Black hole in space 2020

What's black hole in space. Is there a black hole in space. What is the black hole in space called.

because an external observer would see the surface of the frozen star in time when its collapse leads it to the Schwarzschild radius. [46] Golden Age In 1958, David Finkelstein identified the surface of Schwarzschild as an event "A perfect unidirectional membrane: causal influences can cross it in one direction." [47] This has not strictly contradicted the results of Oppenheimer, but extended it to include the point of view of the infallitive observers. Finkelstein's solution extended the Schwarzschild solution for the future of observers falling into a black hole. A complete extension was already found by Martin Kruskal, who was invited to publish it. [48] These results arrived at the beginning of the golden age of general relativity, which was marked by general relativity and black holes that become mainstream research subjects. This process was helped by the discovery of Jocelyn Bell Burnell's Pulsars in 1967, [49] [50] which, in 1969, would have proved to rotate neutron stars quickly. [51] Until then, the stars of neutron, like black holes, were considered only theoretical curiosity; But the discovery of PULSARS showed their physical relevance and pushed further interest in all types of compact objects that could be formed by gravitational collapse. They were found [Required quote] More general black hole solutions have been found at this time. In 1963, Roy Kerr found the exact solution for a rotating black hole. Two years later, Ezra Newman found the asymmetrical solution for a black hole that is both rotating and electrically loaded. [52] Through the work of Werner Israel, [53] Brandon Carter, [54] [55] and David Robinson [56] theorem without hair emerged, stating that a stationary solution of the black hole is completely described by the three parameters of the Kerrâ€ "Newman's Metric: mass, angular momentum and electric charge. [57] At first, it was suspected that the strange characteristics of the black hole solutions were pathological artifacts with the conditions of symmetrical imposed and that the singularities will not fit in generic situations. This vision was held in particular by Vladimir Belinsky, Isaak Khalatnikov and Evgeny Lifshitz, who tried to prove that they do not appear singular in generic solutions. However, at the end of the 1960s, Roger Penrose [58] and Stephen Hawking used global techniques to prove that singularities appear generically. [59] For this job, Penrose received half the 2020 Nobel Prize in Physics, hawking having died in 2018. [60] Based on observations in Greenwich and Toronto in the early 1970s, Cygnus X-1, a galactic X-ray source discovered in 1964, became the first commonly accepted astronomical object to be a black hole. [61] [62] Works by James Bardeen, Jacob Bekenstein, Carter and Hawking in the early 1970s led to the formulation of the thermodynamics of the black hole. [63] These laws describe the behaviour of a black hole in the close analogy to the laws of thermodynamics related to the mass of energy, the zone to entropy and the gravity of the surface to the temperature. The analogy was completed when Hawking, in 1974, demonstrated that quantum field theory implies that black holes should radiate as a black body with a temperature proportional to the severity of the surface of the black hole, predicting the effect now known as Hawking radiation. [64] Etymology John Michell used the term "Dark Star", [65] and at the beginning of the 20th century, the physicists used the term " gravitational collapsed object". Science Writer Marcia Bartusiak Tracks the term "black hole" to the physicist Robert H. Dicke, who in the early 1960s, according to reference, compared the phenomenon to the black hole of Calcutta, famous as a prison where people entered, but never went alive. [66] The term "black hole" was used in the press by magazines of news about life and science in 1963, [66] and by the journalist of scienceEwing in his article "black holes in space" of 18 January 1964, which was a report on An American Association meeting for the progress of science held in Cleveland, Ohio. [67] [68] In December 1967, a student suggested that a student suggested the phrase "black hole" in a John Wheeler lesson; [67] Wheeler adopted the term for its brevity and "advertising value", and quickly captured, [69] leading some to Wheeler with Coining the phrase. [70] [70]and simple structure illustration of a black hole not sputting the no-haired theorem postulates that, once a stable condition after training, a black hole has only three independent physical properties: mass, electric charge and angular momentum; The black hole is otherwise without characteristic. If the conjecture is true, any two black holes sharing the same values for these properties, or parameters are indistinguishable from each other. The degree in which the conjecture is true for real black holes under the laws of modern physics is currently an unresolved problem. [57] These properties are special because they are visible from outside a black hole. For example, a loaded black hole rejects more accusations like any other loaded object. Similarly, the total mass within a sphere containing a black hole can be found using the