Programming a black-hole universe and cosmological constant in a Planck unit Simulation Hypothesis

Malcolm Macleod

e-mail: maclem@platoscode.com

The Simulation Hypothesis proposes that all of reality is an artificial simulation, analogous to a computer simulation. Outlined here is a low computational cost method for programming cosmic microwave background parameters in Planck time Simulation Hypothesis Universe. The model initializes 'micro Planck-size black-holes' as entities that embed the Planck units. For each incremental unit of Planck time, the universe expands by adding 1 micro black-hole, a dark energy is not required. The mass-space parameters increment linearly, the electric parameters in a sqrt-progression, thus for electric parameters the early black-hole transforms most rapidly. The velocity of expansion is constant and is the origin of the speed of light, the Hubble constant becomes a measure of the black-hole radius and the CMB radiation energy density correlates to the Casimir force. A peak frequency of 160.2GHz correlates to a 14.624 billion year old black-hole. The cosmological constant, being the age when the simulation reaches the limit, approximates $t = 10^{123} t_p$.

Table 1	Black-hole	Cosmic microwave background
Age (billions of years)	14.624	13.8 [4]
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 $10^{-26} kg.m^{-3}$ [6]
Radiation energy density	0.417 x $10^{-13} kg.m^{-3}$ (eq.7)	0.417 x $10^{-13} kg.m^{-3}$ [4]
Hubble constant	66.86 km/s/Mpc (eq.10)	67.74(46) km/s/Mpc [5]
CMB temperature	2.7269K (eq.3)	2.7255K [4]
CMB peak frequency	160.2GHz (eq.12)	160.2GHz [4]
Entropy CEH	2.3 x $10^{122} k_B$ (eq.13)	2.6 x $10^{122} k_B$ [10]
Casimir length	0.42mm (eq.8)	

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]. The principal problem with such hypothesis is the immense computing resources required. In this article I discuss a low-cost method for programming principal cosmic microwave background parameters applicable for use in a Planck-level Simulation Hypothesis universe, the only variable required being the universe age t, thus the simulation may begin at any chosen unit of time, updating in real-time as the simulation proceeds.

A Planck 'micro black-hole', being an entity that embeds the Planck units is initialized. The simulation begins with a single micro black-hole, time $t = 1$. A second micro black-hole is added, $t = 2$ and so on ... t as the clock rate of our simulation and measured in units of Planck time t_p, the sum black-hole growing in Planck steps accordingly.

The velocity of the universe expansion is constant and is the origin of the speed of light. It is also this outward expansion of the sum black-hole that gives an omnidirectional (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 simulation clock will stop.

If we include an inverse contracting white-hole twin as the source of the micro black-holes, upon reaching near absolute zero the roles could then reverse, the black-hole then becoming a contracting white-hole feeding its (now) expanding black-hole, and so forth ad infinitum.

2 Mass density

Assume that for each expansion step, to the black-hole 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, volume and so density of this black-hole at any chosen step 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.

$$t_p = \frac{2l_p}{c}\ (s)$$

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

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

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

Via the Friedman equation, replacing p with the above mass density formula, $\sqrt{\lambda} = r = 2ct_{sec}$ reduces to the black-hole radius ($G = c^2 l_p/m_P$);

$$\lambda = \frac{3c^2}{8\pi Gp} = 4c^2 t_{sec}^2 \quad (2)$$

3 Temperature

Measured in terms of Planck temperature = T_P;

$$T_{bh} = \frac{T_P}{8\pi\sqrt{t_{age}}} \quad (3)$$

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.

$$T_p = \frac{m_P c^2}{k_B} = \sqrt{\frac{hc^5}{2\pi G {k_B}^2}} \quad (4)$$

$$\frac{m_{bh}}{v_{bh}T_{bh}^4} = \frac{2^5 3\pi^3 m_P}{l_p^3 T_P^4} = \frac{2^8 3\pi^6 k_B^4}{h^3 c^5} \quad (5)$$

4 Radiation energy density

From Stefan Boltzmann constant σ_{SB}

$$\sigma_{SB} = \frac{2\pi^5 k_B^4}{15h^3c^2} \quad (6)$$

$$\frac{4\sigma_{SB}}{c}.T_{bh}^4 = \frac{c^2}{1440\pi}.\frac{m_{bh}}{v_{bh}} \quad (7)$$

5 Casimir formula

The Casimir force per unit area for idealized, perfectly conducting plates with vacuum between them, where $d_c 2l_p$ = distance between plates in units of Planck length;

$$\frac{-F_c}{A} = \frac{\pi hc}{480(d_c 2l_p)^4} \quad (8)$$

if $d_c = 2\pi\sqrt{t_{age}}$ then eq.7 = eq.8, equating the Casimir force with the background radiation energy density.

$$\frac{-F_c}{A} = \frac{c^2}{1440\pi}.\frac{m_{bh}}{v_{bh}} \quad (9)$$

Fig.1 plots Casimir length $d_c 2l_p$ against radiation energy density pressure measured in mPa for different t_{age} with a vertex around 1Pa, fig.2 plots temperature T_{bh}.
A radiation energy density pressure of 1Pa gives $t_{age} \sim 0.8743\ 10^{54} t_p$ (2987 years), length = 189.89nm and temperature T_{bh} = 6034 K .

