Cosmological constant and the Black-hole White-hole Universe

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In this essay I look at a simple rotating expanding black-hole universe with a contracting white-hole universe twin. Units of Planck momentum are transferred in discrete integer steps from the white-hole universe to the black-hole universe thereby giving a simple rationale for the expansion of the universe, (Planck) time, the arrow of time, the speed of light, dark energy, dark matter and the Stefan Boltzmann constant. A discrete unit of temperature is suggested and this is used to solve the cosmological constant to 0.101373253 x 10^{-124} units of Planck time. Results for the universe mass density, the cosmic radiation energy density and the cosmic microwave background temperature correspond with observed.

1 Introduction

Let us suppose that our universe is a charged rotating expanding black hole with a contracting white hole twin [6].

Units of Planck momentum are transferred in discrete integer 'drops' from the white hole universe to our black hole universe. Each drop (each unit of Planck momentum) corresponds to 1 unit of Planck time.

The velocity of this expansion gives the velocity of light '2.c'. This velocity is constant.

With momentum, time and velocity, our universe also has mass (momentum/velocity) and length (velocity x time), and so with every increment to the universe clock (each unit of Planck time), our universe expands by 1 unit of Planck mass and 1 unit of spherical Planck volume and so the mass density of our universe decreases linearly (mass per volume).

The universe temperature drops from Planck temperature but according to a square root progression, i.e.: it initially drops quickly but then tapers off. It can be used to solve the cosmological constant and suggests that the universe will reach absolute zero after 10^{73} years.

It is this constant expansion of the black hole universe in discrete Planck steps (the universe clock rate) which gives both time (units of Planck time) and 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). This universe time-line, as measured in units of Planck time, is also a constant.

As particles and photons thus have a frequency along this time-line (for example an electron at rest, as a wave, does not exist at any 1 unit of time but rather is spread over 10^{23} units of Planck time), then the initial big bang would have been without particles or radiation, a pure black hole.

When the white-hole universe has contracted completely and the black hole universe therefore reached the limit of its expansion, the universe clock will stop.

As both c and the universe time-line are constants, there is no relativity. It is our unit the second which varies for it is synchronized to the cesium atom and not to Planck time.

As the expansion of the universe is forced by this constant addition of momentum, for our black hole universe is not a closed system but is constantly fed by its white hole twin, dark energy equates to Planck momentum.

If the fabric of a black hole is momentum (with velocity and time), then dark matter also equates to momentum.

We may therefore reduce both white and black universe to the 3 units of motion; Planck momentum, velocity -c (the velocity of Planck momentum and the velocity of the universe expansion) and Planck time (the incremental expansion and so clock rate of the universe). [1].

2 Universe mass density

We do not know either the mass or size of our universe, but we can estimate both its age (t_u = 13.8 billion years) and 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 age of the universe as measured in units of Planck time and t_{sec} the age of the universe as measured in seconds)... i.e.: if $t_u = t_{sec}$ = 1s then T_{age} = .927554668 x 10^{43} (units of t_p).

$$t_p = 2.l_p/c$$

$$mass : m_{universe} = 2.T_{age}.m_P$$

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

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

The black hole energy distribution of emission as described by Planck's law for M = m_P gives a method for solving the universe temperature (Planck temperature = T_P, temperature at big bang = t_{max}, universe temperature = $t_{universe}$) [1];

$$t_{max} = \frac{h.c^3}{16.\pi^2.G.k_B.M} = \frac{T_P}{8.\pi} \ (K) \tag{2}$$

$$temperature : t_{universe} = \frac{t_{max}}{\sqrt{T_{age}}} \ (K) \tag{3}$$

3 Friedman equation

The Friedman equation, using 'p = mass density' reduces to the radius of the universe;

$$\lambda = \frac{3.c^2}{8.\pi.G.p} = 16.l_p^2.T_{age}^2 \tag{4}$$

$$\sqrt{\lambda} = radius\ r = 4.l_p.T_{age} = 2.c.t_{sec}\ (m) \tag{5}$$

4 Stefan Boltzmann constant

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

$$\frac{m_{universe}}{v_{universe}.t_{universe}^4} = \frac{96.\pi^3.m_P}{l_p^3.T_P^4} \tag{6}$$

We note a similarity with the Stefan Boltzmann constant σ

$$\sigma = \frac{2}{15}.\frac{\pi^5.k_B^4}{h^3.c^2} = \frac{2}{15}.\frac{\pi^2.m_P}{t_p^3.T_P^4} \tag{7}$$

However the Stefan Boltzmann constant uses the volume of time instead of the volume of space. Furthermore, it appears to use the formula for the surface area of a 4-D sphere.

$$mass : m_{universe} = T_{age}.m_P$$

$$area : a_{universe} = 2.\pi^2.r^3 \quad (r = 16.t_p.T_{age})$$

$$\frac{m_{universe}}{a_{universe}} = \frac{m_P}{2^{16}.\pi^2.T_{age}^2.l_p^3} \tag{8}$$

