Black Hole Universe and Hawking Temperature

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Abstract

It has been shown that the Hawking temperature of the Black Hole Universe is directly proportional to the Hubble constant. The value of this temperature, the power of radiation, the energy emitted in one year and the wavelength corresponding to the maximum radiation power were estimated.

Keywords: Black Hole Universe, Hawking Temperature, Stefan-Boltzmann law, Wien's wavelenght displacement law.

1. Introduction

In the dissertation [1] I proposed a black-hole model of the Universe. Our Universe can be treated as a gigantic homogeneous Black Hole with an anti-gravity shell. Our Galaxy, together with the solar system and the Earth, which in the cosmological scale can be considered only as a point, should be located near the center of the Black Hole Universe.

In the following, we will show that Hawking temperature of the Black Hole Universe is directly proportional to the Hubble constant. We will estimated the value of this temperature, the power of radiation, the energy emitted within one year and the wavelength corresponding to the maximum radiation power.

2. Hawking Temperature of the Black Hole Universe

Hawking temperature (T_H) [2] is called the expression:

$$T_H = \frac{\hbar c^3}{8\pi G k_B} \cdot \frac{1}{M}, \quad \frac{\hbar c^3}{8\pi G k_B} \approx 1.227 \times 10^{23} \mathrm{kg} \cdot \mathrm{K}$$

$$\downarrow \quad \frac{M}{R} = \frac{c^2}{G} \rightarrow \frac{1}{M} = \frac{G}{c^2 R} \qquad \text{See [1], page 26}$$

$$T_H = \frac{\hbar c}{8\pi k_B} \cdot \frac{1}{R}, \quad \frac{\hbar c}{8\pi k_B} \approx 9.111 \times 10^{-5} \mathrm{m} \cdot \mathrm{K}$$

$$\downarrow \quad R = \frac{1}{2k_H} = \frac{c}{2H} \rightarrow \frac{1}{R} = 2k_H = \frac{2H}{c} \qquad \text{See [1], page 47}$$

$$\downarrow$$

$$T_H = \frac{\hbar}{4\pi k_B} \cdot H, \quad \frac{\hbar}{4\pi k_B} \approx 6.078 \times 10^{-13} \, s \cdot K$$

$H = 75 \, km \cdot s^{-1} \cdot Mpc^{-1} \approx 2.43 \times 10^{-18} \, s^{-1}$ See [1], page 47

$R \approx 6.168 \times 10^{25} \, m$ See [1], page 48

$$T_H \approx 1.477 \times 10^{-30} \, K$$

where:
h – Planck constant
ħ = h/(2π)
ħ – reduced Planck constant
c – standard value of the speed of light in vacuum
G – gravitational constant
k_B – Boltzmann constant
M – the mass of the black hole (the mass of the Black Hole Universe)
R – the radius of the Black Hole Universe
H – Hubble constant
k_H = H/c See [1], page 47
k_H – Hubble's coefficient

3. The power of radiation emitted from the border surface of the Black Hole Universe

On the basis of Stefan-Boltzmann law, we will determine the power of radiation emitted from the border surface of the Black Hole Universe.

$$P = A\sigma T^4$$ Stefan-Boltzmann law

$$A = 4\pi R^2$$

$$\sigma = \frac{\pi^2 k_B^4}{60\hbar^3 c^2} \approx 5.67 \times 10^{-8} \, Wm^{-2}K^{-4}$$

$$T = T_H = \frac{\hbar c}{8\pi k_B} \cdot \frac{1}{R}$$

$$P = \frac{\hbar c^2}{61440 \cdot \pi} \cdot \frac{1}{R^2}, \quad \frac{\hbar c^2}{61440 \cdot \pi} \approx 4.91 \times 10^{-23} \, W \cdot m^2$$

$$R = \frac{1}{2k_H} = \frac{c}{2H} \quad \rightarrow \quad \frac{1}{R^2} = \frac{4H^2}{c^2}$$ See [1], page 47

$$P = \frac{\hbar}{15360 \cdot \pi} \cdot H^2, \quad \frac{\hbar}{1536110 \cdot \pi} \approx 2.185 \times 10^{-39} \, J \cdot s$$

$H = 75 km \cdot s^{-1} \cdot Mpc^{-1} \approx 2.43 \times 10^{-18} \, s^{-1}$ See [1], page 47

$$P \approx 1.29 \times 10^{-74} \, W$$

where:
A – boundary surface of the Black Hole Universe
σ – Stefan-Boltzmann constant
T – temperature

Considering that $1\,\text{year} = 3.156 \times 10^{7}\,\text{s}$, for energy emitted from the boundary surface of the Black Hole Universe in one year we get approximately only $5.649 \times 10^{-67}\,\text{J}$.

4. The wavelength corresponding to the maximum radiation power

The wavelength (λ_{max}) corresponding to the maximum radiation power will be determined from the Wien's wavelenght displacement law.

$$\lambda_{max} = \frac{b}{T}$$

Wien's wavelenght displacement law

$$b \approx 2.8978 \times 10^{-3}\,\text{m} \cdot \text{K}$$
$$T = T_H \approx 1.477 \times 10^{-30}\,\text{K}$$

$$\lambda_{max} \approx 1.962 \times 10^{27}\,\text{m}$$

where:
b – Wien's wavelenght displacement constant

5. Final remarks

The effects associated with the Hawking temperature of the Black Hole Universe do not introduce measurable corrections to the model of Our Universe.

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References

[1] Zbigniew Osiak: *Anti-gravity*. viXra:1612.0062 (2016)
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[2] S. W. Hawking: *Black hole explosions?* Nature **248**, 5443 (01 March 1974) 30-31.
[3] The values of universal constants come from the website:
https://physics.nist.gov/cuu/Constants/