Time and the Black-hole White-hole Universe

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In this essay I look at a simple geometrical model for an expanding black-hole universe with a contracting white-hole universe twin. Discrete Planck unit 'drops' are transferred in integer steps from the white-hole universe to the black-hole universe thereby forcing an expansion of the black-hole universe and giving a rationale for Planck time, the arrow of time, the speed of light, dark energy and dark matter. Presuming that universe expansion will cease when the universe reaches absolute zero gives a cosmological constant $\Omega_u \sim 1.0137x10^{123}$ (units of Planck time). Selected related cosmic microwave background CMB parameters calculated using age in units of Planck time give a best fit for a 14.643 billion year old black hole.

	Black-hole [2]	Wikipedia CMB [5]
Age (billions of years)	14.643	13.8
Mass density	0.21 x $10^{-26} kg.m^{-3}$ (eq.1)	0.24 x $10^{-26} kg.m^{-3}$
Radiation density	0.463 x $10^{-30} kg.m^{-3}$ (eq.10)	0.46 x $10^{-30} kg.m^{-3}$
Hubble constant	66.775 km/s/Mpc (eq.13)	67 (ESA's Planck satellite 2013)
CMB temperature	2.72548K (eq.7)	2.72548K
CMB peak frequency	160.1GHz (eq.17)	160.2GHz

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cosmic microwave background, CMB, cosmological constant, Planck unit theory, Mathematical Universe Hypothesis, black-hole universe, white-hole universe, Planck time, arrow of time, dark energy, relativity, Hubble constant, expanding universe;

1 Premise

Let us suppose that there is a total universe TU that incorporates an expanding black hole universe BHU with a contracting white hole universe WHU twin such that TU = BHU + WHU [6]. Let us further suppose that discrete Planck 'drops', defined as that 'entity' which is the source of the Planck units (for example a theoretical Planck micro black hole), are transferred one by one from the white hole universe to the black hole universe thereby forcing an expansion of the black hole universe at the expense of the (contracting) white hole universe in incremental (integer) steps.

With each additional Planck 'drop' the universe time-line increments by 1 unit of time. We could define this unit of time as Planck time. This time, as a measure of this universe clock rate, equates to time-line and is therefore a constant.

The speed of this expansion gives us the speed of light. The speed of light is therefore also a constant.

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

As the fabric of a black hole universe is the black hole itself, an independent dark matter is not required, the mass density of the universe equating to black hole mass density.

It is this constant outward expansion of the black hole universe in discrete Planck steps (the universe clock rate) which gives the forward arrow of time. All events within the universe may thus be measured alongside this expansion time-line... in other words, all events, from particles to galaxies, have a time dimension, aka a frequency, relative to this time-line.

When the white-hole universe has contracted completely and/or the black hole universe has reached the limit of its expansion (i.e.: when it reaches absolute zero), the universe clock will stop. The direction of transfer and so arrow of time will reverse; the expanding black hole universe becomes the contracting white hole universe feeding its now expanding black hole twin.

2 Universe mass density

We do not know either the mass or size of our universe, but we can estimate its mass density. Assuming that for each unit of Planck time t_p the universe expands by 1 unit of Planck mass m_P and 1 unit of Planck (spherical) volume (Planck length = l_p), then we can calculate the mass density of the universe for any chosen instant (for any time t_u where t_{age} is the dimensionless age of the universe as measured in units of Planck time (the universe time-line) and t_{sec} the age of the universe as measured in seconds)... i.e.: if $t_u = t_{sec}$ = 1s then t_{age} = .92755467... x 10^{43} units of (Planck) time [1].

$$t_p = 2l_p/c$$

$$mass : m_{universe} = 2t_{age}m_P$$

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

$$\frac{m_{universe}}{v_{universe}} = 2t_{age}m_P.\ \frac{3}{4\pi(4l_pt_{age})^3} = \frac{3m_P}{128\pi t_{age}^2 l_p^3}\ (\frac{kg}{m^3}) \tag{1}$$

