the general science journal

Investigating observation of the Black Hole Event Horizon and its results from the point of view of the CPH Theory

Hossein Javadia

Independent researcher and founder of CPH Theory, Tehran, Iran

Javadi_hossein@hotmail.com

April 22, 2019

Abstract:

On April 21, 2019, the masterpiece of human harmony, instrumentation, and nature was shown in the first image of the black hole event horizon in the M 87 galaxy, which was called the Greatest Astronomical Event of the Century. The M 87 has a special place in the history of cosmology and the cosmological theories.

Almost simultaneously with the emergence of Einstein's general relativity and the Schwarzschild black hole equation, the M 87 galaxy attracted the attention of astronomers. When empirical evidence showed that the universe is expanding, the two theories Big Bang and the steady stable stood in front of each other and the M 87 galaxy was one of the focal points for the controversy which is still ongoing. Although the Big Bang fans claim complete victory, even by viewing the horizons of the M 87 black hole event, they cannot solve the problem of material eruption by the black hole and put off the supporters of the steady state theory that one of which was Einstein. The main problem is not in cosmic observations, the real problem is the weakness of cosmological equations that cannot explain the big bang's reason and can be interpreted on both sides of the dispute.

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In this paper, the theoretical and empirical foundations of the formation of a black hole are described, the theoretical and empirical background formulation Einstein and Friedman cosmological equations were explained. And the role of these equations with cosmic observations is described in the emergence of the two theories Big Bang and steady state. Then, by revising the Friedman cosmological equation, the reason and mechanism of the black hole explosion are described, and we will see that the two Big Bang and the Steady State theories with a bit of flexibility are adaptable, and by using this new approach, some cosmological problems can be resolved.

Keywords: A black hole, Event horizon, Big Bang, Steady State, M 87 Galaxy, General Relativity

What is a black hole and what is made of?

Throw a piece of stone toward up the top, it reaches to a certain height, when its speed reaches zero speed, returns to the ground again. The height of the stone is obeyed of the primitive speed and gravity intensity of the earth. For that a stone to go to space and not back to Earth, its initial speed should be more than 11.2 k m/s, which is called the escape velocity from the earth. The escape velocity from the Moon is about 2.4 km/s, and from the Sun is 618 km/s. The intensity of gravity on the surface of the moon is so low that has not the atmosphere. But the Earth can keep some gases, including oxygen and nitrogen, but it cannot prevent hydrogen escape. That's why the Earth has the atmosphere. Gases in the Earth's atmosphere are constantly moving in and colliding with each other, and some molecules may reach to escape velocity and leave the atmosphere. Also, the atmosphere of the Earth has a small amount of hydrogen gas and even dust of minerals and heavy metals such as lead.

The Sun is composed of approximately 73% hydrogen and 25% helium, and the remaining 2 percent contain elements such as oxygen, carbon, neon, iron, and the like. The intensity of gravity at the Sun's surface is such that it prevents the hydrogen escape, which is the lightest element. But the light with the speed 300,000 km/s escapes from the Sun, but in the Solar storms particles such as electrons, protons, and alpha (helium nuclei) are emitted from the Sun. Solar storms in the collision with the high Earth's atmosphere create Aurora. The star is formed when a large amount of gas, which is almost hydrogen, is collapsed by gravity and its atoms collide rapidly and the heat of the gas rises. Eventually, the gas is so hot that hydrogen atoms collide with each other instead of dispersing, they combine and forms helium. The heat released in this reaction is a star's radiation. This thermal radiation, such as gas pressure, increases to an equal degree that can stop the gravity compression of the gas. The stars are balanced with the gravity and the heat generated from the nuclear interactions and are stable for a long time.

However, the star eventually loses hydrogen and other fuel materials. The star with more fuel matter at the start, it will sooner be silenced. Because whatever the star is more massive, it requires more heat to balance gravity, and the more heat it will, the sooner it will consume its own fuel. After Newtonian mechanics was used as the celestial mechanic in recognizing the universe, one of the things which were considered, was the black hole. For the first time in 1784, "John Michell understood the concept of "escape velocity," and that this critical speed would be determined by the mass and size of the star. Specifically, Michell pondered what would happen if a star were so massive, and its gravity so strong, that the escape velocity was equivalent to the speed of light." [1] Independently, In 1796, Laplace claimed that light could not escape from the great stars, and called them "black bodies" [2] In fact, the term black hole was first introduced by John Wheeler in a speech in 1967. [2] At Laplace's time, the theory of light particle proposed by Newton was used and approximately scientists have known the speed of light, but the speed limit was not the speed of light. Because in the Newtonian mechanics was acceptable the infinite speeds. But in the late nineteenth century, the speed of light was completely determined and measured, and light wave theory was accepted. After explaining the photoelectric effect by Einstein, the wave-particle duality of the light theory accepted. In 1915, Einstein, by presenting the theory of general relativity, showed that the space around the celestial bodies was curved and replaced Newton's gravitational law by the geometric properties of space and called it space-time. A few months later, Carl Schwarzschild, with the solution of the Einstein field equation for a point mass, states that, from a theoretical standpoint, there are black holes. [2] After Schwarzschild, independently, a Lorentz student named Johannes Droste came to the same conclusions as Schwarzschild. [3]

In 1931, Chandrasekhar, a student of Edington using quantum mechanics, showed that if the speed of escape would be greater than the speed of light, the mass of the star should be at least 1.44 times the mass of the sun, which is called the Chandrasekhar limit. [4] Chandra's work was a turning point in the history of black holes because his argument was based on the properties of subatomic particles. He began with the question; how much the star's mass should be, which, after its fuel reaching the end, is still able to withstand its gravity? The summary was this: When the star becomes small, its particles become much closer together and then, according to Pauli's exclusion principle, such particles should have very different speeds. This difference in velocities causes them to be separated from each other, and thus extends the star. In this expansion, the star's sphere rises to a point where the gravity and force of the repulsive force caused by the Pauli exclusion principle are balanced and the radius of the star's sphere is stabilized to such an extent. Which is exactly the same as the events of the star's life, in which star gravity is balanced by the radiation pressure from nuclear fusion?