gravitational analogue of the Gauss Law (through the mass of ADM), far from the black hole. [71] In the same way, the angular moment (or rotation) can be measured from afar by using the drawing frame from the gravitomagnetic field, through for example the lense-thirring effect. [72] When an object falls into a black hole, any information on the shape of the object or charge distribution on it is uniformly distributed along the horizon of the black hole, and is lost to external observers. The behavior of the horizon in this situation is a dissipative system that is strictly similar to that of a conductive elastic membrane with friction and electrical resistanceâ€ "the membrane paradigm. [73] This is different from other field theories such as electromagnetism, which have no friction or microscopic resistance, because they are reversible over time. Because a black hole finally reaches a stable state with only three parameters, there is no way to avoid losing information on the initial conditions: the gravitational and electrical fields of a black hole give very few information on what has gone in. Lost information includes any quantity that cannot be measured away from the black hole horizon, including quantum numbers approximately preserved as the total number of Baroon and the number of Leptons. This behavior is so disconcerting that it was called the paradox of information loss of black hole [74] [75] Distaction of gravitational time around a black hole physical properties The simpler static black holes have mass but no electric charge nÃ © Angular momentum. These black holes are often indicated as Schwarzschild black holes after Karl Schwarzschild who discovered this solution in 1916. [30] According to Birkhoff's theorem, it is the only empty solution that is a spherical symmetrical. [76] This means that there is no difference observable at a distance between the gravitational field of such a black hole and that of any other spherical object of the same mass. The popular notion of a black hole "suck in all" in its surroundings is therefore correct only near the horizon of a black hole; Far away, the external gravitational field is identical to that of any other body of the same mass. [77] There are also solutions that describe more generally black holes. Non-rotating black holes are described by the reissner-NordstrÃ¶m metric, while the Kerr metric describes a non-loaded rotating black hole. The solution PIA 1 for general stationary blacks holes note Ã Ì the Kerr-Newman metric, which describes a black hole with charge and angular momentum. [78] While the mass of a black hole can take any positive value, the charge and angular quantity are bound by the mass. The total electric charge Q and the total amount of angular momentum J are expected to satisfy Q 2 4 Ïµ Ï 0 + c 2 J 2 2 â ¤ GM GM 2 {\ displaystyle {\ frac {Q ^ {2}} { 4 000 _ {0}}} + {frac {c ^ {2} j ^ {2}} {gm ^ {2}}} leq gm ^ {2}} for a black hole mass m . Holes blacks with the mass possible that satisfies this inequality are called extremes. There are solutions of Einstein's equations that violate this inequality, butThey do not have a horizon of events. These solutions have so-called naked singularity that can be observed from the outside, and are therefore considered infisiche. The cosmic censorship hypothesis rules out the formation of such singularities, when they are created through the gravitational collapse of realistic matter. [2] This is supported by numerical simulations. [79] Because of the relatively large strength of the electromagnetic force, the blacks holes that form from the collapse of stars are expected to retain the nearly neutral charge of the star. The rotation, however, should be a universal feature of compact astrophysical objects. The black-hole candidate binary X-ray source GRS 1915 + 105 [80] it appears to have an angular momentum near the maximum allowed value. That limit is not loaded [81] J â ¤ GM 2 c, {\ displaystyle J \ leq {\ frac {GM ^ {2}} {c}},} which allows the definition of a rotational parameter without dimension such that [81] â ¤ c JGM 2 â ¤ 1. {\ displaystyle 0 \ leq {\ frac {cJ} {GM ^ {2}}} \} leq 1. [81] [Note 1] Classification of black hole black hole Class Approx.mass Approx.radius supermassico 105-1010 Mâ 0.001A 400 AU black hole intermediate-mass 103 Mâ 103 km â Rearth stellar black hole 10 Mâ 30 km Micro hole black up to MMoon up to 0.1 mm the blacks holes are commonly classified according to their mass, independent of the angular momentum, J. the size of a black hole, as determined by the radius of the event horizon, or Schwarzschild radius , is proportional to the mass, M, through rs 2 = c 2 â GM {M {M} _ {\ odot)}} ~ \ mathrm {km}} where rs is the Schwarzschild radius and Mâ is the mass of the sun. [83] For a black hole with nonzero spin and / or electric charge, the radius is smaller, [Note 2] until an extreme black hole event horizon could have a close [84] r = G + M c 2. {\ Displaystyle r _ {\ mathrm {+}} = {\ frac {GM} {c ^ {2}}}}. Main article: Event horizon Far away from the black hole a particle can move in any direction, as shown by the set of arrows. It is only limited by the speed of light. Closer to the black hole spacetime starts to deform. There are more paths going towards the black hole that the paths that move. [Note 3] Inside