The physical nature of the basic concepts of physics

Part 10: Black holes and Dark Matter [(i)]

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Abstract

In the 1930's and the 1970's astronomers discovered that the outer regions of spiral galaxy clusters moved much faster than their combined mass could explain. This led to the supposition that there must be a huge amount of some kind of invisible (dark) mass (matter), that amounts up to 85% of all matter in the universe!
After thirty years of searching, no sign of 'dark' matter has been found. On the contrary, irregularities among galaxies have been found that even dark matter cannot explain, such as: the Tully-Fisher relation between the brightness of a galaxy and the velocity of its outermost stars, and the strange gamma ray signals from the center of the milky way,
In section 6 "The physical nature of photons" of his paper part 8 on the physical nature of velocity, the author has demonstrated that photons have significant mass characteristics such linear momentum, variable velocity and gravitational interaction, in a plane perpendicular to their invariable speed of light.
In this paper the author demonstrates that, since only massless particles can propagate at the speed of light, this means that when 3-dimensional mass particles accelerate to a black hole, their length in their direction of motion is gradually contracted until they reach the Schwarzschild radius where they are dismantled into 2-dimensional wave-particles when they obtain the speed of light. This means that they simply become light, with transverse mass characteristics, such as gravitational interaction in a plane perpendicular to their invariable speed, which explains the bright two-dimensional ring of high energy photons gradually circulating into the black hole. This means that only light is strong enough to withstand the most extreme, infernal conditions in the universe, at the event horizon of a Black Hole.
This allows the author to demonstrate that the high velocities in the outer regions of spiral galaxy clusters, which is assigned to the gravitational action of some invisible 'dark' matter, is in fact caused by the transverse gravitational interaction of the X- and γ-rays circulating those galaxy clusters. And this also explains the Tully-Fisher relation between the brightness of a galaxy and the velocity of its outermost stars. And this also explains the fireball of γ-rays that followed immediately after the detection of the gravity waves released by the merging of two neutron stars.

1. The stubborn elusiveness of "Dark" Matter

In the early 1930's astronomer Fritz Zwicky discovered that the outer regions of the Coma cluster moved much faster than their combined mass could explain! He concluded that the

(i) Updated edition of the paper "Velocity, Mass and Time" April 1991 by the same author.

cluster had to contain some "invisible mass", which he called "dark matter".
In the early 1970's astronomer Vera Rubin studied the motion of spiral galaxy clusters and noticed that:

- The galaxies outer arms, where gravitation is very weak, were rotating too fast for the conceivable matter,
- Clusters of galaxies bend light more than their visible mass accounts for,
- The fluctuations of the cosmic microwave background fit the data only when we add supplementary matter. Without it, the density variations couldn't have grown fast enough to form the galaxies,
- Dark matter is also needed to make the formation of galactic structures match the observations

This confirmed Fritz Zwicky's and Vera Ruben's conclusion that there must a huge amount of some invisible 'dark' matter.

In her book "Lost in Math" [1], Sabine Hossenfelder, a research fellow at the Frankfurt Institute for Advanced Studies, concludes that one possibility was that these galaxies contain huge amounts of some kind of undetectable mass, like mini black holes or ultra-compact heavy objects. But these should cause gravitational lensing, which isn't observed!

- So most scientists began to believe that dark matter, which represents up to 85% of all matter, might consist of some yet unknown weakly interacting massive particles (WIMP's).
- Another serious candidate for dark matter were Axions.

After thirty years of searching, we haven't however found any proof of these suppositions. On the contrary: irregularities among galaxies have been found, that even particle dark matter cannot explain:

- The Tully-Fisher relation between the brightness of a galaxy and the velocity of its outermost stars
- Dark matter offers no explanation for why almost all galaxies lie in a plane
- The galactic centers aren't coming out correctly with particle dark matter. The matter density should be higher in the centers we observe.

This leads Katherine (Katie) Mack conclude [2] that we probably need new physics!

In his recent paper "What is Dark Matter" [3] Dan Hooper, head of FERMILAB and professor of Astronomy and Astrophysics at the university of Chicago, writes "*We see its effects in how stars move within galaxies, and how galaxies move within galaxy clusters. Without it, we can't explain how such large collections of matter came to exist, and certainly not how they hang together today. There is only one problem: We don't know what it is"*!
All possible solutions have been ruled out:

- Huge underground experiments have detected nothing,
- Particle-smashing experiments at the LHC haven't created any dark matter.