The Stefan Boltzmann constant σ becomes;

$$\frac{m_{universe}}{a_{universe}.t_{universe}^4} = \frac{\pi^2.m_P}{2.t_p^3.T_P^4} \tag{9}$$

$$\sigma = \frac{4}{15}.\frac{m_{universe}}{a_{universe}.t_{universe}^4} \tag{10}$$

5 Results

With an additional curvature term; i.e.: for a non-flat universe, ω=1.038 [10] gives;

$$T_{age} = T_{age}.\omega$$

$$t_{universe} = \frac{t_{max}}{\sqrt{T_{age}.\omega}}\ (K) \tag{11}$$

$$Hubble = \frac{2.c.(3.08567758e22)}{4.l_p.T_{age}} = \frac{3.08567758e22}{\omega.t_{sec}} \tag{12}$$

Big bang (age $t_u = 1t_p$) [2]:
- mass density = 0.357e95 $kg.m^{-3}$ (eq.1)
- radiation density = 0.739e91 $kg.m^{-3}$ (eq.8)
- Hubble = 2.756e62 km/s/Mpc (eq.12)
- temp = 0.54e31 K (eq.11)

t_u = 100s:
- mass density = 4.15e4
- radiation density = 8.59
- Hubble = 2.97e17
- temp = 1.78e8

t_u = 400 years:
- mass density = 2.6e-12
- radiation density = 0.539e-15
- Hubble = 2.36e9
- temp = 15877

t_u = 2e8 years:
- mass density = 1e-23
- radiation density = 2.157e-27
- Hubble = 0.47e4
- temp = 22

t_u= 13.58e9 years:
- mass density = 0.226e-26
- radiation density = 0.47e-30
- Hubble = 69.3
- temp = 2.725 (online calculator [3])

CMB cosmic background radiation:
- density of dark matter = .23 x $10^{-26} kg.m^{-3}$
- temperature 2.725 K
- Hubble = 70.4 km/s/Mpc [9]
- radiation density = 0.466 x $10^{-30} kg.m^{-3}$ [5]

6 Black body peak frequency

Using Wien's displacement law.
For temperature t;
If t_{sun} = 5884K, λ_{sun} = .4745nm

$$\frac{i.e^i}{e^i - 1} - 5 = 0;\ i = 4.965114231744276 \tag{13}$$

$$\lambda_{max} = \frac{2.\pi.l_p.T_P}{i.w.t} \tag{14}$$

Using Planck's law for black body spectrum.
If $t_{universe}$ = 2.725K, $f_{universe}$ = 160.2GHz
$j = ln(e)$ = 2.718281828459;

$$\frac{1}{f_{max}} = \frac{2.\pi.l_p.T_P}{j.c.w.t} \tag{15}$$

7 Cosmological constant Ω

The presence of a sqrt ($\sqrt{T_{age}}$) suggests that the minimum temperature the universe (eq.3) may reach is the inverse of the maximum temperature.
From (eq.3) we see that $t_{universe} = t_{min}$ when $T_{age} = t_{max}^4$;

$$t_{min} = \frac{8.\pi}{T_P} = 0.177\ 10^{-30}\ K \tag{16}$$

We can thereby calculate the maximum age of the universe; Og's constant [6] $\Omega = t_{max}^4 = 0.101373253\ 10^{124}$ units of Planck time t_p (= 0.34632 10^{73}) yrs (see notes 2). As the next increment would reach absolute zero, the universe clock would presumably then stop.

The mid way point ($t_{universe} = 1K$) would be when $t_u = t_{max}^2$ = 108.77 billion years (.318391666 10^{62} units of t_p).

8 Summary

The mass density is a function of the age of the universe T_{age}, the temperature however is a function of the square root of the age $\sqrt{T_{age}}$ and so while the mass density of the universe has decreased linearly, the change in temperature is in accordance with this square root progression. For example, it took 3000 years for the universe temperature to drop from Planck temperature to 6000K (the temperature of the sun), but another 13.6 billion years to further drop to 2.7K.

Consequently we have 2 measures in respect to the expansion of our universe, those factors which relate to mass and volume follow a linearity but the rate of change for parameters relating to temperature drops as the universe expands.

This also suggests that as the universe expands, it also rotates and as rotation is uni-directional it may also be considered to be charged. Seen from 'above', our black hole universe would resemble a spiral whose curved length is T_{age} and whose spiral radius is $\sqrt{T_{age}}$ [6]. Note that the Schwarschild metric for rotating charged black holes also gives a white hole solution.

In a following paper I use the formula [8] for a magnetic monopole to derive eq.16 suggesting that there may be a temperature particle which I have labeled the 'kelvon', consequently the temperature rate of change would apply to the electromagnetic domain.

Notes:

1. 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 [4].

2. ... 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 $\Omega \sim 1.7 \text{ x } 10^{-121}$ 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 $1/t_u{}^2 \sim 1.6 \text{ x } 10^{-122}$, where $t_u \sim 8 \text{ x } 10^{60}$ is the present expansion age of the universe in Planck time units. Attempts to explain why $\Omega \sim 1/t_u{}^2$ have relied upon ensembles of possible universes, in which all possible values of Ω are found [7].

3. Formulas and numerical values for all the constants used here were taken from [1]. See also online calculator [3].

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