the event horizon, all paths bring the particle closer to the center of the black hole. It is no longer possible to escape the particle. The distinguishing feature of a black hole is the appearance of a horizon of events â a boundary in spacetime through which matter and light can only pass to the mass of the black hole. Nothing, not even light, can escape from inside the event horizon. [86] [87] The event horizon is identified as such because © if an event occurs inside the boundary, information from that event can not reach an outside observer, making it impossible to determine if such an event occurred. [88] As predicted by general relativity, the presence of a mass deforms spacetime in such a way that the paths taken by particles bend towards the mass. [89] of the event horizon of a black hole, this deformation becomes so strong that there are no paths that lead away from the black hole. [90] To a distant observer, clocks near a black hole appear to tick more slowly than those further away from the black hole. [91] Because of this effect, known as gravitational time dilation, an object falling into a black hole appears to slow down as it approaches the event horizon, taking an infinite time to reach it. [92] At the same time, all the processes on this object slow down, from the point of view of a fixed external observer, causing any light emitted from the object to appear redness and dimmer, an effect known as gravitational redshift. [93] Eventually, the falling object vanishes as long as © can no longer be seen. Typically this process takes place quickly with an object that disappears from sight within less than a second. [94] On the other hand, the indestructible observers who fall into a black hole do not makequalsiasi di questi effetti mentre attraversano l'orizzonte degli eventi. Secondo i loro orologi, che sembrano loro di spuntare normally, attraversano l'orizzonte deglii dopo un tempo finito senza notare alcun behavior singolare; nella relatività generale classica, è impossibile determine la posizione dell'orizzonte degli eventi da osservazioni locali, La topologia dell'orizzonte degli eventi di un buco nero in equilibrio è always sferica. [Note 4] [99] Per i buchi neri non rotanti (statici) la geometry dell'orizzonte dell'evento è precisely sferica, mentre per i buchi neri rotanti l'orizzonte dell'evento è oblato. Articolo principale: singolarità gravitazionale Al centro di un buco nero, come descritto dalla relatività generale, può trovarsi una singolarità gravitazionale, una regione in cui la curvatura spaziale diventa infinite. [103] Per un buco nero non rotante, questa regione la forma di un singolo punto e per un buco nero rotante, si fa sprofondare per formare un anello singolarità che se trova nel piano di rotazione.[104] In entrambi i casi, la singolare regione ha volume zero. Si può anche dimostrare che la singolare regione contiene tutta la mas della soluzione buco nero. [105] La regione singolare può così essare considerata come una densità infinite. [106] Gli osservatori che cadono in un buco nero di Schwarzschild (cioè, non rotanti e non caricati) non podeno avoide di essere portati nella singolarità una volta che attraversano l'orizzonte dell'evento. Essi canno prolungare l'esperienza accelerando via per rallentare la loro discesa, ma solo thin a unlimit.[107] When raggiungono la singolarità, sono schiacciati a densità infinite e la loro mas viene aggiunta al totale del buco nero. Prima che ciò accada, essi saranno stati strappati dalle Crescenti forze di marea in un process a volta indicato come spaghettification o "effetto noodle".[108] Nel caso di un carico (Reissner-Nordström) o rotante (Kerr) buco nero, è possibile avoide la singolarità. Extend queste soluzioni per as possibile rivela l'ipotetica possibilità di uscire dal buco nero in un tempo di spazio diverso con il buco nero che agisce come un wormhole. [109] La possibilità di viaggiare in un altro universe è, tuttavia, theoric soil poiché qualsiasi disturbzione avrebbe distrutto questa possibilità.[110] Sembra anche possibile followe curve temporali chiuse (ritorno al proprio passeto) intorno alla singolarità del Kerr, che porta problematic Ad oggi, non è stato possibile combinare gli effetti quantici e gravitazionali in una singola theory, anche se esistono tentativi di formulare una tale theory della gravità quantistica. It is generally predicted che una tale theory non abbia alcuna singolarità.[114][115 sfera fotonica Articolo principale: sfera fotonica La sfera fotonica è un confine sferico di spessore zero in cui i photoni che si muovono sui tangenti a quella sfera sarebbero intrappolati in un'orbita circulsare sul buco nero. Per i buchi neri non rotanti, la sfera fotonica ha un raggio di 1.5 volta il raggio di Schwarzschild. Le loro orbite sarebbero dinamicstically instabili, quindi qualsiasi piccola disturbzione, come una particella di materia in caduta, causerebbe un'instabilità che growebbe nel tempo, the imposing il photone su una traiettoria esterna che lo fa fuggire dal buco nero, the su una spirale internal dove allorizzoblack hole. So each light that reaches an external observer from the photonic sphere must have been issued by objects between the photonic sphere and the horizon events. [116] For a kerr black hole the beam of the photonic sphere depends