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Cosmic Background Photon Gas as the Aether Caused the Dipole of CMB Anisotropy and Light Red Shift

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Abstract- The stable cosmic background photon gas as the Aether fulfilled in our universe at cosmic background temperature, the CMB radiation is not relic radiation from the hot primeval fireball of big bang, it is just radiated by the cosmic background photon gas itself. After the two dynamic equations are established, it is clear that photon gas is the medium or Aether of electromagnetic waves, and there is a proper system where the average velocity of the photons is zero, but in other system the photon gas is an anisotropy medium of electromagnetic waves. The existence and the moving of cosmic background photon gas will interference the measurement of electromagnetic waves of thermal radiation and the negative pole of the anisotropy dipole is in the moving forward direction of the satellite. A small damping at cosmic background photon gas caused the light red shift and it is nonlinear with respect to distance, *more far more red*, this misguide people to believe that *more far more fast* of star recession.

Keywords- *Photon Gas, CMB Anisotropy, Red Shift*

I. INTRODUCTION

Considering the Faraday rotation effects, it is reasonable to suppose that every photon has the same proper magnetic moment, then the photon's magnetic property will cause negative mechanical pressure in the photon gas, and the photon's kinetic energy will cause the positive one. The total mechanical pressure should be zero at the cosmic background temperature in the space where the photon gas is at an open state of thermal equilibrium. When the local temperature is higher than the cosmic background temperature, the mechanical pressure of the photon gas is positive and the energy will be diverging. However, when the local temperature is lower than the cosmic background temperature, the mechanical pressure of the photon gas is negative and the energy will be converging. At last there is a stable cosmic background photon gas fulfilled in our universe, its thermal equilibrium temperature is just the cosmic background temperature T_{CB}, and in large scale range its own thermal radiation property is equal to a blackbody at the same temperature [1].

In the thermal radiation of a black body, the intensity is composed of two parts: one is the shot noise of travelling photons, at high temperature it can be written as Wien formula,

$$I_p(\nu) = 2\pi c^{-2} h\nu^3 \exp(-h\nu/kT) \tag{1}$$

but it may be in more dense state and of subtle structure when temperature very lower.

The other part is the wave noise of electromagnetic waves which is independent of the dense of matter or photon gas

$$I_w(f) = \frac{2\pi c^{-2} hf^3 \exp(-hf/kT)}{\exp(hf/kT)-1} \tag{2}$$

There are three factors that significantly influence the wave noise, rewrite Eq. 2 as

$$I_w = \frac{1}{6}\bar{\varepsilon} PHR, \quad \bar{\varepsilon} = \frac{3kT}{2}, x = \frac{hf}{kT}, \quad P = \frac{x}{e^x - 1}, H = 8\pi c^{-2} f^2, R = e^{-x}. \tag{3}$$

In a black body or in the photon gas, the time duration of the inter-collision of particles and photons is not zero, the collision is "harder" at higher temperature and is "softer" at lower temperature, and the spectrum of *Rayleigh-Jeans* oscillator is flat at low frequency but is in exponential decay at high frequency, this is just the physics meaning of the *Planck factor P*. *H* is just the classical *Rayleigh-Jeans oscillator radiation factor*, but the *frequency radiation factor R* restricts the radiation at high frequency when the wavelength is comparable with photon's interspace, where the radiation is dominated by the reactance of photons and the radiated energy is deduced as the frequency goes higher or the temperature goes lower.

The stable cosmic background photon gas as the Aether fulfilled in our universe at cosmic background temperature, it is so subtle and undetectable that people can't help to think about dark energy and dark matter. The CMB radiation is not relic radiation from the hot primeval fireball of big bang, but is just radiated by the cosmic background photon gas itself.

II. RELATIVISTIC DYNAMICS OF THE PHOTON GAS

The medium of electromagnetic waves has been vainly searched for many years, and now it has been caught after the establishment of the dynamic equations in photon gas. The photon's rest mass has been estimated from the thermal

equilibrium of cosmic background photon gas which is at an open state. Supposing every photon has the same rest mass m_s and the rest frequency ν_s, when it is moving with the group velocity c_g, the parameters of the photon is [1]

$$h\nu_s = m_s c^2, \quad \nu = \gamma\nu_s, \quad c_g^2 = c^2(1-\gamma^{-2}) \tag{4}$$

Suppose that every photon has the same rest magnetic moment in the proper system (x_0, y_0, z_0)

$$\mathbf{m}'_p = \hat{x}_0 m'_{px_0} + \hat{y}_0 m'_{py_0} + \hat{z}_0 m'_{pz_0} \tag{5}$$