These efforts have learned us that dark matter:

- isn't atomic matter or any of the exotic forms of matter created by the LHC
- doesn't interact with itself or with ordinary matter, except via gravity
- doesn't emit, absorb or reflect any easily measurable quantity of light

According to Dan Hooper, the best evidence for Dark Matter comes from the temperature patterns of the cosmic microwave background radiation. These patterns tell us that shortly after the Big Bang, our universe was very uniform. Without Dark Matter, there is no way that these density variations could have grown fast enough to form galaxies!
And Dan Hooper concludes that Dark Matter must surely exist, because alternative explanations, such as e.g. Modified Gravity (MOND), don't seem to work so that the only other possibility we have for WIMP's comes from a strange gamma-ray signal emanating

from the center of the Milky Way.

2. The present physical knowledge of black holes

Our present understanding of black holes is based:

- On the first image of the black hole at the center of galaxy M87 that has been taken in April 2017, and that was released on The Black Hole Conference on 2019-04-10.
According to E.H.T. Director Shep Doeleman, it shows a bright ring of light and hot gas moving around the black hole at nearly the speed of light.
The image is a proof that the black hole's gravity is so strong that nothing, not even light can escape. It shows light bending around the black hole creating a sort of bright halo, as predicted by Albert Einstein. The biggest problem now is how to make general relativity (which governs gravity) and quantum mechanics, fit together.
We haven't seen no sign of Hawking radiation.

- On the considerations of Einstein's General Theory of Relativity on black holes
According to Einstein's General Theory of Relativity, when you fall in a black hole you wouldn't feel anything special [4]. By the time you are able to see the event horizon, you will feel that the gravity inside the black hole increases so quickly that it will pull apart every part of your body at different speeds, so that it is torn apart into its basic particles.

3. The problem of "mathematical" physics

In the present 'mathematical' physics, the basic concepts, such as 'velocity', 'mass' 'force', 'momentum', 'kinetic energy', 'potential energy, etc., are quantitatively defined in function of one each other by means of the mathematical equations between them. And these mathematical equations, when formulated in spoken words, have the status of 'physical laws'. This procedure, known as "the scientific method", has the incredible benefit that it allows us to calculate the measurable parameters of physical phenomenon with mathematical precision.
The problem is however that this quantitative approach doesn't allow us to understand the physical nature of the basic concept of physics. And if you don't know what 'mass' is and you don't know what 'velocity' is, you cannot in any way understand why 'masses' proceed spontaneously to each other with increasing 'velocities'. In other words: you cannot in any way understand 'gravity'.
So, when in this quantitative, mathematical physics, you are suddenly confronted with a peculiar behavior of matter that considerably deviates from your quantitative laws, you can only have two possible reactions:
- you 'imagine' some invisible(dark) matter), or
- you 'adapt' the established (quantitative) equations, according to the observations (MOND).
But neither one of these remedies is able to give you a fundamental understanding of why and how two masses spontaneously proceed to each other with increasing velocities, and where the enormous amounts of their increasing energies come from [ii] !

(ii) The physical nature of gravitation will be analyzed in my paper on 'gravitation'.

4. The massless origin of mass

In classic physics, the total initial energy of an object falling to Earth from a standstill at a very large distance ($v_i = 0$, $r_i = \infty$), which is the sum of its kinetic and its potential energy, is zero and remains zero during its fall: $mv^2/2 + (- GMm/r) = 0$.
So that when that falling object reaches the surface of the celestial body (r = R), its impact velocity (which is equal to the escape velocity) is: $v_{esc} = \sqrt{2GM/R}$.
For a black hole, the escape velocity at the Schwarzschild radius is by definition equal to the speed of light ($v_{esc} = c$). This means that for a black hole with a radius smaller than the Schwarzschild radius $R < 2GM/c^2$, the theoretical required escape velocity is greater than the speed of light, so that not even light can escape a Black Hole.

Since only massless particles can travel at the speed of light, this means that massive objects crossing the event horizon must necessarily have collapsed into their massless components!
In section 4.2 of my paper part 8 on velocity, I have demonstrated that the so-called 'creation' and 'annihilation' processes fully comply with this massless origin of mass particles:

- the process of 'gamma decay', whereby high energy photons are emitted by the nucleus,
- the electron-positron annihilation and creation, whereby an electron-positron pair is transformed into photons and vice-versa, and
- with the fact that electrons interact with each other by exchanging photons.

This built up of mass 'particles' from massless particles, completely matches the requirement of the Standard Model, that the Universe has started with massless particles and that the Higgs boson gave them mass.