on the spin parameter and the details of the photonic orbit, which can be program (the photon rotates in the same sense of the black hole spin) or retrograde. [117] [118] Main article: Ergosphere The ergosphere is a region outside the event horizon, where objects cannot remain in place. [119] The rotating black holes are surrounded by a region of spacetime in which it is impossible to stand still, called the ergosphere. This is the result of a process known as Frame-Dragging; The general relativity provides that any rotating mass tenders to "drag" slightly along the space immediately surrounding. Any object near the rotating mass will tend to move in the direction of rotation. For a rotating black hole, this effect is so strong near the horizon of the event that an object should move more quickly than the speed speed in the opposite direction to stand still. [120] The ergosphere of a black hole is a volume delimited by the horizon of the events of the black hole and from the ergosurface, which coincides with the horizon of events to the poles but is at a much greater distance around the equator. [119] Objects and radiation can escape normally from the ergosphere. Through the penous process, objects can emerge from the ergosphere with more energy than they have entered. Extra energy is taken from the rotational energy of the black hole. The rotation of the black hole slows down. [121] A variation in the penus process in the presence of strong magnetic fields, the Blandford-Znajek process is considered a probable mechanism for the enormous brightness and relativistic quasar jets and other active galactic nuclei. More stable circular orbit (ISCO) Main article: more stable circular orbit in Newtonian gravity, the test particles can permanently orbit at arbitrary distances from a central object. In general relativity, however, there is a more stable circular orbit (often called ISCO), within which, any infinitesimal disturbance to a circular orbit will lead to inhale in the black hole. [122] The position of the ICO depends on the rotation of the black hole, in the case of a black Schwarzschild hole (spin zero) is: R ISC GMO = 3 R = 6}} Einstein itself mistakenly thought that black holes were not formed, Because he believed that the angular moment of the particles that collapsed stabilized their movement in a certain ray. [124] He took the community of general relativity to reject all the results on the contrary for many years. However, a minority of relativists continued to argue that black holes were physical objects, [125] and at the end of the 1960s, had persuaded the majority of researchers in the field that there is no obstacle to the formation of an event horizon . [Necessary quote] Simulation of two black holes that collide penrose has shown that once a horizon of form events, general relativity without quantum mechanics requires that a singularity will form inside. [58] Shortly thereafter, Hawking showed that many cosmological solutions describing the Big Bang have singularity without scalar camps or other exotic subjects (see "Penrose-Hawking singularities"). The Kerr solution, the NO-HAIR theorem, and the laws of the thermodynamics of the black hole have shown that the physical properties of the black holes were simple and understandable, making them Subjects for research. [126] Conventional black holes are formed by the gravitational collapse of heavy objects such as stars, but can also in theory be formed by other processes. [127] [128] Main article: gravitational collapse Gravitational collapse occurs when the internal pressure of an object is insufficient to resist the gravity of the object. For stars this usually occurs either because a star has a "combustible" too small to maintain its temperature through stellar nucleosynthesis, or because a star that would be stable receives the extra matter in a way that does not lift its internal temperature. In both cases the temperature of the star is no longer high enough to prevent the collapse under its own weight. [129] The collapse can be stopped by the pressure of the degeneration of the Star constituents, allowing the condensation of matter in a more dense exotic state. The result is one of the various types of compact star. What kind of forms depend on the mass of the original star residue left if the outer layers were wiped away (for example, in a type II supernova). The mass of the residue, the collapsed object that survives the explosion can be substantially lower than the original star. The remains above 5 mâ ~ are produced by stars that were over 20 mâ ~ before the collapse. [129] If the mass of the residue exceeds about 3 ... 4â mÂ ‰ ‰ (the tolmanâ€ "Oppenheimer" Volkoff Limit [39]), either because the original star was very heavy or because the residual collected further mass through the increase of matter, Neutron degeneration pressure is also insufficient to stop collapse. No known mechanism (except for quark degeneration pressure, see Quark Star) is powerful enough to stop implosion and the object will inevitably collapse to form a black hole. [129] The impression of the supermax black hole seed artist [130] the gravitational collapse of the heavy stars is assumed to be responsible for the formation of black holes of stellar mass. The formation of stars in the first universe could have brought very massive stars, which on their collapse would have produced black holes up to 103 mâ ~ ‰. These black holes could be the seeds of supermassive black holes found in the centers of most galaxies. [131] It was further suggested that massive black holes with typical masses of ~ 105 mâ ~ could have formed from the direct collapse of the gas clouds in the young universe. [127] These huge objects were proposed as the seeds that eventually formulated the first quasars already observed at redshift z 1⁄4 7 {\displaystyle z \ sim 7}. [132] Some candidates for such objects were found in the observations of the young universe.