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How the Flat Space Cosmology Model Correlates the Recombination CMB Temperature of 3000 K with a Redshift of 1100

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Abstract

This paper shows how the Flat Space Cosmology model correlates the recombination epoch CMB temperature of 3000 K with a cosmological redshift of 1100. This proof is given in support of the recent publication that the Tatum and Seshavatharam Hubble temperature formulae can be derived using the Stephan-Boltzmann dispersion law. Thus, as explained herein, the era of high precision Planck scale quantum cosmology has arrived.

Keywords

Hubble Constant, Cosmic Microwave Background, Quantum Cosmology, Stephan-Boltzmann, Upsilon Coupling Constant, Flat Space Cosmology, ΛCDM Cosmology

1. Introduction and Background

It has long been established that the cosmic recombination epoch Cosmic Microwave Background (CMB) temperature of 3000 K correlates with a cosmological redshift z value of around 1100. This has been especially true since Fixsen updated his fitting of the CMB black body radiation spectrum with a peak temperature of 2.72548 K [1]. Given the black body nature of the 3000 K universe, it is perhaps not surprising that one can successfully apply the Stephan-Boltzmann dispersion law to derive the Tatum and Seshavatharam Hubble temperature T_H formulae [2]:

$$
\left.
\begin{array}{l}
k_B T_t \cong \dfrac{\hbar c^3}{8\pi G\sqrt{M_t M_{pl}}} \cong \dfrac{\hbar c}{4\pi\sqrt{R_t R_{pl}}} \\
\begin{cases}
M_t \cong \left(\dfrac{\hbar c^3}{8\pi G k_B T_t}\right)^2 \dfrac{1}{M_{pl}} & \text{(A)} \\
R_t \cong \dfrac{1}{R_{pl}}\left(\dfrac{\hbar c}{4\pi k_B}\right)^2 \left(\dfrac{1}{T_t}\right)^2 & \text{(B)} \\
R_t T_t^2 \cong \dfrac{1}{R_{pl}}\left(\dfrac{\hbar c}{4\pi k_B}\right)^2 & \text{(C)} \\
t \cong \dfrac{R_t}{c} & \text{(D)}
\end{cases}
\end{array}
\right\}
\tag{1}
$$

Proof of the Stephan-Boltzmann derivation was given recently [3].

While the Tatum and Seshavatharam temperature formulae are modeled for a Planck scale quantum cosmology for the entire history of universal expansion, we will specifically show in the present paper the correlation between the CMB temperature of 3000 K and the redshift z value of 1100. Our particular Planck scale quantum cosmology model is called Flat Space Cosmology (FSC) [4].

2. Relevant Equations for Our CMB Temperature and Redshift Calculations

This section provides the relevant FSC equations useful for correlating a given Hubble CMB temperature T_X with its predicted redshift z and predicted Hubble parameter value H_T.

The usual cosmology redshift formula with regard to past and current cosmic temperatures is:

$$z \cong \frac{T_x}{T_0} - 1 \tag{2}$$

wherein z is the redshift, T_x is any given Hubble CMB temperature, and T_0 is the 2009 current Fixsen CMB temperature of 2.72548 K.

To correlate the predicted z value with the predicted temperature-dependent Hubble parameter value H_T, the following FSC Hubble quantum cosmology formulae [5] are used:

$$H \cong \frac{32\pi^2 k_B^2 T^2 G^{1/2}}{\hbar^{3/2} c^{5/2}} \qquad H_0 \cong \frac{32\pi^2 k_B^2 T_0^2 G^{1/2}}{\hbar^{3/2} c^{5/2}} \tag{3}$$

wherein the latest NIST 2018 CODATA [6] are used for all constants, and T_0 is the 2009 Fixsen CMB temperature, the only observational input to the right-hand equation.