The former examples of the permanent interchange between mass particles and photons as well as their common upper limit, strongly indicates that elementary mass particles consist of (entangled) photons. The problem is however that photons are Bosons that are not known to easily interact with one another!
In 1991, Allan Snyder [5] then head of the Optical Science Centre at the Australian National University, has demonstrated that if two intense light beams are brought close enough together, they may attract or repel each other, depending on whether they are in or out of phase with each other. This is recently confirmed by the publication of the paper "*Observation of three-photon bound states in a quantum nonlinear medium*" [6] in Science of February 16, 2018 which confirms this interacting property of photons. A team of scientists of Massachusetts Institute of Technology, Harvard University, University of Maryland, Princeton University and University of Chicago have experimentally demonstrated that, under extreme circumstances, pairs and even triplets of photons can effectively interact with each other and form pairs and triplets of entangled photons. Their phase was shifted compared to that of free photons, which means that they were strongly entangled. These "atoms of light", as they are called, were not travelling at the speed of light, but had moderate velocities of 0,0001c (30km/s) to 0,00001c (3km/s), and had a fraction of the electron's mass!
These results also meet the conditions of the Standard Model, which tells us that the Universe started with massless particles moving at the speed of light, and that shortly after the Big Bang, 'something' happened (the appearance of the Higgs boson) by which some particles obtained variable velocity (iii).

(iii) The physical nature of mass will be analyzed in my paper on the physical nature of mass.

5. The physical nature of the variable velocity of mass particles

In section 4.4 "A new kinematic speed equation" of my paper Part 8 on "the physical nature of velocity", I have demonstrated that a particle system, consisting of entangled massless particles moving about each other, can gradually increase its congruent velocity from zero to the speed of light, by increasing the degree of congruence of the motions of its massless components. This allowed me to represent the variable velocity of a mass particle-system, as a complex number:

- in which the real number 'v' indicates the total amount of congruent velocity with which the particle system moves as a whole in a given (x) direction, and
- in which the imaginary number 'q' indicates the total amount of internal, repetitive, isotropic motion, represented by its internal RMS-speed 'q'.

In that way the total velocity of all the massless components of a mass particle system remains invariably equal to the speed of light, so that $v^2 + q^2 = c^2$ (Fig. 10.1).

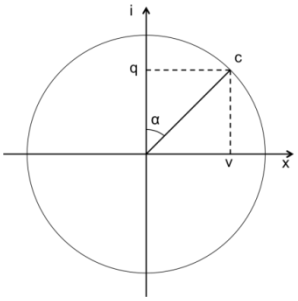

Fig. 10.1

The variable velocity 'v' of a particle system as a while, which is an absolute, physical state of that system, can then be expressed as "the degree of rectification (or congruence) of the velocities of its massless components, which can be expressed as the sinus of the angle of rectification (α): $v/c = \sin\alpha$.

The congruent velocity of such a mass particle as a whole, consisting of massless components moving around each other, is then an absolute physical state of that system, that can be expressed as the degree of congruence of the motions (expressed as $\sin\alpha$) of its massless components:

$$v = c.\sin\alpha$$

In that same paper Part 8, I have also demonstrated that the size of a particle system is the area that is repeatedly covered by the motions of its basic components. This means that a particle system that is a perfect sphere when at rest, will undergo an anisotropic compression in its direction of propagation (x), while it remains unchanged in the directions (yz) perpendicular to their propagation, so that the spherical form of an accelerating particle system will gradually deform into an ellipsoid in its direction of propagation. And this is exactly the physical explanation of the "length contraction" as first described by Hendrik Lorentz.

It follows from this, that the proportion of the size of this ellipsoid in its direction of motion (l_v) to its size at rest (l_0) will be equal to the proportion of the internal speed (q) in its direction of motion to the internal speed at rest (c), so that: $l_v/l_o = 1/\gamma = q/c = \cos\alpha$

Which can be written as: $l_v/l_o = (1-\sin^2\alpha)^{1/2}$

And which, since $\sin\alpha = v/c$, gives us the equation of the Lorentz-Fitzgerald length contraction of moving mass particles: $L_v = L_o\sqrt{1 - v^2/c^2}$

In that way, this equation of the physical length contraction of a particle system moving at a velocity 'v, expresses the proportion of its size in its direction of motion, to that size when at rest.