However, Chandrasekhar concluded that there is a limit to the repulsive forces that the principle of exclusion determines. The theory of general relativity limits the maximum difference between the velocities of the particles in the star at speed of light, which means that when the star is sufficiently dense, the repulsive force from the principle of exclusion will be less than gravity. Chandrasekhar had calculated that a cold star, whose mass is more than 1.44 times that of the sun, would collapse. Almost at the same time, such exploration was carried out by the Russian scientist Lev Davidovich Landau. These discoveries implied serious implications in relation to the final fate of stupendous stars. If the mass of the star is less than the Chandrasekhar limit, then that star can finally end its compactness, and possibly fall like a white dwarf, with a radius of several thousand kilometers and a specific density of several hundred tons per cubic cube. Einstein never accepted the existence of a black hole. In an article published in 1939, he attempted to prove that the gravity of black holes - dense celestial objects - do not stop light escaping. [5] But several months later, Oppenheimer with his student Snyder predicted that a massive star would collapse into gravity and become a black hole. [6] At the beginning of World War II, the issue of black holes was forgotten. In the 1960s, the theory of black holes and the Schwarzschild solution, also the gravitational collapse were researched by physicists. In 1971, Stephen Hawking said that the black hole event occurred when the universe began its big bang. When all the ingredients in the universe exploded, some of these materials were squeezed so much that they turned into a black hole. [2] He even provided a formula for the entropy of black holes, the entropy of a black hole must be overseen by a black hole observer to comply with thermodynamic laws. [2]

Event Horizon: The ‘event horizon’ is the boundary defining the region of space around a black hole from which nothing (not even light) can escape. Event horizon: simply, the event horizon is boundary (an area of space-time and outside of a black hole) between a visible and invisible space from the viewpoint of an external observer. Any object or particle that passes through the event horizon and enters the black hole space is invisible to the exterior observer (Figure 1).

Singularity: Singularity is a region in space in which the material density or the curvature of space-time is infinite. In such a zone, the standard concepts of space and time become meaningless (Figure 1).

“Singularities are regions of space where the density of matter, or the curvature of spacetime, becomes infinite. In such locales, the standard concepts of space and time cease to have any meaning. Singularities are predicted to occur in all black holes and also in certain models of the Universe. For example, open Friedmann models of the Universe possess a singularity in the finite past, while the closed models have both an initial and final singularity. In general, cosmic censorship hides singularities behind event horizons, the exception being the initial singularity of the Big Bang.” [7]

In Hawking's definition of singularity, gravitational singularity, or gravitational space-time, is the place where the values used to measure gravity fields are infinite and do not depend on the coordinate system. In the singularity of the volume is reduced, the density of particles will be infinite, in which all the laws of physics are ineffective. With regard to general relativity, the initial state of the universe began with the explosion of a singularity or the big bang. [8] However, Hawking later reconsidered the claim that general relativity was ineffective during the Big Bang, saying that singularity is not predictable with general relativity. [9]

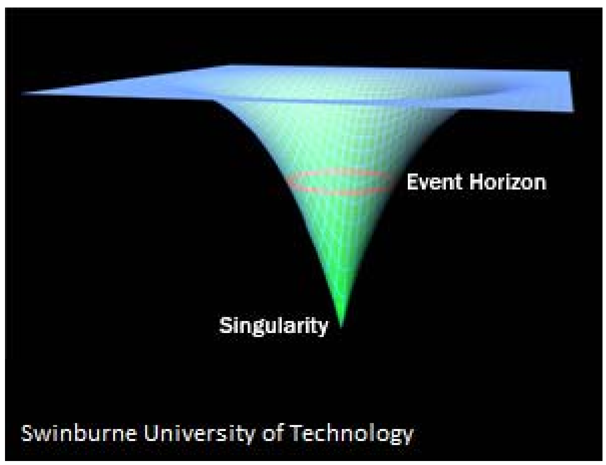

Fig. 1; Black hole areas

Cosmological equations and universe expansion

A static universe is a cosmological model in which the universe is both spatially infinite and temporally infinite, and space is neither expanding nor contracting. Such a universe does not have spatial curvature; that is to say that it is 'flat'.

A static infinite universe was first proposed by Giordano Bruno: “The universe is then one, infinite, immobile.... It is not capable of comprehension and therefore is endless and limitless, and to that extent infinite and indeterminable, and consequently immobile”. [10] Einstein, like his predecessor (Bruno and Newton), believed in a static universe. In order to obtain his cosmological model in 1917, Einstein presented three assumptions that were beyond the scope of his equations [11]:

1 - The material has a moderate density in space that is constant and is not zero everywhere.

2 - The magnitude of the space radius does not depend on time, which is in accordance with the first assumption.

3 - The universe is generally static - for example, its broad properties do not change with time.

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When Einstein, using general relativity, studied the universe in large scale, Einstein even achieved a mathematical relation for the radius of the universe. In Einstein's equation, there are two constant coefficients, one gravitational constant, and the other the speed of light, which do not play any role in the interpretation of the equation.