The photon is travelling in the y_0 direction with the group velocity c_g in the visual system (x, y, z) where the observer is rest, and the visual characteristic magnetic moment is

$$\mathbf{m}_p = \hat{x}_0\gamma^{-2} m'_{px_0} + \hat{y}_0\gamma^{-1} m'_{py_0} + \hat{z}_0\gamma^{-2} m'_{pz_0} \tag{6}$$

It is important that the property of a moving magnetic moment of photon is like an electric dipole and the visual characteristic electric moment is

$$\mathbf{p}_e = c^{-2}\gamma^{-2} c_g (\hat{x}_0 m'_{pz_0} - \hat{z}_0 m'_{px_0}) \tag{7}$$

Then the relativistic dynamics processing of the photon gas are, in simpler form:

A. The locale magnetic field is the integration of photon's visual characteristic magnetic moment

$$\mathbf{H} = \sum \mathbf{m}_p \text{ (unit volume)}, \quad \mathbf{B} = \mu_0 \mathbf{H}$$

B. The curl of locale magnetic field is interacting with the magnetic moment of every photon.

$$f'_B = \begin{vmatrix} \hat{x}_0 & \hat{y}_0\gamma^{-2} & \hat{z}_0 \\ m'_{px_0} & \gamma^{-1} m'_{py_0} & m'_{pz_0} \\ \text{curl}_{x_0}\mathbf{B} & \text{curl}_{y_0}\mathbf{B} & \text{curl}_{z_0}\mathbf{B} \end{vmatrix} \tag{8}$$

C. Photon's visual characteristic electric moment is changed by its acceleration, the mathematical processing is very tedious and complicated [1].

D. The change of local electric field is the integration of visual characteristic electric moment changes of photons. For one dimension wave and at general temperature,

$$\frac{\partial D_y}{\partial t} = \frac{20\pi c^{-3}\nu_s^2 m'^2_p}{9h}\frac{\partial B_z}{\partial x} \tag{9}$$

E. In a similar way the locale electric field is the integration of photon's visual characteristic electric moment, the curl of locale electric field is interacting with the electric moment of every photon. Photon's visual characteristic magnetic moment is changed by its acceleration, the mathematical processing is very tedious and complicated too [1]. The change of local magnetic field is the integration of visual characteristic magnetic moment changes of photons. For one dimension wave and at general temperature

$$\frac{\partial H_z}{\partial t} = \frac{20\pi c^{-3}\nu_s^2 m'^2_p}{9h}\frac{\partial E_y}{\partial x} \tag{10}$$

Although the two dynamic equations (9) and (10) are similar with Maxwell's, but their physics meaning are different completely since the one is based on essential medium and the other is based on bodiless energy. When dealing with *E-B* transformation there is a preferential, origin, or proper system where the photon gas is rest i.e. the average velocity of the photons is zero. In other system the photon gas is an anisotropy medium of electromagnetic waves.

III. Cosmic Background Photon Gas Caused CMB Anisotropy

The cosmic background explorer satellite COBE, proposed to NASA in 1974 and launched in 1989, provided the spectrum of the cosmic microwave background CMB radiation which has the spectrum of blackbody emitter at cosmic background temperature T_{CB} = 2.725±0.001K. The differential microwave radiometers DMR experiment discovered CMB anisotropies from analysis of its first year of data. The CMB dipole has amplitude [2]

$$\Delta T_{CB} = 3.358 \pm 0.024\text{mK}$$

As the medium of electromagnetic waves, the photon gas is full filled outer space at cosmic background temperature, its number density or structure is different from that at general temperature, the shot noise is affected more and the wave noise is affected less. At The differential microwave radiometers DMR experiment, Smoot teem avoided theoretical error by using artificial blackbody of 3K as the calibrator. People believe the microwave as cosmic background is relic radiation from the hot primeval fireball of big bang, not think about it is radiated by the cosmic background photon gas itself.

