

DOI: <https://doi.org/10.24297/jap.v18i.8905>**Hawking Radiation is Nothing: Developed Correlation of Entropy with Black Hole Area****Sayed A. El-Mongy**

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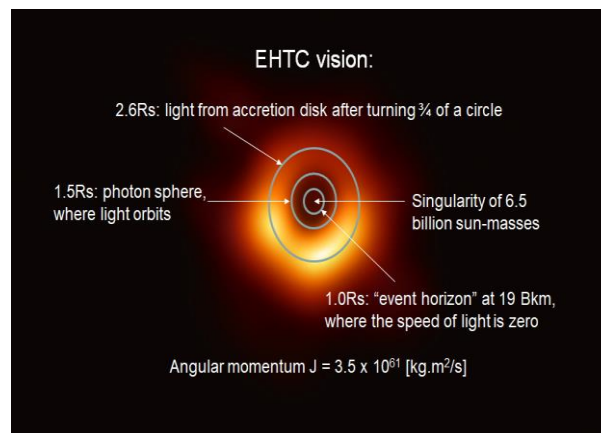
Abstract

Read is the first word and divine order in the Holy Quran. My lovely physics does not answer many mysteries in the universe including black holes. The observed ordinary matter in the universe is only ~5 %. The remaining is 27% dark matter and approximately 68% dark energy. This paper introduces a developed model and concept to black hole anatomy and entropy-surface area correlation. It considers the stationary black hole a one entity of 4 concentric spheres around the singularity. They are the event horizon, photon sphere at 1.5Rs, unstable light sphere at 2.6Rs and innermost stable particle sphere at 3Rs. An equation (Sayed Ts formula) was derived excluded heuristics of Professor S. Hawking. This formula is based on different proportional constant between entropy and black hole surface area; not $\frac{1}{4}$ as He conjectured. In spite of my respect and humanity sympathy with Prof. Hawking, his tombstone equation should be corrected. There is neither radiation escape from black holes nor any signal detected due to micro black holes evaporation. Finally, it can be stated that Hawking radiation is Nothing.

Keywords: Sayed (Ts) formula, Black hole anatomy, different entropy-surface area proportional constant.

I. Introduction

There nothing personal against anyone on the earth. This is the science. Black holes (BH) are regions of space where the gravitational effects are so strong that even light cannot escape from those regions. The existence of such regions was proposed for the first time by Michell and Laplace already in the late 18th century. Their arguments, however, were based on Newton's theory of gravitation. General relativity also predicts the existence of black holes, and the first black hole solution to Einstein's field equation was found by Schwarzschild in 1916. The term "black hole" was coined many years later in 1967 by astronomer John Wheeler (1). Using the Event Horizon Telescope -NASA, scientists obtained an image of the black hole at the center of galaxy M87, outlined by emission from hot gas swirling around it under the influence of strong gravity near its event horizon (EH). The M87 BH Photo: The blurred ring has a diameter of about 41 micro arc-seconds (μs), ranging from about 25 to 60 μs . The EHTC explains the blurred ring as radiation from the accretion disk as it is curved by the black hole in $\frac{3}{4}$ of a full circle and observed as a ring of about 2.6 Schwarzschild radii (Rs) (Fig.1). The \$29 million dollar picture, is truly remarkable and a landmark to human kind's history (1,2,3).

**Figure 1: The M87 Black Hole Photo (2)****II. Review of Paradox and Betting of Professor S. Hawking:**

In this part, some of Prof. Hawking paradox are given and summarized as follow (1,4,5,6,7,8):