But the radius and density of the universe that appeared on both sides of the relation shows the dependence of these two quantities. Increasing the radius is equivalent to decreasing the density and short radius, synonymous with increasing the density of the universe. These results are the collapse or the unlimited expansion of the universe. He realized that his equation predicted a universe of expansion or compaction that was not consistent with the astronomical observations of that time.

He modified the equation to be consistent with the observations. This correction was in accordance with the assumption that a constant pressure has penetrated the entire universe (it balances the universe and prevents its expansion or compression). This universal pressure is called a cosmological constant and is represented by Λ (lambda) and presented its cosmological equation. Friedman, the Russian physicist, and mathematician, carefully reviewed Einstein's cosmological equation and in 1922 showed that if the second assumption (the constancy of magnitude the radius of universe) be neglected, the first assumption can be maintained, without the need for the cosmological constant in the equation. That is, the average magnitude of density can be considered the same in all space, but the radius of the universe was assumed to be time dependent. Friedman presented a differential equation with such assumptions. [12] "All three Friedmann models give R = 0 in the past. This hints that Universe did not exist forever but was born some time ago from a point (a singularity)." [13] In other words, Friedmann raised the possibility of a dynamic universe, which changes in size over time. Einstein wrote a short note in the German Physics Journal, Zeitschrift fur Physik, calling Friedmann's non-stationary world "suspicious." Friedmann immediately sent the great physicist an extended letter detailing his work. Six months later, Einstein wrote in the journal:". . . my criticism . . . was based on an error in my calculations. I consider that Mr. Friedmann's results are correct and shed new light." [14] In 1925, Edwin Hubble, at the Wilson Observatory, by studying astronomical observations, the galaxies are moving away from us (the Earth). The farther away the galaxies are moving away from us faster and this means the universe is expanding! (15) Indeed, years before Hubble discovered the expansion of space, Friedman had precisely predicted his discoveries.

Universe expansion: the Big Bang and the Steady State Theories

The expanding universe has shown that the expansion was started at a moment in space. The Big Bang theory was originally presented by a Belgian priest and physicist named George Lemaitre in 1927. According to this theory universe that we are seeing, 13.7 billion years ago with an explosion, threw all the things in the universe all around. And the universe was created. Lemaitre's theory after observing a red shift in distant nebulae (large massive gases) by astronomers, as a model based on the theory of general relativity for the universe was proposed. The next step was taken by the Russian immigrant George Gamow and former Friedman student with a nuclear physics specialization. Gamov and Ralph Alfer explained the formation of atoms after the Big Bang by publishing an article. In addition, Gamow predicted the existence of the cosmic microwave background (CMB radiation from the Big Bang). The Big Bang theory was firmly endorsed the cosmic microwave background were discovered in 1964 by Arno Penzias and Robert Wilson. They were awarded the Nobel Prize for this discovery. Since then, the Big Bang theory has been widely accepted. [16]

In 1948, before Gamov's work and the discovery of the cosmic microwave background, Fred Hoyle, Hermann Bondi, and Thomas Gold who were dissatisfied with Lemaitre's theory (and Hoyle called it "big bang" to ridicule it) propose the steady state theory. The founders of the steady state theory accepted the expanding universe and they claimed that by distancing the galaxies from each other due to the expanding the universe, the new substance is created in the form of hydrogen in the space between them. New hydrons eventually create new galaxies. [17] However, Hoyle has mocked Lemaitre theory, but after accepting it, the title of the Big Bang theory came into account. There is "an unpublished manuscript by Albert Einstein in which he attempted to construct a 'steady-state' model of the universe. The manuscript, which appears to have been written in early 1931, demonstrates that Einstein once explored a cosmic model in which the mean density of matter in an expanding universe is maintained constant by the continuous formation of matter from empty space." [18] Therefore, both groups, advocates of the Big Bang theory and the supporters of the Steady State, were unanimous about the expansion of the universe, because it was consistent with astronomical observations. "Fred Hoyle constructed a steady-state model of the cosmos by means of a daring modification of the Einstein field equations. Replacing Einstein's cosmological constant (Lambda Λ) with a scalar field Cik, representing the continuous creation of matter from the vacuum." [18] Big Bang's theory, especially after the discovery of the microwave background, seemed to be more real than the steady state theory of the universe. In the Big Bang theory, all material in the universe has emerged from nothing, later, Hawking claimed that the universe arose from a gravitational singularity which was past and invisible, but the creation of a new substance could be supported by empirical evidence. The more we look at the depth of the cosmos, in fact, we look at the depth of the past. A star that is 10 light years away from us, as we see it, it was 10 years before. The farthest objects that humans can observe with astronomical telescopes are quasars. A quasar is a member of a variety of star-shaped groups which has exceptional red beams and often broadcast radio frequencies and visible light waves. Can the creation of a new substance be seen in very distant parts of the universe, including in the quasars area? Finding such evidence could be a strong reason to invalidate the Big Bang theory.

