Redefining Black Hole Entropy Due to Proporcionality to the Fine Structure Constant

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Abstract

In this article we propose a new definition of the entropy of black holes. For this we base ourselves on a reformulation of the Hawking-Bekenstein formula in such a way that, on the one hand, by introducing a new variable that represents the number of microstates and On the other hand, taking into account the mass of the black hole, we can conclude a new equation for the entropy of black holes.

Keywords: *Black hole,Entropy,Microstates,Black hole mass.*

Introduction

In this paper I will present an equation which will show how the black hole entropy is proportional to the fine structure constant.Afterwards I will explain how this equation relates to black hole entropy and how we can define it in relation to the original Hawking-Bekenstein black hole entropy formula.We can see below the original formula

$$S_{BH} = \frac{4\pi r_{BH}^2}{4l_P^2}$$

The equation above tells us the amount of entropy of a black hole.Originally Bekenstein derived this formula and concluded a black hole entropy is proportional to the black hole's event horizon surface area.

The fine structure constant

$$\alpha_e = \frac{1}{137} = \frac{k_e e^2}{\hbar c}$$

Above we have an equation which gives us the value of the fine structure constant.We represent the fine structure constant as "α_e" .The variable "α_e" can be also given by the 2nd expression $\frac{k_e e^2}{\hbar c}$. This expression essentially implies that the fine structure constant is a probability which shows the chance of an electromagnetic interaction between a photon and an electron within an atomic electrostatic interaction.The probability is one out of 137 atomic electrostatic interactions emitting or absorbing a photon.

The new micro-state variable for black hole entropy

$$\phi_M = \frac{Gm^2}{k_c e^2}$$

This is the micro-state variable we will use in our new black hole entropy equation. The variable tells us how many atomic electro-static interactions are needed within a certain surface

area to result in the gravitational field of the mass "m".Keep in mind the surface area is derived using the Schwarzchild radius of the mass "m".Whenever the mass "m"equals the Planck mass , ϕ_M equals 137 which is the maximum of the fine structure constant.

Multiplying the fine structure constant and the micro-state variable

$$\alpha_e \phi_M = \alpha_e \frac{Gm^2}{k_c e^2} = \frac{m^2}{m_P^2}$$

The product of both the fine structure constant α_e and the micro-state variable ϕ_M give us the squared number of Planck masses "m_P" within an overall mass "m" .Within each Planck mass there are 137 atomic electro-static interactions and each 137 electro-static interaction there are at least one of the interactions has an electro-magnetic absorption or emission of a photo

Presenting a new form of black hole entropy

$$S_{BH} = k_B \frac{4\pi r_B^2}{4l_P^2} = 4\pi k_B \alpha_e \phi_M$$

This is the black hole entropy equation in its original form reduced to $4\pi k_B \alpha_e \phi_M$ **.** The original Hawking-Bekenstein

equation makes the black hole entropy proportional to the surface area $4\pi r_B^2$ where "r_B" is the Schwarzchild radius of the mass "m" . "r_B" equals $2Gm$ divided by c^2 .The new form makes ϕ_M the micro-state variable proportional to the black hole entropy S_{BH} .Keep in mind α_e is the fine structure constant and ϕ_M equals $\frac{Gm^2}{k_c e^2}$

This new form of black hole entropy needs to be interpreted.Because of how I have defined above the variables of the fine structure constant and the micro-state.

Conclusion

I conclude black hole entropy in this new form can be interpreted as a measure of the different states in which a certain number of atomic electro-static interactions can be arranged in a Schwarzchild surface area to result in the gravitational field of mass "m".

Bibliography

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List of physical parameters

S_B : Black hole entropy
k_B : Boltzmann constant, $1.3807\ x\ 10^{-23} JT^{-1}$
c : Speed of light , $299792458\ ms^{-1}$
G : Gravitational constant, $6.674\ x\ 10^{-11} m^3 kg^{-1} s^{-2}$
m : Mass of black hole
r_B : Schwarzschild radius of mass ‘’m’’
l_P : Planck length, $1.6162\ x\ 10^{-35} m$
ϕ_M : Micro-state variable of black hole entropy
m_P: Planck mass , $2.176\ x\ 10^{-8} kg$