To correlate the FSC cosmic radius value R_T at a given CMB temperature, the top equation in formulae (1) is used (see the right-hand term):

$$T_t \cong \frac{\hbar c^3}{8\pi G k_B\sqrt{M_t M_{pl}}} \cong \frac{\hbar c}{4\pi k_B\sqrt{R_t R_{pl}}} \tag{4}$$

Results of calculations made using Equations (2) thru (4) are presented in **Table 1**.

3. Discussion

Beginning in 2015, FSC has proven to be one of the most successful Planck scale quantum cosmology models to date. In fact, the Hubble parameter quantum cosmology formulae [current Equation (3)] and the top equation of the Tatum and Seshavatharam Hubble temperature T_X formulae [current Equation (4)] have been used to predict, with high precision, the most recent Hubble parameter values derived from CMB studies published in 2023 [7].

Reference [7] mentions a "deeper theoretical understanding" of the relationship between the Hubble parameter and the CMB temperature. One can see in our H_X/T_X^2 column of **Table 1** that there is an obvious coupling constant linking H_X and T_X^2. There is slight variation in the value of this coupling constant in **Table 1**, but this is only because abbreviated numbers are used in order to fit them into the table. This coupling constant first appeared in 2015 in Equation (3) of FSC reference [2]. It has now been calculated out to 29 decimal places [7], using Mathematica software and the NIST 2018 CODATA [6]. However, the number of decimal places is not nearly as important as the expected reduction in the uncertainty of H_0 in terms of standard deviation. The result of this new coupling constant precision should be high precision in Hubble parameter determinations going forward. Any cosmology formulae using a Hubble parameter value and incorporating this newer and more precise FSC coupling constant (tentatively called "Upsilon") would be expected to vastly improve cosmological model predictions. Many such "Hubble formulae" are used in standard ΛCDM cosmology, in the same way that they are used in FSC.

The "deeper theoretical understanding" mentioned above is now revealed to be inherent in the FSC model. As clearly alluded to by Lineweaver and Patel [8], the modeling of our universe as an expanding black hole-like object is not such an outlandish idea after all.

Table 1. Correlations between radii, temperatures, redshift and Hubble parameter.

$\log\left(\frac{R_0}{R_x}\right)$	T_x	T_x^2	$\frac{H_x}{T_x^2}$	z	H_x
0	2.72548	7.4282412304	2.917245E-19	0	2.167E-18
0	2.7	7.29	3.049643E-19	0	2.167E-18
1.08	9.5	90.25	2.967313E-19	2.49	2.678E-17
1.95	25.8	665.64	2.955051E-19	8.47	1.967E-16
2.16	33.2	1102.24	2.944005E-19	11.18	3.245E-16
2.38	42.7	1823.29	2.936998E-19	14.67	5.355E-16
2.6	55.0	3025	2.920992E-19	19.18	8.836E-16
2.87	70.8	5012.64	2.908647E-19	24.98	1.458E-15
6.08	**3000.0**	**9000000**	**2.918444E-19**	**1099.72**	**2.6266E-12**

4. Summary and Conclusions

This paper shows the exquisite FSC correlation between a CMB temperature of 3000 K and a cosmological redshift of 1100.

Furthermore, by revealing the obvious coupling constant linking H_X and T_X^2, this paper shows the continued value of FSC as an accurate Planck scale quantum cosmology model. Although the most useful FSC quantum cosmology formulae were first published in 2018 (reference [5], Section 2.9), they have been inherent in FSC since its 2015 inception. Thus, a theoretical model which is now more than eight years old continues to show its value with respect to observational correlations.

The "deeper theoretical understanding" mentioned in reference [7] comes from the gradual recognition in the astrophysics and cosmology community that modeling our universe as an expanding black hole-like object is likely to be *necessary*, in order to achieve high precision Hubble cosmology. Such a cosmology, which *requires* the use of the Hubble parameter in its formulae, also requires an exquisitely high precision in its CMB-derived Hubble parameter determinations. This appears to have now been achieved. FSC provides this "deeper theoretical understanding".

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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