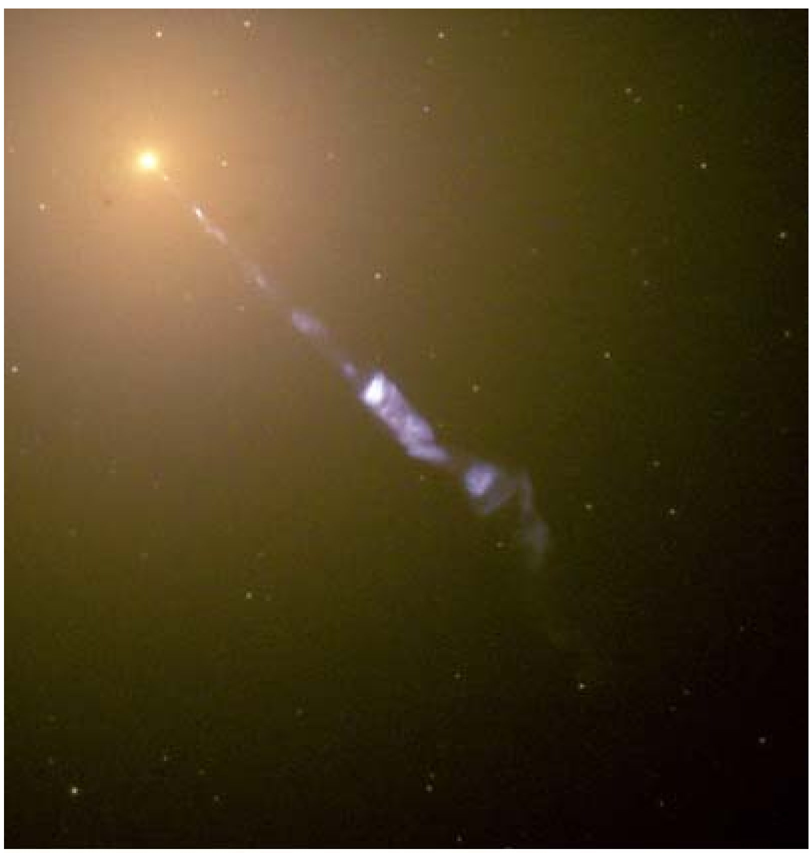
"Halton Arp was a thorn in the side of those who held to the standard story line of the big bang. In many papers and several books, he promoted the idea that quasars are born from the nucleus of active galaxies-parent galaxies. In the standard big bang model their very large redshifts are interpreted according to the Hubble Law to mean they are the most distant sources in the universe. According to Arp's alternative model, evidence strongly suggests that they are associated with relatively nearby active galaxies and that they have been ejected from those parent galaxies." [19]

Universe Expansion and M 87 Galaxy

During the 1950s, clear radio sources, now known as quasars, was discovered that they did not seem to have an optical counterpart and astronomers could not explain them, because their spectrum was not characterized by any atomic or molecular spectra. In 1963, Maarten Schmidt studied one of these strong radio sources called 3C 273 (later known as quasar 3C 273) and discovered that its range belongs to the hydrogen emission lines, but its redshift was very high. The redshift indicates that the source is moving at a very fast pace. This great speed prevented any clear explanation. Schmidt noted that the redshift, as defined in Hubble's law, is also associated with the expansion of the universe. If the redshift measured was due to expansion, then the desired source should be very far away. So it has an extraordinary luminance that is just as far beyond anything. This intense glow also explains the great radio signal. Schmidt has come to the conclusion that the quasars are very far and very interesting. [20]

In 1966, Halton Arp released a collection of images of strange galaxies that contained photos of 338 galaxies which were closer to us. They were not in the category of any of the classic galaxies. Articles and books of the arp are the most important sources of astronomical observations in cosmology. The observations and basic Halton Arp data on quasars and galaxies were not consistent with the Big Bang theory. Scientists believed that Arp data was incorrect and rejected. In fact, Arp claimed that the universe is eternal. Therefore, the Steady State theory required experimental confirmation. And this was something that could have benefited from Halton Arp observations and data. Halton Arp has analyzed his observations and data and wrote: "Everything created instantly out of nothing. It had a point beginning and we were right there!" [21]

“Galaxies, like a group of animals, reveal at a glance all stages of birth, growth and maturity. Take one example. M 87 is a famous galaxy near the center of our Local Super Cluster. In 1918, even before the recognition of galaxies, it was observed with a small telescope to have a blue spike coming out of its center. With the most expensive modern day telescope, the Hubble Space Telescope, Fig. 2 shows this spike contains a number of small, compact objects. These objects are radiating a continuous spectrum of synchrotron (charged particle) radiation. The conventional view is that they are clouds of hot gas ejected from the nucleus with about the speed of light (observed from displacement over time). But how do you accelerate a cloud of hot gas to velocity near c? How do you get a hold of it? And why does it not just go POOF and dissipate? Even more revealing, one sees these objects grow in size and luminosity as they move outward along the jet.” [21]



A 1998 Hubble image shows the relatavistic jet escaping Virgo A (M87).
Credit: J. A. Biretta et al., Hubble Heritage Team (STScI /AURA), NASA

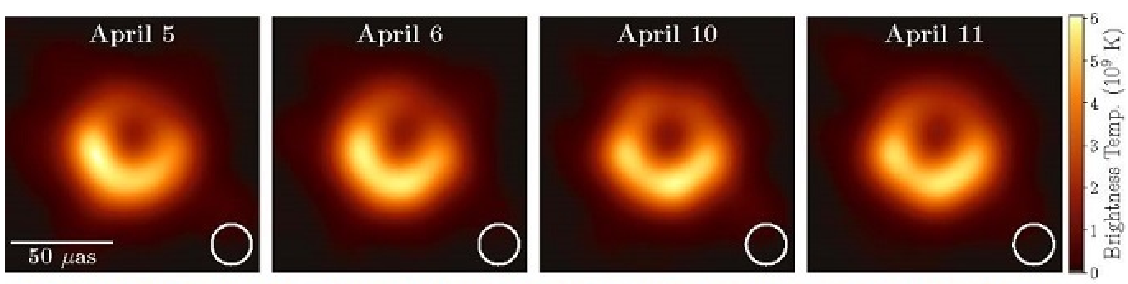
Fig.2: The image of the Hubble Space Telescope comes from an eruption from the M 87 galaxy. Plasmids (a coherent structure of plasma and magnetic field) move at a speed close to the speed of light C and become brighter