[127] While most of the energy released during the gravitational collapse is emitted very quickly, an external observer does not actually see the end of this process. Although the collapse takes a certain amount of time from the frame of reference of the infallible matter, a distant observer would see the slow-falled material and stood just above the horizon of the event, due to the expansion of gravitational time. Light from the collapsed material takes longer and longer to reach the observer, with the light emitted just before the event horizon modules delayed an infinite amount of time. So the external observer never sees the formation of the horizon of the event; Instead, the collapsing material seems to become dimmer and increasingly reddish moved, eventually disappear. [133] The primordial black holes and the Big Bang gravitational collapse requires a large density. In the current epoch of the universe these high density are found only in the stars, but in theUniverse shortly after the big bang density were much larger, possibly allowing the creation of black holes. The only high density density is not enough to allow the formation of black hole since a mass uniform distribution will not allow the mass to group. For the primordial black holes formed in a half-thick half, there must have been Perturbations of density that could then grow under their own gravity. Several models for the primitive universe vary widely into their predictions of the scale of these fluctuations. Various models provide for the creation of primordial black holes that are dimensions from a Planck mass (MP = âšä§c / g Â ‰ 1.2Ã-1019 GEV / C2 Â ‰ 2.2Ã-10Â'8 kg) to hundreds of thousands of solar masses. [128] Although the primitive universe is extremely dense, much more dense than it is usually necessary to form a black hole, it has not re-connected in a black hole during the Big Bang. The models for the gravitational collapse of relatively constant objects, such as the stars, do not necessarily apply the same way to quickly expand space as the Big Bang. [134] Event simulated in the CMS detector: a collision in which a black micro hole can be created gravitational collapse is not the only process that could create black holes. In principle, black holes could be formed in high energy collisions that achieve sufficient density. Starting from 2002, these events were not detected, nor directly or indirectly as the lack of mass equilibrium in particle accelerator experiments. [135] This suggests that there must be a lower limit for the mass of black holes. Theoretically, this limit is expected to lie around Mass Planck, where the quantum effects are provided to invalidate the forecasts of general relativity. [136] This would make the creation of black holes firmly out of reach of any high energy process that occurs up or near the earth. However, some developments in quantum gravity suggest that the minimum black hole mass could be much lower: some braneworld scenarios for example put the border low as 1 TEV / C2. This would make it conceive for black micro holes to be created in high-energy collisions that occur when cosmic rays affect the atmosphere of the earth, or perhaps in the large Hadron Collider at CERN. These theories are very speculative, and the creation of black holes in these processes is considered unlikely by many specialists. [138] Although micro black holes could be formed, it is expected that they evaporated in about 10Â's 25 seconds, doing no threat to the earth. [139] Growth Once a black hole has formed, it can continue to grow absorbing additional matter. Any black hole continuously absorbs gas and interstellar powder from its surroundings. This growth process is a possible way through which some supermassive black holes may have been formed, even if the formation of supermassive black holes is still an open search field. [131] A similar process has been suggested for the formation of intermediate black holes found in globular clusters. [140] Even black holes can merge with other objects such as stars or even other black holes. It is thought that it was important, especially in early growth of supermassive black holes, which could have been formed by the aggregation of many smaller objects. [131] The process was also proposed as the origin of some intermediate black holes. [141] [142] Evaporation Main article: Hawking radiation in 1974, Hawking predicted that black holes are not completely black, but emit small quantities of thermal radiation at a temperature Ä§C3 / (8ï € GMKB); [64] This effect has become known As hawking radiation. Applying the theory of quantum field to a background of the static black hole, he determined