6. The transverse mass of photons

In section 6 "The physical nature of photons" of my paper Part 8 on 'velocity', I have demonstrated that it follows automatically from the length contraction that, when a mass particle (system) approaches the speed of light 'c', its size 'l_v' (and consequently its repetitive internal motions in its direction of propagation) will have become zero. This means that a mass particle system that moves at the speed of light, has only internal vibrational-rotational wavelike motion and therefore mass characteristics such as variable velocity, linear momentum and gravitational interaction, in the plane perpendicular to its invariable speed of light [(iv)]! This explains that 'particles' that are moving at the speed of light, such as photons [(v)] have their spin aligned with their velocity vector (Fig. 10.2)!

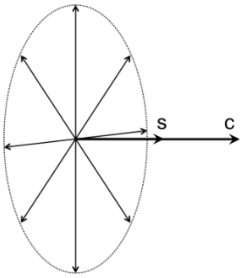

Fig. 10.2

This confirms that when a 3-D mass 'particle' is accelerated to the speed of light, such as this is the case in the vicinity at the Schwarzschild radius ($R_S = 2GM/c^2$), it simply becomes light!
And I concluded in my paper Part 8 (Velocity) that this is the real, physical explanation of the postulated mass-energy equivalence ($E = mc^2$), which simply tells us that the momentum flow of 'm' unit mass particles, moving an invariable speed 'c' is equal to 'mc^2'.
And it also explains why light is only deflected sideways by the gravitation of a heavy mass, because it has only mass characteristics in directions perpendicular to its invariable speed!

7. The physical nature of Black Holes

My former conclusions are confirmed by the following observations of Black holes:

- In the paper "*X-ray technology reveals never-before-seen matter around black hole*" [7] published in July 2018, Scientists of an international collaboration between Japan and Sweden clarified how gravity affects the shape of matter near the black hole in binary system Cygnus X-1. And they came to the conclusion that the hard X- and γ-ray light that is observed near the black hole, comes from matter siphoned of a star that closely orbits the black hole.
- In the paper "*New telescopes could help spot photon ring of the first black hole*" [8], Emily Conover writes that the doughnut-shaped glow observed in the first image of a black hole at the center of galaxy M87 (released on October 4, 2019 by the event Horizon Telescope

(iv) This will be further analyzed in my paper on the physical nature of mass.
(v) The concept of photons was introduced by Einstein in his paper on the photoelectric effect, for which he received the Nobel Prize in 1921.

Collaboration) shows that the black hole's gravity is so intense that photons can circle the Black hole multiple times and it also shows that this photon ring consists of a series of subrings.
- The recent paper "*Black Hole Movies*" [9] gives an overview of the research by the team of Michael Johnson and Alex Lupsasca at Harvard University, on the picture made by the Event Horizon Telescope of the suppermassive black hole M87 in the Virgo cluster. They found that the hazy orange-bright glow that was seen, is in fact a photon ring moving around the black hole. This photon ring seems to be made of subrings, each corresponding to photons taking a certain number of turns around the black hole. Because the inner subrings are made of light that has made more orbits, this light has been captured earlier on. The size and shape of these rings don't depend on where the photons came from, but on the properties of the black hole.

These observations demonstrate that matter, accelerating to a black hole is, due to its increasing length contraction, gradually compressed in the direction of its increasing speed, so that, when it approaches the black hole horizon, its velocity approaches the speed of light, while its 3-dimensional mass particles are transformed into 2-dimensional (massless) particles. This means that as they cross the Schwarzschild radius of the black hole, the accelerating mass 'particles' have simply become light and proceed at the invariable speed of light and have mass characteristics, such as linear momentum, variable velocity and gravitational interaction, in a plane perpendicular to their invariable speed (vi). These transverse mass characteristics deflect the photons around the black hole so that they form in that way a bright two-dimensional ring turning around the black hole.
This affirms my view that when matter is accelerated to the speed of light, it becomes light, which gives a physical explanation for the curved trajectory of light near a celestial body, which in Einstein's General Theory of Relativity is explained as a consequence of the 'geodesics of space-time' that affect massive as well as massless particles.
This also demonstrates that only light can survive the most extreme conditions at the event horizon of a Black Hole.
It is thereby important to observe that no sign of Hawking radiation has been found yet.

