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Temperature of Black Holes and Minimum Wavelength of Radio Waves

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ABSTRACT

The temperature for a black hole is identified as the temperature of the cosmic microwave background. The exact separating value for wavelength is found to classify electromagnetic waves into electric field waves and magnetic field waves. The maximum possible diameter of molecules in our universe is found. A Chandrasekhar's limit for black holes is used to guess somewhat reasonable values of radii for electrons, protons and neutrons.
Keywords : Electromagnetic Waves, Cosmic Microwave Background, Black Holes.

I. INTRODUCTION

An electromagnetic wave is a wave which has the speed of light c (=2.9979250 x 10^8 m/s) in the vacuum. The authors established in the article [5] that there is a positive number w such that any electromagnetic wave with wave length less than w is an electric field wave which free from magnetic fields, and such that any electromagnetic wave with wave length greater than w is a magnetic field wave which free from electric fields. The present article fixes this value w approximately. The earlier article [5] tried to find the value of w by using the maximum possible diameter of molecules in our universe, when this maximum possible value was unknown. The present article also fixes this maximum possible value approximately. The theory developed in the article [5] also contradicted the existence of gravitational waves (see also [6, 7, 9]).

This article does not provide a definition for planets and stars. This article assumes the following hypothesis for the special theory of relativity. There is no particle and there is no energy wave which can have a speed that is greater than the speed of light c in the vacuum. This article assumes that the minimum possible mass of black holes is equal to 1.474 times of the mass of the sun, when the mass of the sun is 1.989 x 10^{30} kg. This is a Chandrasekhar's limit given in the article [1]. The present article also assumes the following definitions, which may not be applicable to the articles of the other researchers.

Electric fields [3,4]: These fields are the fields which can be realized around electrons and protons.

Light ray/wave [3,4]: It is an energy wave with speed c in the vacuum and which is created by electric fields. It is also called an electric field wave.

Dark planet (object/star): It is a planet (object/star) which does not emit light waves, and which cannot emit light waves.

Black hole: It is a spherical type object or planet or star, which does not permit energy waves to escape.

Every black hole should be a dark object/planet/star according to these definitions. Let λ_m be the wavelength of the waves for which the intensity of a black body radiation is a maximum for a radiating black body with temperature T. It was found empirically that the following relation is true (see section 4.5 in [8]).

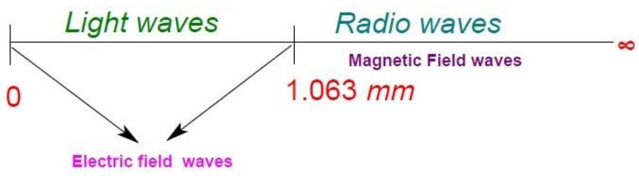
Wien's distribution law: $\lambda_m T = b$, where b is a universal constant, whose value is $b = 2.8978 \times 10^{-1}$ cm K.

This empirical relation is assumed to be universally true in this article. The temperature of the cosmic microwave background is assumed in this article to be 2.726 K, which is the value given in [2].

The first aim is to show that this temperature 2.726 K is the minimum possible temperature of black holes. The second aim is find an approximate value for w mentioned above. The third aim is to find the maximum possible diameter of molecules in our universe. The fourth aim is to guess a common reasonable value for radii of electrons, protons and neutrons.

II. The temperature of black holes

If there are light ray radiations from an object with temperature T, then the wavelength λ_m of the waves for which the intensity is maximum satisfies the relation $\lambda_m = b/T$. The maximum possible wavelength of a light ray is somewhat approximately equal to 10^{-3} m (see [5]). Thus, if $\lambda_m > 10^{-3}$ m, then it can be concluded that the object with temperature T has no light radiation, when $(b/T) > 10^{-3}$ m or $T < \frac{b}{10^{-3}} = \frac{0.0028978}{10^{-3}} = 2.8978$ K. Thus, an object has no emission of light rays, if its temperature is less than 2.8978 K; when an approximation of 10^{-3} m is considered as the maximum possible wavelength for light rays. It is simple to guess that 2.8978 K should be replaced bay 2.726 K, and the corresponding 10^{-3} m should be replaced by $\frac{b}{2.726\,K} = \frac{0.0028978\,m\,K}{2.726\,K} = 1.063022744 \times 10^{-3}$ m. This is the value of w mentioned above in this article. That is, $w = 1.063022744 \times 10^{-3}$ m (approximately). The article [5] proposed a method to find the value of w in terms of the maximum possible diameter of molecules in our universe. The value of w was not calculated in [5] because the maximum possible diameter of molecules was unknown. Now, one can reverse the calculation procedure given in [5], by using $w = 1.063022744 \times 10^{-3}$ m and he/she can calculate the values of the maximum possible diameter of molecules in our universe as $1.825841138 \times 10^{-7}$ m, approximately. The diameters of electrons, protons and neutrons are also unknown. A compromising common value is found in the next section.