- In 1971, Hawking showed under general conditions that the total area of the event horizons (EH) of any collection of classical black holes can never decrease, even if they collide and merge (2014, He said there is no event horizon – the apparent horizon is the real boundary).
- In 1974, Hawking predicted that black holes are not entirely black but emit small amounts of thermal radiation at a temperature; $T_H = \hbar c^3 / (8 \pi G M k_B)$, this effect has become known as Hawking radiation.
- In 1975 Hawking published a shocking result: if one takes quantum theory into account, it seems that black holes are not quite black! Instead, they should glow slightly with "Hawking radiation", consisting of photons, neutrinos, and to a lesser extent all sorts of massive particles. This has never been observed, since the only black holes we have evidence for are those with lots of hot gas falling into them, whose radiation would completely swamp this tiny effect.
- If black holes evaporate via Hawking radiation, a supermassive black hole with a mass of 10^{11} (100 billion) solar mass (M_\odot) will evaporate in around 2×10^{100} yrs.; vastly longer than the age of the universe; $\sim 14 \times 10^9$ yrs.
- The most massive BH in the universe, the supermassive BH (millions the mass of the Sun) will have a temperature of 1.4×10^{-14} Kelvin. Almost absolute zero. Nothing in the universe or in a lab has ever reached absolute zero as far as humans know.
- For a black hole of one solar mass ($M_\odot = 1.98892 \times 10^{30}$ kg), the evaporation time is 2.098×10^{67} yrs.
- A stellar black hole of $1 M_\odot$ has a Hawking temperature of 62 nanokelvins. This is far less than the 2.7 K temperature of the cosmic microwave background radiation.
- The power in the Hawking radiation from a solar mass BH turns out to be minuscule 10^{-28} watts. It is indeed an extremely good approximation to call such an object 'black'.
- For instance, a 1 second-lived black hole has a mass of 2.28×10^5 kg, could be released by 5×10^6 megatons of TNT. The initial power is 6.84×10^{21} W.
- A black hole of 4.5×10^{22} kg (\sim Moon mass) would be in equilibrium at 2.7 K, absorbing as much radiation as it emits. Consequently, micro black holes are predicted to be larger emitters of radiation than more massive BH and should thus shrink and dissipate faster.
- Micro BH of 10^{11} kg, will evaporate in 2.6×10^9 yr. (\sim 3 billion years), it is hot enough to emit both massless particles such as photons and massive ones; electrons and positrons.
- The first object considered to be a black hole is Cygnus X-1. Cygnus X-1 was the subject of a 1974 friendly wager between Stephen Hawking and fellow physicist Kip Thorne, with Hawking betting that the source was not a BH. In 1990, Hawking conceded defeat.
- 2001, researchers show that for a black hole with large horizon area, the correction to the Bekenstein-Hawking entropy is $^{-3/2} \log$ area.
- Hawking proposed that information is lost in black holes, and not preserved in Hawking radiation. Susskind disagreed, arguing that Hawking's conclusions violated one of the most basic scientific laws of the universe, the conservation of information. It took 28 years for Leonard Susskind to formulate his theory that would prove Hawking wrong. He then published his theory in his book, *The Black Hole War*; Hawking finally conceded that Susskind was right in 2008. (See Thorne–Hawking–Preskill bet).
- Stephen Hawking bet Gordon Kane \$100 that physicists would not discover the Higgs boson. After losing that bet when physicists detected the particle in 2012, Hawking lamented the discovery, saying it made physics less interesting.
- In 2014, Steven Hawking again shook up the astro-physics world by a paper he submitted to the Cornell University web site "arXiv, black holes simply do not have an event horizon. An apparent horizon is the real boundary. The key is that quantum effects around the black hole cause space-time to fluctuate too

wildly for a sharp boundary surface to exist. Sabine Hossenfelder, Sweden, the event horizon is a mathematically well-defined property of space-time, but it's a mathematical construct entirely. You would have to wait literally till the end of time to find out whether an event horizon really is an event horizon in the sense of this definition. Also, according to Hawking, there could even be no singularity at the core of the black hole.

- Neil Turok said that Stephen Hawking wasn't always right (Quanta magazine). This concerning the No-boundary wave function of the universe?. In 2017, Turok said in his paper, "it just seemed to be inescapable that the Hartle-Hawking proposal was a disaster.
- 2017, Hawking, had posited the idea that Earth would turn into a giant ball of fire. Therefore, humans would need to colonize another planet or face extinction.
- April 27, 2018. Hawking published online paper "A Smooth Exit from Eternal Inflation?" make predictions for the end of universe, or could prove the multiverse exists abound. It tackles the idea of a multiverse, a vast collection of universes that exist simultaneously, though they're spread out almost unimaginably far from each other. This inflation continues forever in most places, but, in some patches, it stops. Where it stops, universes form our own and others, in a repeating process that never ends.
- Current theories suggest the entropy gap to have been originally opened up by the early rapid exponential expansion of the universe. Therefore, the entropy in a specific system can decrease as long as the total entropy of the universe does not.
- Paradox in the content of his books such as; "Brief history of time", "A Grand Design".

III. Iconic and Brilliant Scientific Observations:

Here are some of the iconic discoveries and observations concerning black holes and universe (1, 9,10,11,12,13,14,15).