He cited an example of the M84 galaxy and explained: "So we have spread out before us a more or less complete empirical demonstration of how galaxies are born and evolve. As the variable mass theory requires, the emergence of new matter near m = 0 requires speeds of pure energy near c. As the particle masses grow they slow down in order to conserve momentum in the extragalactic rest frame. That means the elementary particles cool. Together with the increasing gravity the growing matter condenses into a proto quasar/galaxy." [21] Halton Arp observations and data are very wide and include many things like; the galaxies that make stars: Arp 299, Arp 273, collision galaxies: Arp 256, and the galaxies are swallowed up by one another. [22] Halton Arp has written: "It is a cruel fact of life that whatever the current official theory is, it must explain all the observed facts. A single, well-founded contradictory observation will suffice to topple the whole edifice. But we have seen that the conventional theory that galaxy redshifts can only be due to Doppler velocity has been violated not just once, but in numerous, independent instances." [23]

Opponents of the theory of the Steady State have their own reasons [24] which are outside the discussion of this article. In this paper, after reviewing and analyzing the unveiling of the black hole event horizon of the galaxy M 87, the problems of both theories and their solutions are presented.

Event horizon telescope observations and its results

“This Focus Issue shows ultra-high angular resolution images of radio emission from the supermassive black hole believed to lie at the heart of galaxy M 87 (Figure 3). A defining feature of the images is an irregular but clear bright ring, whose size and shape agree closely with the expected lensed photon orbit of a 6.5 billion solar mass black hole. Soon after Einstein introduced general relativity, theorists derived the full analytic form of the photon orbit, and first simulated its lensed appearance in the 1970s. By the 2000s, it was possible to sketch the "shadow" formed in the image when synchrotron emission from an optically thin accretion flow is lensed in the black hole's gravity. During this time, observational evidence began to build for the existence of black holes at the centers of active galaxies, and in our own Milky Way. In particular, a steady progression in radio astronomy enabled very long baseline interferometry (VLBI) observations at ever-shorter wavelengths, targeting supermassive black holes with the largest apparent event horizons: M 87, and Sgr A* in the Galactic Center. The compact sizes of these two sources were confirmed by studies at 1.3mm, first exploiting baselines that ran from Hawai'i to the mainland US, then with increased resolution on baselines to Spain and Chile.” [25]



EHT images of M87 on four different observing nights. In each panel, the white circle shows the resolution of the EHT. All four images are dominated by a bright ring with enhanced emission in the south. From Paper IV (Figure 15).

https://iopscience-event-horizon.s3.amazonaws.com/journal/2041-8205/page/img/focus_figure_1_resized.jpg

Fig.3: The images of the black hole event horizons of the Galaxy M 87 in four consecutive days

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"Over the past decade, the EHT extended these first measurements of size to mount the more ambitious campaign of imaging the shadow itself. During 5-11 April 2017, the Event Horizon Telescope (EHT) observed M 87 and calibrators on four separate days using an array that included eight radio telescopes at six geographic locations: Arizona (USA), Chile, Hawai'i (USA), Mexico, the South Pole, and Spain (Figure 4). Years of preparation (and an astonishing spate of planet-wide good weather) paid off with an extraordinary multi-petabyte yield of data. The results presented here, from observations through images to interpretation, issue from a team of instrument, algorithm, software, modeling, and theoretical experts, following a tremendous effort by a group of scientists that span all career stages, from undergraduates to senior members of the field. More than 200 members from 59 institutes in 20 countries and regions have devoted years to the effort, all unified by a common scientific vision." [25]

A map of the EHT. Stations active in 2017 and 2018 are shown with connecting lines and labeled in yellow, sites in commission are labeled in green, and legacy sites are labeled in red.

https://iopscience-event-horizon.s3.amazonaws.com/journal/2041-8205/page/img/focus_figure_2_resized.jpg

Fig.4: A collection of 8 telescopes in 6 geographic locations created a virtual telescope for the event horizon

"The sequence of Letters in this issue provides the full scope of the project and the conclusions drawn to date. Paper II opens with a description of the EHT array, the technical developments that enabled precursor detections, and the full range of observations reported here. Through the deployment of novel instrumentation at existing facilities, the collaboration created a new telescope with unique capabilities for black hole imaging. Paper III details the observations, data processing, calibration algorithms, and rigorous validation protocols for the final data products used for analysis. Paper IV gives the full process and approach to image reconstruction. The final images emerged after a rigorous evaluation of traditional imaging algorithms and new techniques tailored to the EHT instrument--alongside many months of testing the imaging algorithms through the analysis of synthetic data sets. Paper V uses newly assembled libraries of general relativistic magnetohydrodynamic (GRMHD) simulations and advanced ray-tracing to analyze the images and data in the context of black hole accretion and jet-launching. Paper VI employs model fits, comparison of simulations to data, and feature extraction from images to derive formal estimates of the lensed emission ring size and shape, black hole mass, and constraints on the nature of the black hole and the space-time surrounding it. Paper I is a concise summary.” [25]

“Our image of the shadow confines the mass of M 87 to within its photon orbit, providing the strongest case for the existence of supermassive black holes. These observations are consistent with Doppler brightening of relativistically moving plasma close to the black hole lensed around the photon orbit. They strengthen the fundamental connection between active galactic nuclei and central engines powered by accreting black holes through an entirely new approach. In the coming years, the EHT Collaboration will extend efforts to include full polarimetry, mapping of magnetic fields on horizon scales, investigations of time variability, and increased resolution through shorter wavelength observations.” [25]

“In short, this work signals the development of a new field of research in astronomy and physics as we zero in on precision images of black holes on horizon scales. The prospects for sharpening our focus even further are excellent.” [25]

Great questions that the black hole event horizon has not responded to

Erin Benning, an astrophysicist, and researcher for the black hole did answer these questions:

Q1: How do black holes produce their enormous jets of hot, fast matter?