Gravitation constant G as Planck units;

$$G = \frac{c^2 l_p}{m_P} \tag{2}$$

$$\frac{m_{universe}}{v_{universe}} = \frac{3}{32\pi t_{sec}^2 G} \tag{3}$$

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

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

$$\sqrt{\lambda} = radius\ r = 2ct_{sec}\ (m) \tag{5}$$

3 Universe temperature

In 1974, Stephen Hawking showed that black holes, which are objects that light cannot escape from and hence classically are at absolute zero, do radiate at temperature T_{BH} where black hole mass M = n.m_P, Planck temperature = T_P;

$$T_{BH} = \frac{hc^3}{16\pi^2 G k_B M} = \frac{T_P}{8\pi n}\ (K) \tag{6}$$

I propose that n can then be fractionated into sqrt values such that temperature $T_{universe}$ is a function of $\sqrt{t_{age}}$;

$$T_{universe} = \frac{T_P}{8\pi\sqrt{t_{age}}} \tag{7}$$

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 Stefan Boltzmann constant σ_{SB}.

$$\frac{m_{universe}}{v_{universe}T_{universe}^4} = \frac{3m_P}{128\pi t_{age}^2 l_p^3}.\ \frac{1}{T_{universe}^4} = \frac{2^8 3\pi^6 k_B^4}{h^3c^5} \tag{8}$$

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

4 Radiation density

$$\frac{8\pi^5 k_B^4}{15h^3c^5}.T_{universe}^4 = \frac{1}{15}.\frac{m_P}{2^{12}\pi^2 l_p^3 t_{age}^2} \tag{10}$$

5 Casimir formula

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

$$\frac{-F_c}{A} = \frac{\pi hc}{480(d_c l_p)^4} = \frac{1}{15}.\frac{\pi^2 m_P c^2}{16 d_c^4 l_p^3} \tag{11}$$

when $d_c = 4\pi\sqrt{t_{age}}$, distance = 0.42mm (eq.10 = eq.11);

$$\frac{1}{15}.\frac{\pi^2 m_P c^2}{16 d_c^4 l_p^3} = \frac{1}{15}.\frac{m_P c^2}{2^{12}\pi^2 l_p^3 t_{age}^2} \tag{12}$$

6 Hubble constant

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

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

7 Wien's displacement law

$$\frac{xe^x}{e^x - 1} - 5 = 0, x = 4.965114231... \tag{14}$$

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

8 Black body peak frequency

$$\frac{xe^x}{e^x - 1} - 3 = 0, x = 2.821439372... \tag{16}$$

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

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

9 Cosmological constant

Riess and Perlmutter (notes 2) using Type 1a supernovae calculated the end of the universe t_{end} ~ 1.7 x 10^{-121} ~ 0.588 x 10^{121} units of Planck time;

$$t_{end} \sim 0.588x10^{121}\ \sim 0.2x10^{71}yrs \tag{19}$$

I have used T_{max} to represent the maximum temperature. What is of equal importance is the minimum possible temperature T_{min} - that temperature 1 unit (1 step) above absolute zero, for in the context of this universe expansion theory, this temperature would signify the limit of the universe expansion (the universe could expand no further). For example, if we 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 then gives us a value for the final age of the universe in units of Planck time (~ 0.35 10^{73} yrs);

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

The mid way point ($T_{universe} = 1K$) would be when $t_u = T_{max}^2 \sim 3.18\ 10^{61}$ ~ 108.77 billion years.

10 Comments

In comparing this black hole universe with the cosmic microwave background data I have used the CMB temperature value T = 2.72548K as my reference and used this to solve t_{age} and so the other formulas. The best fit for the above parameters in comparison to the CMB data (see table, page 1) is for a 14.643 billion year old black hole. In other words, a black hole whose temperature is T = 2.72548K will compare with our universe.

Notes:

1. Further discussion of this model can be referenced at: http://planckmomentum.com/

2. 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 two Universes 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].

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].

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.

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