- 1992, Neutron stars have very high magnetic field (Magnetars) with gamma ray burst.
- In 2003, the naturally occurring ^{209}Bi was thought to be stable until its half-life was measured as 1.9×10^{19} yrs. (much longer than the age of the universe; $\sim 14 \times 10^9$ yrs.).
- Sep 19, 2014, gamma-ray bursts (GRBs) are extremely energetic explosions that have been observed in distant galaxies. They are the brightest electromagnetic events known to occur in the universe. Bursts can last from ten milliseconds to several hours. These explosions generate beams of high-energy radiation, called gamma-ray bursts (GRBs), which are considered by astronomers to be the most powerful thing in the universe.
- Apr 8, 2014, the hottest thing that we know of (and have seen) is actually a lot closer than you might think. It's right here on Earth at the Large Hadron Collider (LHC). When they smash gold particles together, for a split second, the temperature reaches 7.2 trillion degrees Fahrenheit. That's hotter than a supernova explosion.
- CERN's Large Hadron Collider may be able to create micro black holes and observe their evaporation. No such micro black hole has been observed at CERN.
- Although much progress has been made in our understanding of black hole thermodynamics, many important issues remain unresolved. Primary among these are the "black hole information paradox" and issues related to the degrees of freedom responsible for the entropy of a black hole.
- On 14 September 2015, Detection of gravitational waves from merging black holes, the LIGO gravitational wave observatory made the first-ever successful direct observation of gravitational waves. The signal was consistent with theoretical predictions for the gravitational waves produced by the merger of two black holes: one with about 36 solar masses, and the other around 29 solar masses. This observation provides the most concrete evidence for the existence of black holes to date.

- GW190521, as the 0.1-second signal has been catalogued, was produced some 7 billion years ago, when two “stellar-mass” black holes in a remote galaxy collided and merged into a 142-solar-mass behemoth – by far the heaviest black hole ever found via gravitational waves. The discovery suggests that black holes can grow through successive mergers, maybe all the way up to the supermassive ones found in the cores of galaxies.
- Intermediate-mass black holes (IMBHs) fill the gap between stellar-mass black holes produced by supernova explosions and the supermassive black holes found in galaxy cores, which can contain the mass of millions or billions of Suns. .
- 2020, invisible magnetic fields play a role in everything from star formation to galaxy evolution to black hole phenomena. But astronomers still debate what that role is (SOFIA’s HAWC+ instrument).
- August 3, 2020, Astronomers have discovered what can happen when a giant BH does not intervene in the life of a galaxy cluster. Using NASA’s Chandra X-ray Observatory and other telescopes they have shown that massive black hole behavior may explain a remarkable torrent of star formation occurring in a distant cluster of galaxies
- 2020, we’ve long known that only about 5% of the content of the universe is ordinary baryonic matter; the remainder is dark matter and dark energy. But when scientists have searched for this baryonic matter in the nearby universe, they found a puzzle: galaxies’ gas, dust, and stars only accounted for a small fraction of baryonic matter.
- Italy 2019, a trap for dark matter experiment. The longest half-life measured directly is xenon-124 with a measured half-life of 18×10^{21} yr. two neutrino electron double captures(Brandon Specktor)
- October 2020 - ESO's VLT, astronomers find monster black hole (supermassive) with 6 galaxies trapped in its gravitational spider’s Web; soon after the big bang.
- Sir Penrose has been awarded Physics Nobel Prize for his black holes studies.

IV. Anatomy of the Black Holes:

The anatomy of a black hole as we know it today is comprised of the following components (1,15,16,17):

- a) Singularity: An infinitely-dense point of mass with no volume at the center of a BH.
- b) Event Horizon: The region of gravity surrounding the black hole that is too great for even light to escape. The radius of a black hole’s event horizon is one Schwarzschild (or gravitational) Radius (1Rs)
- c) Photon Sphere: 1.5Rs away from the singularity is a shell of light photons that’s in an unstable orbit around the black hole.
- d) Shadow: Black holes distort space-time so heavily that they bend the path of light back over on itself. This effect creates a difficult to comprehend “shadow” that is 2.6Rs large.
- e) Stable Orbit: The innermost edge of the accretion disc just beyond the rim of the shadow is a stable orbit of matter 3Rs from the singularity. The innermost stable circular orbit of matter is actually at 3Rs within that all matter plummets towards the black hole never to be seen again. Light, however, has no mass and can orbit closer.
- f) Accretion Disc: There is a large disc of hot gas and matter around a black hole spinning rapidly enough to give off light.
- g) Jets: Spinning supermassive black holes can compress and expel light-years long jets of bright, hot matter.

V. Derivation of Sayed Formula (Ts):

It was suggested that the entropy (S) of a black hole is correlated to surface area (A) of the event horizon as follows (1,17,18,19,20,21):

$$S = \eta A \quad (1)$$

In 1973, Bekenstein suggested the constant to be $(\ln 2/8\pi)$. He tried to determine this constant but ended up producing a wrong value about 9 times lower: $K_{H \text{ Bekenstein}} = \ln 2 k_H / 2 \pi = 0.11035 k_H = 1/9 k_H$. However, inspired by Bekenstein's ideas, Prof. Hawking heuristically conjectured the value of the proportionality constant η to be one-quarter (1/4).