“All supermassive black holes have the ability to chew up nearby matter, absorb most of it past their event horizons, and spit the remainder out into space at near light speed in blazing towers astrophysicists call "relativistic jets”. (Figure 5) And the black hole at the center of Virgo A (also called Messier 87 or M 87) is notorious for its impressive jets, spewing matter and radiation all over space. Its relativistic jets are so huge that they can fully escape the surrounding galaxy. And physicists know the broad strokes of how this happens: The material accelerates to extreme speeds as it falls into the black hole's gravity well, then some of it escapes while retaining that inertia. But scientists disagree about the details of how this happens. This image and the associated papers don't yet offer any details.” [26]

“Figuring that out, Bonning said, will be a matter of linking up Event Horizons Telescope observations - which cover a fairly small amount of space — with the much bigger images of relativistic jets. While physicists don't yet have answers, she said, there's a good chance that they'll come soon - especially once the collaboration produces images of its second target: the supermassive black hole Sagittarius A* at the center of our own galaxy, which doesn't produce jets like Virgo A's. Comparing the two images, she said, might offer some clarity.” [26]

Q2: How do general relativity and quantum mechanics fit together?

“Whenever physicists get together to talk about a really exciting new discovery, you can expect to hear someone suggest that it might help explain "quantum gravity”. That's because quantum gravity is the great unknown in physics. For about a century, physicists have worked using two different sets of rules: General relativity, which covers very big things like gravity, and quantum mechanics, which covers very small things. The problem is, those two rulebooks directly contradict one another. Quantum mechanics can't explain gravity, and relativity can't explain quantum behavior.” [26]

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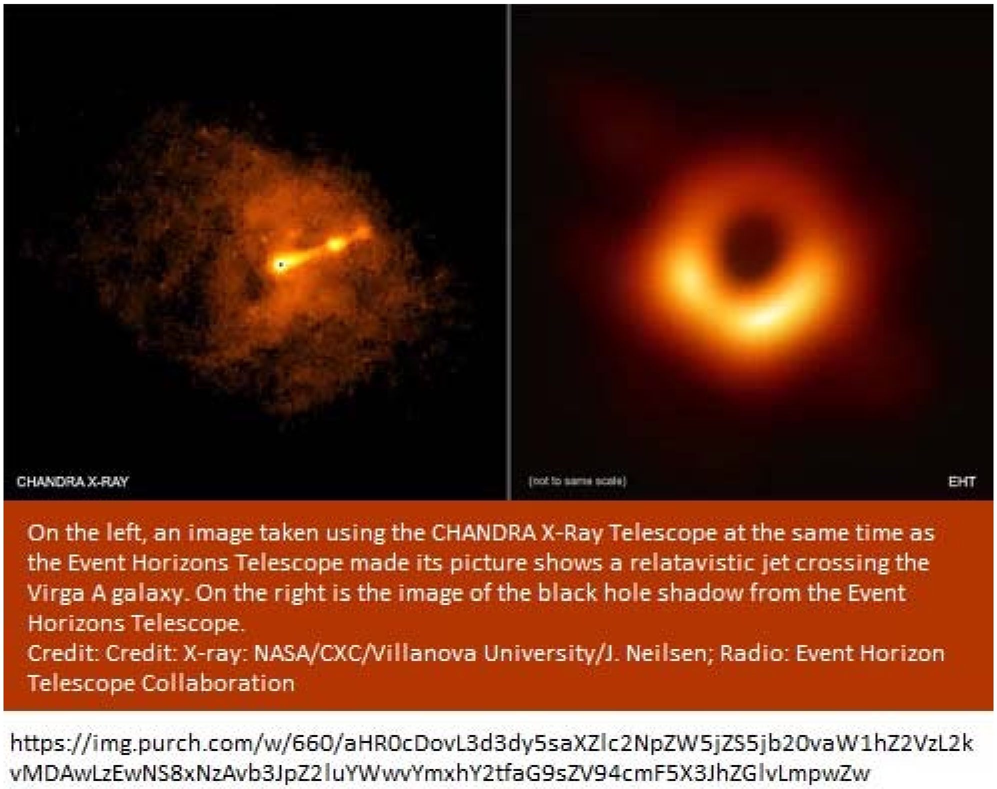

Fig.5: The left side of the image taken by the X-ray Chandra telescope simultaneously with the horizon telescope and the right side of the image taken by the horizon telescope of the event

Q3: Were Stephen Hawking's theories as correct as Einstein's?

“The physicist Stephen Hawking's greatest early-career contribution to physics was the idea of "Hawking radiation" - that black holes aren't actually black, but emit small amounts of radiation over time. The result was hugely important, because it showed that once a black hole stops growing, it will start to very slowly shrink from the energy loss.But the Event Horizons Telescope didn't confirm or deny this theory, Bonning said, not that anyone expected it to. Giant black holes like the one in Virgo A, she said, emit only minimal amounts of Hawking radiation compared to their overall size. While our most advanced instruments can now detect the bright lights of their event horizons, there's little chance that they will ever tease out the ultra-dim glow of a supermassive black hole's surface.” [26]

Overlap and differences between the Big Bang and Steady State theories

To know what happens in a black hole, how the material explodes and erupts out from the black hole, we have two methods, the first is to look inside the black hole and explain that is impossible. So there is only one way, better understand the particles that the black hole is formed up of and describe how they can behave in the black hole's conditions. Therefore, we need to focus more precisely on the existing theories and generalize them, and to better understand the structure and properties of fundamental particles. Then explaining how fundamental particles can (and should) behave in a very high gravity pressure. To solve the theories problems, we should examine their overlap and differences, do referee them by experimental evidence. And keep which is acceptable, modify which needs and reject others.