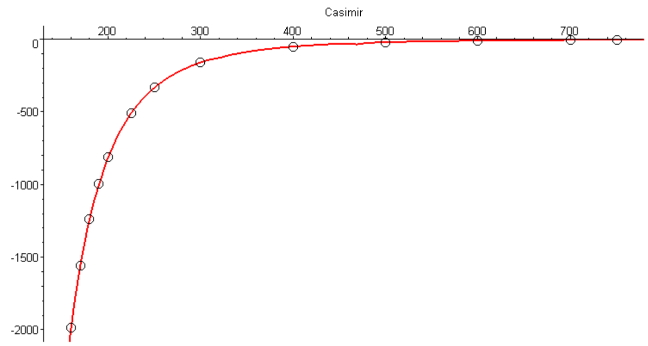

Fig. 1: y-axis = mPa, x-axis = $d_c 2l_p$ (nm)

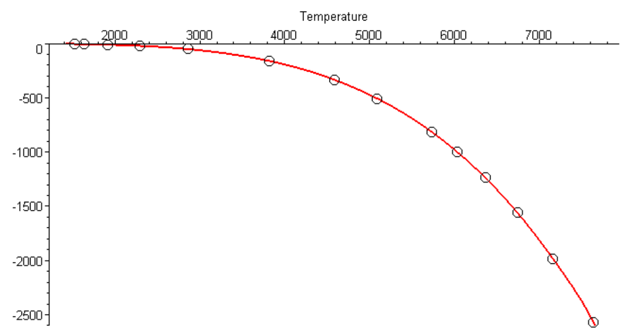

Fig. 2: y-axis = mPa, x-axis = T_{bh} (K)

6 Hubble constant

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

$$H = \frac{1Mpc}{t_{age}t_p} \quad (10)$$

7 Black body peak frequency

$$\frac{xe^x}{e^x - 1} - 3 = 0, x = 2.821439... \quad (11)$$

$$f_{peak} = \frac{k_B T_{bh} x}{h} = \frac{x}{8\pi^2\sqrt{t_{age}}t_p} \quad (12)$$

8 Entropy

$$S_{BH} = 4\pi {t_{age}}^2 k_B \quad (13)$$

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;

$$t_{end} \sim 0.588x10^{121} \tag{14}$$

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 Planck 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;

$$T_{min} \sim \frac{1}{T_{max}} \sim \frac{8\pi}{T_P} \sim 0.177\ 10^{-30}\ K \tag{15}$$

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;

$$t_{end} = T_{max}^4 \sim 1.014\ 10^{123} \tag{16}$$

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

10 Rotation

This model has the mass volume component expanding linearly and the radiation components as a sqrt progression. By expanding according to a spiral pattern the universe can rotate with respect to itself giving potential for an L and R universe and so differentiation between otherwise identical L and R states. A Theodorus spiral increments in units of 1 but such that its radius is the square root of its length, i.e.: if we set the sides of the small shaded square to represent 1 micro black-hole then for any age t the spiral axis = $\sqrt{t}$ and spiral length (or box area) = t and thus rotation may be simulated without recourse to an external reference.

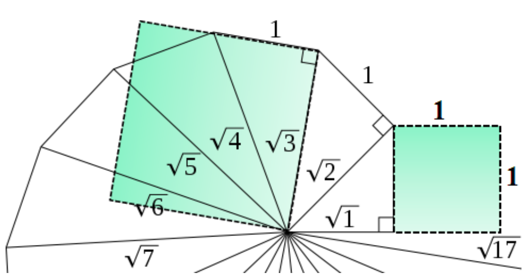

Fig. 3: theodorus spiral

11 Comments

In comparing this black-hole with the CMB data, I took the peak frequency value at exactly 160.2 GHz as my reference and used this to solve t_{age} eq(12) and from there the other formulas. This gives a 14.6 billion year old black-hole (see table, page 1).

As t_{age} = number of expansion steps is the only variable required, the simulation may be started at any selected age t_{age}. The CMB parameters will update with minimum computation as the simulation progresses.

The standard temperature expansion formula begins recombination at 380,000 years as opposed to about 3000 years here, this significantly faster temperature drop can be used to reduce the horizon problem. The inflation model however also gives a simple explanation for the generation of the variations on the CMB sky. In this model inflation was not used, a mechanism for introducing those density perturbations will be a subject for further study.

Particles are introduced in 2 separate papers on relativity [8] and gravity [9].

Notes:

a) 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 [2].

b) ... 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 $\Omega \sim 1.7$ 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 $1/{t_u}^2 \sim 1.6$ x 10^{-122}, where $t_u \sim 8$ 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 [3].

d) 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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