Time and the Black-hole White-hole Universe, a Simulation Hypothesis

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The Simulation Hypothesis proposes that all of reality is in fact an artificial simulation, analogous to a computer simulation. Outlined here is a low computational cost method to reproduce the principal cosmic microwave background parameters in a simulation. The underlying analogy is that of a black-hole universe that is expanding in incremental Planck unit steps at the expense of its (contracting) white-hole universe twin, this outwards expansion (the simulation version of 'dark energy') as the clock-rate and thus the origin of (Planck) Time and the arrow of time, the velocity of expansion as the speed of light, the Hubble constant as the universe radius and the CMB radiation density formula combines with the Casimir formula. The CMB peak frequency is used as the benchmark. Comparing with the corresponding CMB gives a best fit for a 14.624 billion year old (Planck) black-hole. Model does not include particle matter.

Table 1	Black-hole [2]	Cosmic microwave background
Age (billions of years)	14.624	13.8 [5]
Age (units of Planck time)	0.4281 x 10^{61}	
Cold dark matter density	0.21 x $10^{-26} kg.m^{-3}$ (eq.1)	0.24 x $10^{-26} kg.m^{-3}$ [7]
Radiation density	0.417 x $10^{-13} kg.m^{-3}$ (eq.10)	0.417 x $10^{-13} kg.m^{-3}$ [5]
Hubble constant	66.86 km/s/Mpc (eq.13)	67.74(46) km/s/Mpc [6]
CMB temperature	2.7269K (eq.6)	2.7255K [5]
CMB peak frequency	160.2GHz (eq.17)	160.2GHz [5]
Cosmological constant	1.0137 x 10^{123} (eq.21)	3.4 x 10^{121} [4]

keywords:
cosmic microwave background, CMB, cosmological constant, black-hole universe, white-hole universe, Planck time, arrow of time, dark energy, Hubble constant, expanding universe, Casimir, Simulation Hypothesis;

1 Premise

The universe simulation hypothesis proposes that all of reality, including the earth and the universe, is in fact an artificial simulation, analogous to a computer simulation, and as such our reality is an illusion [1].

In this article I outline a method for reproducing principal cosmic microwave background parameters in a simulation environment, the only variable required being the universe age. Let us suppose that we begin with a white-hole. As a white-hole it naturally contracts by ejecting information. Let us further suppose that this information occurs as discrete Planck 'drops', defined as that 'entity' which is the source of the Planck units (a Planck-size micro black-hole). These Planck drops are then absorbed by a twin black-hole in integer steps thereby forcing an expansion of the black-hole at the expense of the contracting white-hole.

The expansion steps (the clock-rate) correlate with units of Planck time and are the engine which drives this model.

In dimensional terms the speed of this expansion equates to the speed of light. The speed of light is therefore a constant.

It is the constant addition of these Planck 'drops' that forces the expansion of the black-hole, and so an independent dark energy is not required.

The constant outward expansion of the black-hole gives an omni-directional (forward) arrow of time.

When the black-hole has reached the limit of its expansion (when it is 1 Planck step above absolute zero), the clock will stop. The model then allows for the direction of transfer and so arrow of time to reverse; the expanding black-hole would then become the contracting white-hole feeding its (now) expanding black-hole twin.

2 Mass density

Assume that for each expansion step, to the black-hole universe is added a unit of Planck time t_p, Planck mass m_P and Planck (spherical) volume (Planck length = l_p), such that we can calculate the mass density of this black-hole universe for any chosen instant where t_{age} is the age of the black-hole as measured in units of Planck time and t_{sec} the age of the black-hole as measured in seconds.

$$t_p = 2l_p/c \ (s)$$

$$mass : m_{blackhole} = 2t_{age}m_P \ (kg)$$

$$volume : v_{blackhole} = 4\pi r^3/3, \quad r = 4l_p t_{age} = 2ct_{sec} \ (m^3)$$

$$\frac{m_{blackhole}}{v_{blackhole}} = 2t_{age}m_P.\frac{3}{4\pi(4l_p t_{age})^3} = \frac{3m_P}{2^7\pi t_{age}^2 l_p^3} \ (\frac{kg}{m^3}) \quad (1)$$

Gravitation constant G in Planck units;

$$G = \frac{c^2 l_p}{m_P} \quad (2)$$

From the Friedman equation; replacing p with the above mass density formula, $\sqrt{\lambda}$ reduces to the radius of the universe;

$$\lambda = \frac{3c^2}{8\pi G p} = 4c^2 t_{sec}^2 \tag{3}$$

$$\sqrt{\lambda} = radius\ r = 2ct_{sec}\ (m) \tag{4}$$

Critical density p_c using for H eq(13)

$$p_c = \frac{3H^2}{8\pi G} = \frac{4(Mpc)^2 m_{blackhole}}{v_{blackhole}} \tag{5}$$

3 Temperature

Measured in terms of Planck temperature = T_P;

$$T_{blackhole} = \frac{T_P}{8\pi\sqrt{t_{age}}} \tag{6}$$

The $mass/volume$ formula uses t_{age}^2, the $temperature$ formula uses $\sqrt{t_{age}}$. We may therefore eliminate the age variable t_{age} and combine both formulas into a single constant of proportionality that resembles the radiation density constant.

$$h = 2\pi l_p m_P c$$

$$T_p = \frac{m_P c^2}{k_B} = \sqrt{\frac{hc^5}{2\pi G k_B{}^2}} \tag{7}$$

$$\frac{m_{blackhole}}{v_{blackhole} T_{blackhole}^4} = \frac{2^5 3\pi^3 m_P}{l_p^3 T_P^4} = \frac{2^8 3\pi^6 k_B^4}{h^3 c^5} \tag{8}$$