that a black hole should emit particles showing a perfect spectrum of the black body. From the publication of Hawking, many others have verified the result through various approaches. [143] If the hawking theory of black hole radiation is correct, then black holes should be reduced Evaporate over time while losing the mass for the issue of photons and other particles. [64] The temperature of this thermal spectrum (tow temperature) is proportional to the superficial gravity of the black hole, which, for a black Schwarzschild hole, is inversely proportional to the mass. Then, big black black Endless radiation of small black holes. [144] A stellar black hole of 1 mâ~ ‰ has a 62 NanoKelvins Hawking temperature. [145] This is much less than the temperature of 2.7 K of the microwave background cosmic radiation. The bigger stellar mass or black holes receive more mass from the background of the cosmic microwave that emit through hawking radiation and will therefore grow instead of shrinking. [146] Have a larger hawking temperature than 2.7 k (and be able to evaporate,) a black hole would need a mass lower than the moon. Such a black hole would have a smaller diameter to a tenth of a millimeter. [147] If a black hole is very small, radiation effects are expected to become very strong. A black hole with the mass of a car would have a diameter of about 10Â'24 me take a nanosecond to evaporate, during which time would briefly a brightness of over 200 times that of the sun. The lower mass holes are expected To evaporate even more quickly; For example, a black hole 1 TEV / C2 would require less than 10Â'88 seconds to completely evaporate. For such a small black hole, the effects of quantum gravity should play an important role and could hypothetically make such a small black hole stable, even if current developments in quantum gravity do not indicate this is the case. [148] [149] Hawking radiation for an astrophysical black hole is predicted to be very weak and it would therefore be extremely difficult to detect from the earth. A possible exception, however, is the outbreak of the gamma rays issued in the last phase of the evaporation of the primordial black holes. Research for these flashes have shown failures and provide strict limits on the possibility of existence of low primordial bulk black holes. [150] The NASA Gamma-Ray Space Telescope launched in 2008 will continue searching for these flashes. [151] If the black holes evaporate through hawking radiation, a solar mass hole evaporates (starting from once the background temperature of the cosmic microwave drops below the black hole) for a period of 1064 years. [152] A supermassive black hole with a mass of 1011 mâ~ ‰ evaporates in about 2 to 10100 years. [153] Some black holes monsters in the universe are predictable to continue to grow up to 1014 mâ € ‰ during the collapse of superclusters of galaxies. Even these evaporate on a time scale up to 10106 years. 152] Obsive tests Messier 87 Galaxy â € "Home of the first black hole ImageContestoSupsupsupermassive black hole by nature, black holes do not emit any electromagnetic radiation other than hypothetical hawking radiation, so astrophysics in search of black holes must generally count on observations Indirect. For example, the existence of a black hole can sometimes be defered by observing its gravitational influence on its environment. [154] On 10 April 2019 an image was released by a black hole, which seen in an enlarged way because the light paths near the horizon of the events are very bent. The dark shadow in the middle results from the light paths absorbed by the black hole. [22] The image is in false color, as the light halo detected in this image is not in the visible spectrum, but radio waves. The impression of this artist depicts photons in the vicinity of a black hole. The gravitational curvature and the capture of light from the horizon of the event is the cause of the shadow captured by the Event Horizon telescope. Event Horizon Telescope (ETH) is an active program that directly observes the immediate environment of the horizon events of black holes, such as the black hole in the center of the Milky Way. In April 2017, EHT started the observation of the black hole in the center of Messier 87. [155] "In all, eight radio observers on six mountains and four continents have The galaxy in Virgo up and out for 10 days in April 2017 "to provide data that produce the image two years later in April 2019. [156] After two years of data processing, ETH has released the IL direct image of a black hole, in particular the supermassant black hole that resides in the center of the above-mentioned galaxy. [157] [158] what is visible is not the black hole, which shows black because of the loss of all the light within this dark region, rather than the gases on the edge of the event horizon, which are displayed as oranges or reds, which define the black hole. [159] the growing of this material in the middle of the bottom of the processed eut image is thought to be caused by doppler beaming, so the material that approaches the viewer at relativistic speed is perceived as brighter than the material that moves away. in the case of a black hole, this phenomenon implies that the visible material is rotating at relativistic speeds (> 1.000 m km / s,) the only speeds in