Defining, $S = 1/4 (K_B A / l_p^2)$, where the Planck length $l_p = \sqrt{(\hbar G / C^3)}$

Therefore, in the SI units, the black hole entropy can be given as;

$$S = 1/4 (k_B c^3 / \hbar G) A \quad (2)$$

This result is known as the Bekenstein-Hawking entropy law for black holes. Where \hbar is the reduced Planck constant, K_B is Boltzmann constant and G is the Newton gravitational constant.

$$\text{Surface area (A)} = 4\pi R_s^2 \quad (3)$$

Based on a model considers the black hole as one entity of five components; singularity, Event horizon (R_s), photon sphere (at $1.5R_s$), unstable photon sphere (at $2.6R_s$) and innermost stable particle of matter sphere (at $3R_s$), the surface area should be expressed and rewritten as:

$$A = 4\pi (R_s + 1.5R_s + 2.6R_s + 3R_s)^2 \quad (4)$$

Where, R_s is Schwarzschild radius. The equation 4 can be rearranged to be;

$$A = 4\pi R_s^2 (1+1.5+2.6+3)^2 \quad (5)$$

$$A = 4\pi R_s^2 (8.1)^2 = 4\pi R_s^2 (65.61) = 262.44 \pi R_s^2 \quad (6)$$

Substituting the value of $R_s = 2GM/C^2$ (it is the coordinate radius, not its proper (physical) radius), in the equation 6, where M is the black hole mass, one gets;

$$A = 262.44 \pi (2GM/C^2)^2 \quad (7)$$

$$A = 262.44 \pi (4G^2 M^2 / C^4) \quad (8)$$

$$A = 1049.76 \pi (G^2 M^2 / C^4) \quad (9)$$

The correlation between entropy (S) and surface are (A) of the black hole can be given as;

$$S = \eta (k_B C^3 / \hbar G) A \quad (10)$$

Where the constant η equals 1; not one-quarter (1/4) as He conjectured, substituting value of A of the equation 9 in the equation 10, one gets;

$$S = (K_B C^3 / \hbar G) * 1049.76 \pi (G^2 M^2 / C^4) \quad (11)$$

$$S = 1049.76 \pi (K_B C^3 / \hbar G) * (G^2 M^2 / C^4) \quad (12)$$

$$S = 1049.76 \pi (K_B G M^2 / \hbar C) \quad (13)$$

The relation between temperature, thermal energy and entropy as the differential form of the 2nd law of thermodynamics is; $dS = dQ / T$. When a particle accelerated by the gravity becomes trapped on the black hole's surface, its mass-energy increase is equal to the entropy change ($c^2 dM = T dS$). By correlating and substituting the value of S of equation 13 with the absolute temperature, it produces the following equation;

$$T = E / (1049.76 \pi K_B G M^2 / \hbar C) \quad (14)$$

The final Sayed's temperature (Ts) formula is:

- By using definition of kinetic energy; $E = 1/2 mV^2$, where $V \Rightarrow C$, one gets from equation 14:

$$T_s = \hbar C^3 / 2100 \pi K_B G M \quad (15)$$

- By using the Einstein correlation, $E = mc^2$, the equation 15 to be rewritten as;

$$T_s = \hbar C^3 / 1050 \pi K_B G M \quad (16)$$

Very soon, the scientists will be able to photo and experimentally proof my theory and predication; black holes model as one entity of 4 concentric spheres around singularity.

Conclusion

It is a matter of fact that Prof. Hawking radiation has never been detected in spite of the recent iconic and successful observation; BH photo, detection of gravitational waves due to BHs colliding, successive merging of black holes and the non-existence of micro BH at the Large Hadron Collider (LHC) in CERN. Prof. Hawking equations did not take into consideration the correct value of the proportional constant between entropy and surface area; ($S=1/4A$). Prof. Hawking paradox, betting losses and denying the event horizon existence in 2014 are crucial evidences of his wrong conjectures. Based on my model formula (T_s); the BH as one entity of 4 concentric spheres around singularity, I do not hesitate to conclude that Hawking radiation is Nothing.

Conflicts of Interest

The author has no any conflicts of interest with anyone.

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Biography



Prof. Dr. Sayed A. El-Mongy has B.Sc in physical science in 1984 from the Egypt University. He was awarded Ph.D. degree in nuclear science from Germany – Egypt in application and use of TRIGA II reactor for INAA and delayed neutron assay of fissile ^{235}U and fertile ^{238}U material. He worked as national inspector for the Egyptian nuclear facilities. He was a member of IRRS Regulatory mission and NSGC committee of the international atomic energy authority (IAEA). He was the former V. Chairman of Egypt nuclear regulatory authority. Currently, He is consultant and supervisor for nuclear affairs and member of the Egyptian Nuclear physics association. The author has long way private studies in astronomy and astrophysics.