4 Radiation density

From Stefan Boltzmann constant

$$\sigma_{SB} = \frac{2\pi^5 k_B^4}{15h^3 c^2} \tag{9}$$

$$\frac{4\sigma_{SB}}{c}.T_{blackhole}^4 = \frac{c^2}{1440\pi}.\frac{m_{blackhole}}{v_{blackhole}} \tag{10}$$

5 Casimir formula

F = force, A = plate area, $d_c l_p$ = distance between plates calculated in units of Planck length

$$\frac{-F_c}{A} = \frac{\pi hc}{480(d_c l_p)^4} \tag{11}$$

if $d_c = 4\pi\sqrt{t_{age}}$, then eq(10) = eq(11).

$$\frac{-F_c}{A} = \frac{c^2}{1440\pi}.\frac{m_{blackhole}}{v_{blackhole}} \tag{12}$$

6 Hubble constant

1 Mpc = 3.08567758 x 10^{22}m.

$$H = \frac{1Mpc}{t_{age} t_p} \tag{13}$$

7 Wien's displacement law

$$\frac{xe^x}{e^x - 1} - 5 = 0, x = 4.96511423174427630... \tag{14}$$

$$\lambda_{peak} = \frac{2\pi l_p T_P}{x T_{blackhole}} = \frac{16\pi^2 l_p \sqrt{t_{age}}}{x} \tag{15}$$

8 Black body peak frequency

$$\frac{xe^x}{e^x - 1} - 3 = 0, x = 2.82143937212207889... \tag{16}$$

$$v_{peak} = \frac{k_B T_{blackhole} x}{h} = \frac{x}{8\pi^2 t_p \sqrt{t_{age}}} \tag{17}$$

$$f_{peak} = \frac{xc}{16\pi^2 l_p \sqrt{t_{age}}} \tag{18}$$

9 Cosmological constant

Riess and Perlmutter (notes) using Type 1a supernovae calculated the end of the universe $t_{end} \sim 1.7$ x $10^{-121} \sim 0.588$ x 10^{121} units of Planck time;

$$t_{end} \sim 0.588x10^{121} \tag{19}$$

The maximum temperature T_{max} would be when $t_{age} = 1$. What is of equal importance is the minimum possible temperature T_{min} - that temperature 1 unit above absolute zero, for in the context of this model, this temperature would signify the limit of expansion (the black-hole could expand no further). For example, if we simply set the minimum temperature as the inverse of the maximum temperature;

$$T_{min} \sim \frac{1}{T_{max}} \sim \frac{8\pi}{T_P} \sim 0.177\ 10^{-30}\ K \tag{20}$$

This would then give us a value 'the end' in units of Planck time ($\sim 0.35\ 10^{73}$ yrs) which is close to Riess and Perlmutter;

$$t_{end} = T_{max}^4 \sim 1.014\ 10^{123} \tag{21}$$

The mid way point ($T_{mid} = 1K$) becomes $T_{max}^2 \sim 3.18\ 10^{61} \sim$ 108.77 billion years.

10 Comments

In comparing this black-hole with cosmic microwave background data, I took the peak frequency value at exactly 160.2 GHz as my reference and used this to solve t_{age} eq(18) and from there the other formulas, as t_{age} = number of expansion steps is the only variable I require. The best fit for the above parameters in comparison to the CMB data (see table, page 1) is for a 14.624 billion year old black-hole.

If particles can be construed as energy sinks (their formation absorbs energy from the universe) then as matter appears (as the universe grows), the temperature would be expected to drop faster than in a pure Planck universe such as the one outlined above, this may be 1 reason why the temperature and so age is slightly higher that the NASA given values. NASA estimates our universe to be 4% matter and so an addition of particles to this model may be the next step.

Notes:

The formulas used in this article can be downloaded in maple format at http://planckmomentum.com/time/

The Schwarzschild metric admits negative square root as well as positive square root solutions.

The complete Schwarzschild geometry consists of a black hole, a white hole, and the two Universes are connected at their horizons by a wormhole.

The negative square root solution inside the horizon represents a white-hole. A white-hole is a black-hole running backwards in time. Just as black-holes swallow things irretrievably, so also do white-holes spit them out [3].

... in 1998, two independent groups, led by Riess and Perlmutter used Type 1a supernovae to show that the universe is accelerating. This discovery provided the first direct evidence that Ω is non-zero, with Ω ~ 1.7 x 10^{-121} Planck units.

This remarkable discovery has highlighted the question of why Ω has this unusually small value. So far, no explanations have been offered for the proximity of Ω to $1/t_u{}^2$ ~ 1.6 x 10^{-122}, where t_u ~ 8 x 10^{60} is the present expansion age of the universe in Planck time units. Attempts to explain why Ω ~ $1/t_u{}^2$ have relied upon ensembles of possible universes, in which all possible values of Ω are found [4].

The cosmic microwave background (CMB) is the thermal radiation left over from the time of recombination in Big Bang cosmology. The CMB is a snapshot of the oldest light in our Universe, imprinted on the sky when the Universe was just 380,000 years old. Precise measurements of the CMB are critical to cosmology, since any proposed model of the universe must explain this radiation. The CMB has a thermal black body spectrum at a temperature of 2.72548(57) K. The spectral radiance peaks at 160.2 GHz.

References

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