Vacuum energy: Both the Big Bang and the Steady State theories assume that matter comes from nothing (from space) that was accepted by Einstein. Unlike classical mechanics in quantum mechanics: "The quantum vacuum is not really empty. It is filled with virtual particles which are in a continuous state of fluctuation. Virtual particle-antiparticle pairs are created from the vacuum and annihilated back to it. These virtual particles exist for a time dictated by Heisenberg uncertainty relation. Based on the uncertainty relations, or any virtual particle, there is a limit on the timescale of “being” created from the vacuum fluctuations and then annihilated back to vacuum (its “lifetime”); thus, there should be a limit on the frequency of the virtual particles whose total energies is considered as the vacuum energy. In quantum (field) theory, it is well-known that the reason for naming the quantum vacuum particles as virtual particles is that although they are in “existence” and can have observable effects (e.g. the Casimir effect, spontaneous emission, Lamb shift), they cannot be directly detected (i.e. they are unobservable)". [27] To solve this problem, we should describe the quantum vacuum energy without using the principle of uncertainty.

The weakness of the cosmological equations: The advocates of each of the two Big Bang Steady State theories have their own selective interpretations of cosmological equations. Einstein's and Friedman's cosmological equations are unable to explain the zero moments of an explosion and before it. By revising the cosmological equations, these equations can be solved at zero instant and explain the reason and mechanism of the explosion.

Gravity and the puzzle particle mass: In modern physics, after the big bang, all particles were massless and moving at a speed of light (perhaps faster than the speed of light). As the particles cooled and lost energy, they were acquired masses by interaction with the Higgs field. [28] This is a description of the fundamental particles in the standard model that was introduced in the 1970s. But in the 1950s and 1960s, as yet the standard model and the Higgs field theory were not provided, physicists were described particles masses in the absence of the Higgs theory. For example, remember that Halton Arp wrote: : "As the variable mass theory requires, the emergence of new matter near m = 0 requires speeds of pure energy near c. As the particle masses grow they slow down in order to conserve momentum in the extragalactic rest frame. That means the elementary particles cool." [21]

The three above items are important in modern physics and astrophysics. In the following, by introducing the principles of CPH theory, the above items are discussed and solutions are presented. The difference between a black hole and an ordinary star or a planet are mass and the amount of escape velocity from their surface. Differences between the amount of escape velocity and mass distinguish the black hole from other celestial objects and prevent seeing a black hole. So concentrating on the amount of velocity and mass can lead us to new and exciting solutions.

Bases of the theory of CPH

Creative Particles of Higgs Theory or CPH Theory was presented to explain the common properties of mass, energy, and force. A scientific theory is to answer one or more questions because if no one is looking for an answer until a question is raised. I also had questions that modern physics could not answer. So I should find the answer to them and I did.

This process lasted twenty-five years (from 1962 to 11987) [29], and I combined $F = ma$ and $E = mc^2$ together and obtained a new equation $\nabla V_{CPH} = 0$. Unlike classical mechanics and relativity, this equation defined the acceleration in relation to the structure of particles, which became the link between classical mechanics and modern physics. [30] This approach contrasted with the principles of modern physics, because in quantum mechanics fundamental particles, including photons and electrons, are point-like and unstructured. The result of the new approach can be as follows: all thing in the universe is made of a very small unit of energy, which its amount of speed and mass are constant and never change. That is, external force does not change the amount of speed, and only converts linear speed to nonlinear and vice versa. For this reason, speed has the limit, and in the observable, the maximum speed is the speed of light. This result was very important and promising, since the principle of special relativity, as previously expressed by Einstein, resulted independently and with the use of the new definition of acceleration.

A new scientific theory must have three characteristics: first, it must be able to cover existing theories. Second, it answers the questions that existing theories can not answer. Third, it must anticipate phenomena that have not yet seen. In the first step, I tried to explain known phenomena by using the equation presented. I realized that this equation has high efficiency and describes the physical phenomena much simpler than modern physics. Using this equation, I looked at the gravitational redshift (and blueshift), and reconsidered the Mossbauer effect and the Pound–Rebka experiment, and explained the photon structure. [31] Then I reviewed and generalized the Dirac equation and sea, and I found the same properties in the photon structured as I had in reviewing the Pound–Rebka experiment. In addition, I realized that the properties of interactions from the photon structure to the fermions and bosons can be generalized and vice versa. [32] The result of this review was that photon not only has a structure, but it also is a very weak electromagnetic dipole. But the structure and properties of the electromagnetic dipole of photons were in conflict with modern physics. My hope was that eventually this feature of the photon would be confirmed in the experiment. Finally, in 2016, the following results were obtained in an experiment at the Centre for Quantum Technologies at the National University of Singapore: the photon has two different shapes and is four meters long, and the probability of photon absorption by the atom is about four percent. [33] These results are entirely consistent with the prediction of CPH theory. Because the photon moves at the speed of light, it is absorbable by an electron which is electrically located in a position to be electrically absorbed.