which it is possible to balance centrifuge the immense gravitational attraction of the singularity and therefore remain in orbit above the horizon of the event. this brilliant material configuration implies that the eht observed m87 * from a perspective that captures the black hole credit disc almost the edge, since the entire system rotated clockwise. [160] [161], however, the extreme gravitational tension associated with black holes produces the illusion of a perspective that sees the disk of increase from above. In fact, most of the ring in the image eht was created when the light emitted from the opposite side of the growth disk bended around the gravity of the black hole and escaped; this means that most possible prospects on m87 * can see the whole disk, even the one directly behind the shadow. Before this, in 2015, the eut detected magnetic fields just outside the horizon of the sagittarius event at *, and even searched for some of their properties. the field lines passing through the growth disk were found a complex mixture of sorted and tangled. the existence of magnetic fields had been foreseen by theoretical studies of black holes. [162] [163] the expected appearance of non-roidal black hole with toroidal ring of ionized matter, as proposed [164] as a model for sagittarius to *. asymmetry is due to the doppler effect resulting from the huge orbital velocity necessary for the centrifugal balance of the strong gravitational attraction of the hole. detection of gravitational waves of fusion of black holes on September 14, 2015 the observatory of gravitational wave ligo made the first direct observation of gravitational waves success. [11] [165] the signal was consistent with the theoretical forecasts for gravitational waves produced by the fusion of two black holes: one with about 36 solar masses and the other about 29 solar masses. [11] [166] This observation provides the most concrete evidence for the existence of black holes until today. For example, the gravitational wave signal suggests that the separation of the two objects before the merger was only 350 km (or about four times the radius of schwarzschild corresponding to the deducted masses.) objects must therefore have been extremely compact, leaving the black holes as the most plausible interpretation. [11] even more important, the signal observed by ligo also included the beginning of the post-fusion rebate, the signal produced as a new format compact object settles in a stationary state. probably, the rounding is the most direct way to observe a black hole. [167] from the lygo signal it is possible to extract the frequency and damping time of the dominant mode of the rendation. from these it is possible to deduce the momentum of mass and angular of the final object, which corresponds to the independent forecasts from numerical simulations of the fusion. [168] the frequency and decay of the dominant mode is determined by the geometry of the photon sphere. So,of this mode confirms the presence of a photonic sphere; However, it cannot exclude possible exotic alternatives to black holes that are compact enough to have a photonic sphere. [167] Observation also provides the firstTry for the existence of binaries of the stellar black hole. Furthermore, it is the first observational test of stellar black holes that weigh 25 solar masses or more. [169] Since then many other gravitational wave events have been observed. [13] Proper movements of orbiting stars Sagittarius * The appropriate movements of stars near the center of our Milky Way provide a strong observational test that these stars are orbiting a supermassive black hole. [170] Since 1995, astronomers have traced the 90-star movements that orbit around an invisible object coinciding with the Sagittarius radio source A. * collect their movements towards Keplerian orbits, astronomers were able to deduce, in 1998, that a 2.6Ã-106 the object Mâ € ‰ must be contained in a volume with a radius of 0.02 light years to cause the movements of those stars. [171] Since then, one of the stars, called S2, completed a complete orbit. From orbital data, astronomers were able to refine mass calculations at 4.3-106 mâ € ‰ and a radius of less than 0.002 light years for the object that causes the orbital movement of those stars. [170] The upper limit on the size of the object is still too big to test if it is smaller than its schwarzschild radius; However, these observations strongly suggest that the central object is a supermassive black event the impressions of the artists such as the accompanying representation of a black hole with the crown commonly depict the black hole as if it were a flat-space body that hid the part Of the disc just behind it, but in reality gravitational lenses would greatly distort the image of the accretion disk. [175] NASA simulated the view from the outside of a black Schwarzschild hole illuminated by a thin accretion disk. Within such a disc, friction would cause the transport of angular momentum to the outside, allowing the fall of the most distant material towards the interior, freeing potential energy and increasing the gas temperature. [176] X-ray blur near the black hole (Nustar; 12 August 2014) [173] When the stegrating object is a star of neutron or a black

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