence of expansion. Not only do local islands of discontinuities not collapse but, due to their collective effect of positive charge, they also do not stick each other, all of this being compatible with the "bottom-up" growth of the galactic structures we observe now (also because, otherwise we wouldn't have galaxies orbiting each other).

This happened, at some temperature greater than at $52.000\ K$, while some of the radiation leaves the plasma until the onset of adiabatic expansion occurs. Only then, after the Recombination, will the discontinuities in matter begin to approach and collapse.

[*] - [arXiv:astro-ph/0201405] - Cosmological Perturbations

References from Wikipedia:

[1] - Cosmic microwave background