Recently, in a quantum simulation by physicists at the Federal Institute of Lausanne in Switzerland, it was determined that the photon behaves like a magnetic dipole. [34]

But electricity and magnetism are not separate, that is, a photon is a very weak electromagnetic dipole, which was predicted in CPH Theory. Today, physics and astrophysics are involved with fundamental problems, and physicists believe that this is due to the inability of theories. [35] All these problems stem from the fact that the photon has mass while in modern physics, the photon is assumed to be massless. Notice that the massless photon is only an assumption without experimental support, and this is the biggest unresolved mystery in physics. [36] While in CPH Theory, the photon consists of particles with constant mass and constant amount of speed. What is its physical explanation for a particle structure such as photon and electron? That is, with nonlinear motion, for example, rotational movement spin ... they never stick to each other. In fact, there are two sub-quantum types of positive and negative energies, in increasing the energy of the photon, the number of sub-quantum energies increases in the photon structure. For this reason, the energy and frequency of photons are directly related. [31] Sub-quantum energies do not stick with each other. If they stick to each other, the whole of the universe was an object, hard object, while it is not. We are in a position that according to the CPH Theory, we can answer the huge questions that not answered by the image of the black hole event horizon.

Q1: How do black holes produce their enormous jets of hot, fast matter?

The CPH Theory's answer: In the CPH Theory, there are two types of black holes with two different singularities, normal black holes, and absolute black holes. Note that all subatomic particles are made up of sub-quantum energies. When a black hole is formed, the distance between the sub-quantum energies within it is reduced, that is, the distance between sub-quantum energies in a black hole is much shorter than of stars. For this reason, when a star collapses its volume decreases. The black hole becomes more compact by absorbing more matter and as much as absorbing more matter, more compressed and reduced volume. As the volume drops, the distance between the sub-quantum energies decreases as far as goes towards zero. In this case, the black hole not only prevents light from escaping, even eats itself gravity effect. That is, the event horizon is not observable, and never the external observer feels the gravity effect. because as soon as the external observer feels the gravitational effect, swallowed and disintegrated. An external observer can be an atom, star, or even a galaxy (in papers and books, I have described these cases scientifically), such a black hole is an absolute black hole. The escape velocity at the surface of the black hole is greater than the speed of light, but at the surface of the absolute black hole, the light cannot separate from its surface, it means the speed of light is zero on the surface of the absolute black hole. In this case, the absolute black hole is in a critical condition. As soon as a significant amount of matter is absorbed, the distance between the sub-quantum energies in the part of the absolute black hole reaches to zero, like rotating discs collide and the chain explosions are started everywhere inside of the absolute black hole. In a very small fraction of a second, the absolute black hole explodes, and sub-quantum energies are scattered on every side faster than the speed of light. In this case, the Friedman cosmological equation was reviewed and the reason the Big Bang and even before of Big Bang was explained. [37]

M87 black hole and eruption material: The M 87 black hole is supermassive, but from the point of view of the CPH Theory, it is a normal black hole. When a lot of matter falls in the black hole, breaks down and with the high speed (comparable to the speed of light) reaches to surface of the black hole. As soon as matter enters the black hole collides with matter inside the black hole, if the amount of input matter is sufficient, due to the collision with a part of the substance inside the black hole, a small part of the black hole explodes. And the nonlinear motion of sub-quantum energies part of the matter which can be a combination of the previous matter and the landing matter becomes the linear motion, and at the speed of light or even faster light speed erupts outside of the black hole and it event horizon.

Halton Arp wrote: : "the emergence of new matter near m = 0 requires speeds of pure energy near c. As the particle masses grow they slow down in order to conserve momentum in the extragalactic rest frame". [21] From the point of view of CPH Theory, this is not true, due to radiation the mass and speed of matter are reduced. This approach is also compatible with relativistic mass and that can be explained by the relativistic Newton's second law which was revised in the CPH Theory with a new definition of acceleration. [38]

Q2: How do general relativity and quantum mechanics fit together?

The CPH Theory's answer: Relativity (both specific and general) is an observational theory, for this reason, the observer has a very important role in relativity. While quantum mechanics is an interpretive theory. Quantum mechanics is a mathematical framework consisting of operators. Even the combination of special relativity with quantum mechanics is associated with its own particular problems. For example, in quantum electrodynamics, the mechanism of producing an electric field by charged particles is not explained, and the mechanism of interaction between the charged particles has not described. For example, in the Feynman diagram, the pair production and decay electron-positrons (as in other Feynman diagrams) are only drawn input and output. While in CPH Theory, first, the structure of particles and how they are produced are explained. Then the field production mechanism is explained by the particles. The mechanism of interactions between particles is explained. Finally, according to these descriptions, operators are made and introduced. [32] Therefore, one cannot combine a theory of observation with an interpretive theory. Another problem is that in modern physics, physicists are trying to combine general relativity with quantum mechanics, and classical mechanics was ignored. While in CPH Theory, it is shown that all three theories (classical mechanics, relativity, and quantum mechanics) obey the common laws.

Quantum vacuum and matter production: In both the Big Bang theory and the Steady State, it is claimed that matter is produced of nothing. Of course, it is not clear what means nothing. If this means the quantum vacuum is able to produce matter, this claim is completely reasonable and acceptable. In the CPH Theory, without using the uncertainty principle and by generalizing the Maxwell equations from electromagnetic to gravity, it was shown energy is produced in a vacuum and energy is convertible into the matter. But this is not a one-way process. Matter also supplies vacuum energy. The matter converts to energy and energy converts to gravity and vice versa. [39] In other words, while the Big Bang theory maintains its credibility, the universe is also eternal. The Big Bang and Steady State theories complete each other.

To study more about CPH Theory read: Beyond the Standard Model: Modern physics problems and solutions, written by Hossein Javadi

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