8. The physical nature of the so-called "Dark" matter

- In the paper "*Surplus of radiation at the center of the Milky Way unexplainable with dark matter*" [10] Ans Hekkenberg reports that some ten years ago, astronomers discovered that the center of the Milky Way contains an extreme amount of gamma radiation which made dark matter hunters exited, because that is exactly what you would expect if dark matter is present.
Oscar Macias of the University of Amsterdam and Manoj Kaplinghat of the University of California, have calculated the radiation of the different components in the different areas, and they came to the conclusion that the amount of radiation of the known sources fitted too well without the necessity of the supply of any 'invisible' (dark) matter, and that the radiation agreed exactly with the area that is most densely crowded by stars, which clearly proves that stars and other normal matter are the cause.
- In the paper "*Milky way dark matter signals in doubt after controversial new papers*" [11] Clara Moskowitz of Scientific American reports about the unexplained emission of γ-ray light at the center of the Milky Way. It was supposed that these γ-rays might be produced by the annihilation of dark matter and antimatter.
A recent study led by Rayan Keely of the Korean Astronomy and Space Science Institute and Oscar Macias of the Kavly Institute for the Physics and Mathematics of the University Tokyo,

(vi) This will be analyzed in my paper on the physical nature of mass.

found however that "*the light matches the shape of the regular stars, gas and galactic emission from the "bulge" at the center of our galaxy better than it models how dark energy by-products would act*". According to Kevork Abazajian of the University of California, Irvine, who contributed to the paper, this result doesn't leave much room for dark matter, because we don't see it in the lab, we don't see it in the LHC, and we don't see it in the sky.

In the former section, we came to the conclusion that only photons are strong enough to pass the Schwarzschild radius of a black hole unaltered. And I have also demonstrated that the high energy photons of a black hole, such as the X-rays and γ-rays, have mass characteristics, such as linear momentum, variable velocity and gravitational acceleration, in a plane perpendicular to their invariable speed [(vii)].
This allows me to conclude that the increased gravitation in the outer regions of galaxies and galaxy clusters, comes from the transverse mass characteristics of the (X- and γ-ray) light circulating those galaxies.
And this gives an obvious explanation for the observations that:

- the galaxies outer arms are rotating too fast for the visible matter,
- clusters of galaxies bend light more than their visible mass accounts for,
- the fluctuations of the cosmic microwave background fit the data only when we add the supplementary gravitation matter of the transverse mass of the high energy photons.
- the transverse mass of the moving high energy photons makes the formation of galactic structures match the observations.

And it also explains the irregularities among galaxies that particle dark matter cannot explain:

- The strange gamma ray signals from the center of the Milky Way
- The Tully-Fisher relation between the brightness of a galaxy and the velocity of its outermost stars, which is a normal characteristic of photons
- And the two-dimensional, transverse mass characteristics of photons explains why galaxies mostly lie in a plane.

This means that the missing gravitation of galaxies and galaxy clusters, that is supposed to be produced by some unknown 'dark' matter, is as a matter of fact supplied by the transverse mass characteristics of the so-called 'massless' photons that are circulating the galaxies and galaxy clusters.
This may be an unexpected conclusion, but it is nevertheless in some way in line with the opinion of Patrick Decowski of the Research Institute NIKHEF of the university of Amsterdam, collaborating in the XENON-1T experiment. In this experiment 53 mysterious light flashes are observed from something colliding with the electrons in the detector [12] .
Physical Review Letters has recently published five papers that are representative for the different views.
- Two of them describe adapted versions of former dark matter candidates. One paper from Japanese physicists gives a twist on axions, which are light wave particles that have interactions with photons.
- Canadian physicists propose a new dark-photon model that can explain the present measurements better than the old models.
- Australian physicists describe heavy dark matter particles that can in the detector fall back into their light state, thereby emitting a photon.
- German physicists propose a new model in which 'hidden' neutrinos are formed.

This demonstrates that most of these papers suggest that dark matter has something to do with dark photons. Patrick Decowski is in fact convinced that the so-called dark matter are simply 'dark' photons, because they explain the astronomical as well as the XENON-1T

(vii) This will be analyzed in my paper on the physical nature of mass.

measurements.

My insight, that photons have mass characteristics, such as linear momentum and gravitational interactions in the directions perpendicular to their invariable speed, demonstrates that it are not some exotic, alien 'dark' photons, but that it are ordinary, real photons, circulating the galaxies and galaxy clusters, that produce the missing gravitation in the outer regions of galaxies and galaxy clusters.

9. The emission of γ-rays by colliding neutron stars forming a black hole

In my paper Part 8 on the physical nature of velocity, I have demonstrated that when mass particles are accelerating to a black hole, their length in their direction of motion is gradually contracted. So that while accelerated to the speed of light, their length in their direction of motion is gradually squeezed into their basic constituent: high energy photons, which led me to conclude that photons stretched in the direction of the black hole have mass characteristics. This explains the gravitational signal GW170817 detected by LIGO in august 2017, of the merger of two neutron stars that were rapidly spiraling around each other. That collision was characterized by the detection of incoming gravity waves that were immediately followed by a fireball of γ-ray radiation!

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