Spectrum of Electromagnetic Waves

Let us assume that some stars and some planets have temperatures greater than 2.726 K at least once in their life time. Let us also assume that their temperatures are higher than 2.726 K whenever they have radiations other than light wave radiations. In that case, these planets do not lose heat energy by means of conduction, convection and radiation, when these planets reach the lower temperature 2.726 K from higher temperatures. So, once a planet of this type reaches the temperature 2.726 K, the planet does not emit light waves, the temperature remains constant, and the planet becomes a dark planet. Thus, a black hole cannot have a temperature that is less than 2.726 K, because they do not let energies in wave form to escape, and because energy waves have at most speed c.

III. A CUBIC AVERAGE RADIUS

Let G be the universal gravitational constant 6.67 x 10^{-11} $m^3/(kg\ s^2)$. Consider a black hole with mass M and radius R. Its escape velocity is $(2GM/R)^{1/2}$. It should be greater than c, because the black hole does not permit light waves to escape. That is, (2GM/R) > c^2 or (M/R) >$c^2/(2G)$ = 0.673729708 x 10^{27} kg/m, approximately. For the limiting case and for the smallest possible mass M which is 1.474 times of the mass of the sun, 0.673729708 x 10^{27} kg/m = (M/R) = (1.474 x 1.989 x 10^{30} kg)/R, R = 4351.575959 m, and hence the density $\rho = M/(\frac{4}{3}\pi R^3) \approx (21/88)(M/R^3)$ = 8.4904234 x 10^{17} kg/m^3, approximately.

The masses of electrons, protons and neutrons have been standardized (see Appendix I in [8]).

Mass of an electron = m_e = 9.109559 x 10^{-31} kg; Mass of a proton = m_p = 1.672614 x 10^{-27} kg; Mass of a neutron = m_n = 1.674920 x10^{-27} kg. Let r_e, r_p and r_n be the radii of an electron, a proton and a neutron, respectively. Let r be a number such that $\frac{4}{3}\pi r^3 = \frac{1}{3}(\frac{4}{3}\pi r_e^3 + \frac{4}{3}\pi r_p^3 + \frac{4}{3}\pi r_n^3)$. Let us call r as the cubic average radius. This r is common for electrons, protons and neutrons, for the purpose to understand their radii. There is no binding energy in a black hole with the minimum possible mass, and hence its density ρ should be equal to $(m_e+m_p+m_n)/(\frac{4}{3}\pi r_e^3 + \frac{4}{3}\pi r_p^3 + \frac{4}{3}\pi r_n^3)$, because every particle consists almost of an integer multiple of the combined set {one electron + one proton + one neutron}. Thus 8.4904234 x 10^{17} kg/m^3 = {3(0.0009109559+1.672614+1.674920) x 10^{-27} kg}/($\frac{4}{3}\pi r^3$ m^3). This gives the value of r as 1.413374432 x 10^{-15} m. This provides a somewhat common approximate radius for electrons, protons and neutrons. Observe that this value is derived from a Chandrasekhar's limit. Observe further that these calculations do not depend on actual existence of a black hole. Observe also that if the values of radii of electrons, protons and neutrons are standardized, then the calculation procedure can be reversed to find a best Chandrasekhar's limit.

IV. CONCLUSIONS

1. The minimum possible temperature of any black hole is 2.726 Kelvin, which is equal to the temperature of the cosmic microwave background.
2. Any electromagnetic wave with wavelength less than 1.063022744 x 10^{-3} m (approximately) is an electric field wave which is free from magnetic fields, and any electromagnetic wave with wavelength greater than 1.063022744 x 10^{-3} m is a magnetic field wave which is free from electric fields.
3. The maximum possible diameter of molecules in our universe is approximately 1.825841138 x 10^{-7} m. In particular, no molecule with diameter greater than or equal to 10^{-6} m exists in our universe.
4. A Chandrasekar's limit for black holes implies that an expected cubic average radius for electrons or protons or neutrons is 1.413374432 x 10^{-15} m.

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