Time, Dark Energy and the Black-hole White-hole Universe

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In this essay I look at an 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 to the black-hole thereby giving a simple rationale for the expansion of the universe, time, the arrow of time, the speed of light, dark energy and dark matter.

1 Introduction

Let us suppose that our universe is an expanding black hole with a contracting white hole twin.

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 ‘c’. This velocity is constant.

With momentum, time and velocity our universe has mass and length, 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 Planck volume and the temperature drops by 1 unit of (the inverse of) Planck temperature.

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 is a constant.

As particles and photons have a frequency (for example an electron, 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 earliest universe 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 the universe time-line.

As the expansion of the universe is forced by this constant addition of momentum, for the black hole universe is not a closed system, 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 dimensions of motion; momentum, velocity (the velocity of momentum) and time (the incremental expansion 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 (13.82billion years) and its mass density. Assuming that for each unit of Planck time the universe expands by 1 unit of Planck mass and 1 unit of Planck volume, then we can calculate the mass density of the universe for any chosen period (for any time T where T is measured in units of Planck time).

\[ t_p = \frac{2l_p}{c} \]

\[ \text{age} : T = t/t_p, \ t = \text{seconds} \]

\[ \text{mass} : m_{\text{universe}} = 2.7m_p \]

\[ \text{volume} : v_{\text{universe}} = 4.\pi.r^3/3 \quad (r = 4.l_p,T = 2.c.t) \]

\[ \frac{m_{\text{universe}}}{v_{\text{universe}}} = \frac{3.m_p}{128.\pi.T^3.l_p^3} \quad (\text{kg/m}^3) \quad (1) \]

The black hole energy distribution of emission as described by Planck’s law for $M = \text{Planck mass}$ gives a method for solving the universe temperature;

\[ t_{\text{max}} = \frac{h.c^3}{16.\pi^2.G.k.B.M} = \frac{T_p}{8.\pi} \quad (K) \quad (2) \]

\[ t_{\text{universe}} = \frac{t_{\text{max}}}{\sqrt{T}} \quad (K) \quad (3) \]

Big bang (age = 1$t_p$):

- density = $3.8e94kg.m^{-3}$
- temp = $5.6e30K$

age = 100s:

- density = $4.5e4kg.m^{-3}$
- temp = $1.85e8K$

age = 400 years:

- density = $2.8e-12kg.m^{-3}$
- temp = $16500K$

age = 2e8 years:

- density = $1e-23kg.m^{-3}$
- temp = $23K$
Now (age = 13.82e9 years):
density = 0.235e-26 kg/m^3
temp = 2.805K (ref online calculator [3]).

The result (.235e-26 kg/m^3) corresponds with the WMAP estimate for the density of dark matter (.23e-26 kg/m^3) and the temperature (2.8K) agrees with the cosmic microwave background (2.725K) [2].

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

\[
\frac{m_{\text{universe}}}{v_{\text{universe}} T_{\text{universe}}^4} = \frac{96\pi^3 m_p}{l_p^3 T_p^4}
\]

We find that this constant compares with the Stefan Boltzmann constant \( \sigma \)

\[
\sigma = \frac{2\pi^3 k_B^4}{15h^3 c^2} = \frac{2\pi^2 m_p}{15l_p^3 T_p^4}
\]

The presence of a \( \sqrt{T} \) suggests that the minimum temperature the universe may reach is (i.e.: \( t_{\text{min}} T_{\text{max}}^2 = t_{\text{max}} \));

\[
t_{\text{min}} = \frac{8\pi}{T_p} = 0.177 \times 10^{-30} K
\]

We can thereby calculate the maximum age of the universe being when \( t_{\text{universe}} = t_{\text{min}} \); i.e: \( t_{\text{age}} = t_{\text{max}}^4 = 0.10137 \times 10^{124} \) units of Planck time or 0.34632 \( \times 10^{73} \) years. As the next increment would reach absolute zero, the universe clock would presumably then expire.

For black hole formulas where \( M = \text{Planck mass} \) see [1]

From the Friedman equation, using ‘\( p = \text{mass density} \)’ the Hubble parameter reduces to the radius of the universe:

\[
A = \frac{3c^2}{8\pi G p} = 16l_p^2 T^2
\]

\[
\sqrt{A} = r = 4l_p T = 2c t (m)
\]

References
1. Macleod M.J. Planck Unit Theory: Fine Structure Constant Alpha and Sqrt of Planck Momentum
   http://vixra.org/abs/1308.0118
2. Evolution of the Universe
   physics.uoregon.edu/jimbrau/astr123/notes/chapter27
3. www.planckmomentum.com