However the existence and the moving of cosmic background photon gas will interference the measurement of electromagnetic waves of thermal radiation in situ. In the proper system as where the average velocity of the photons is zero and the proper wave noise intensity at lower frequency in Rayleigh-Jeans regime is

$$dI'_w(f') = 2c^{-2}kT_{CB}f'^2 df' d\Omega' \tag{11}$$

In the visual system of satellite COBE which is moving in the cosmic background photon gas, the wave noise intensity based on **E-B** measurements is changed by the relativity factor and the total error is in second order of β, but nearly unchanged in first approximation.

$$dI_w(f) = 2c^{-2}kT_{CB}f'^2 df\, d\Omega', \quad \beta << 1 \tag{12}$$

The steradian is unchanged in first approximation too,

$$d\Omega' = d\Omega, \quad \beta << 1,$$

but the frequency is changed apparently of Doppler Effect

$$f' = \left(\frac{1-\beta}{1+\beta}\right)^{\frac{1}{2}} f$$

So the visual wave noise intensity toward the moving direction at lower frequency is

$$dI_w(f) = \left(\frac{1-\beta}{1+\beta}\right)^{\frac{3}{2}} 2c^{-2}kT_{\mathrm{CB}}f^{2}df d\Omega$$

in first approximation

$$dI_w(f) = (1-3\beta)2c^{-2}kT_{\mathrm{CB}}f^{2}df\,d\Omega, \quad \beta << 1 \tag{13}$$

It seems contrary to common sense that the negative pole of the anisotropy dipole is in the moving forward direction of the satellite. Then for COBE

$$\beta c = -\frac{c}{3}\frac{\Delta T_{\mathrm{CB}}}{T_{\mathrm{CB}}} = -123 \pm 1\mathrm{km\,s^{-1}} \tag{14}$$

So every satellite can self-determine its own moving state in cosmic background photon gas by the self-measurement and analysis of the anisotropy dipole of wave noise in situ.

IV. Cosmic Background Photon Gas Caused Light Red Shift

Spectrographic analysis of light received from distant galaxies shows that certain prominent spectral lines identified in spectroscopic studies in the laboratory are shifted very significantly toward the lower frequency end of the visible spectrum, and is interpreted as a Doppler shift arising from the velocity of recession of the source. A small damping force may be acting on the travelling photons in cosmic background photon gas that caused Red Shift in fact.

In the proper system of cosmic background photon gas, the visual transverse characteristic magnetic or electronic moment of a transverse polarized traveling photon is reduced by two relativistic factors from its proper magnetic moment [3].

$$m_{\mathrm{p,T}} = \gamma^{-2}m_{\mathrm{p}}', \quad p_{\mathrm{e,T}} = c^{-1}\gamma^{-2}m_{\mathrm{p}}' \tag{15}$$

The interaction between the traveling photon and the cosmic background photon gas is essentially electromagnetic, so the average proper damping force is reduced by two relativistic factors of the traveling photon too, then

$$f_{\mathrm{d}}' = -C\nu^{-2}, \quad \frac{d\nu}{dt} - C\nu^{-2} \tag{16}$$

and the general solution is

$$\nu_2^3 - \nu_1^3 = -D_{\mathrm{p}}(t_2 - t_1) \tag{17}$$

D_{p} is the decay factor of traveling photons. The distance of Virgo Cluster is about 59 million light years away. If the observed photon frequency is the pair of easily recognizable absorption lines in the spectrum of potassium, the red shift is between 7.5899×10^{14}Hz and 7.5593×10^{14}Hz, then

$$D_{\mathrm{p}} = 8.9\times10^{34}\,\mathrm{Hz^3\,yr^{-1}} \tag{18}$$

It is clear that the frequency decay of a photon traveling in the cosmic background photon gas is nonlinear with respect to distance that resulted from relativistic effect of photon's magnetic moment, and the largest distance of a travelling photon can reached in outer space is limited by its original frequency:

$$L_{\max} = D_{\mathrm{p}}^{-1}\nu_0^3\,(\text{light year}) \tag{19}$$

It is clear that the light maximum transmission distance in outer space is limited by its cubic frequency.

Our visual field is finite although the universe is infinite and some star beyond our visual field as black hole which can be determined by gravitational force or electromagnetic wave. The normalized light red shift is

$$\begin{aligned} &\frac{\Delta\nu}{\nu_0} = \frac{\nu_0-\nu}{\nu_0} = 1-\sqrt[3]{1-x}\,, \qquad x = L/L_{\max} < 1. \\ &\frac{\Delta\nu}{\nu_0} = \frac{1}{3}x + \frac{1}{9}x^2 + \frac{10}{162}x^3 + \frac{80}{1944}x^4 + \frac{88}{2916}x^5 \ldots\ldots \end{aligned} \tag{20}$$

The light red shift is obviously nonlinear with respect to distance, more far more red. People is believing that the light red shift is originated from the star recession, and imaging more far more red just is more far more fast, lose sight of the damping on traveling photons. Since the damp is so week that it is reasonable to think of the cosmic background photon gas possess lattice structure as gas crystal.

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