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 invisible/dark mass/matter, that amounts up to 85% of all matter in the universe!
After more than fifty years, no 'dark' matter has however 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 this paper the author demonstrates that, when 3-dimensional mass particles accelerate to a black hole, due to the Lorentz-Fitzgerald contraction, their length in their direction of motion is gradually contracted, until they reach the Schwarzschild radius where they obtain the speed of light and where they are compressed into 2-dimensional wave-particles. This means that they simply have become light particles, with no longitudinal mass but only transverse mass characteristics, such as variable velocity, linear momentum and gravitational interaction, in a plane perpendicular to their invariable speed, which explains the cylindrical photon ring gradually circulating into a black hole.
This means that light is strong enough to survive the most extreme conditions in the universe, at the event horizon of a Black Hole, which is confirmed by the recent Chinese cosmic ray observatory 'LHAASO' that has demonstrated that ultra-high-energy photons can attain energies up to $1{,}4.10^9$MeV, which is 140 times the energy that can be produced by the Large Hadron Collider! And it is also in line with the so-cold "gamma ray burst" that emit the same amount of energy as a supernova, but in seconds or minutes instead of weeks!
This allows the author to demonstrate that the high velocities in the outer regions of spiral galaxy clusters, is not caused by some invisible 'dark' matter, but that it is caused by the transverse gravitational interaction of high energy photons, circulating those galaxy clusters. And it 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.

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

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 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 is 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 (that 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 their existence. 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 that we probably need new physics! [2]

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 possibility for WIMP's comes from a strange gamma-ray signal emanating from the center of the Milky Way".

2. Our present knowledge of black holes

Our present understanding of black holes is based:
- 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.
- 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 light bending around the black hole creating a sort of bright halo. The biggest problem now is how to make general relativity (which governs gravity) and quantum mechanics, fit together.

3. The problem with "mathematical" physics

In the present 'mathematical' physics, the basic concepts, such as 'velocity', 'mass' 'force', 'momentum', 'kinetic energy', 'potential energy, etc., are all quantitatively defined in function of one another, by means of the mathematical equations between them.
These purely quantitative definitions don't however allow us to grasp the physical nature of the mathematically defined basic concept of physics: if you don't know what 'mass' is and you don't know what 'velocity' is, then you cannot by any means know why 'masses' proceed spontaneously to each other with increasing 'velocities', or in other words, you cannot understand how 'gravity' works and where the enormous amounts of the increasing kinetic energies of stellar masses accelerating to each other, come from [(ii)] !
So, when in this quantitative, mathematical physics, you are suddenly confronted with a peculiar behavior of matter that considerably deviates from your established quantitative laws, you can only have two possible reactions:
- you 'imagine' some invisible/dark mass/matter), or
- you 'adapt' the established equations, according to the observations (MOND).
But neither one of these remedies leads to an understanding of the phenomenon.

4. The massless origin of mass particles

4.1 The impact velocity of Black Holes

In classic physics, the total initial energy of an object falling to a large celestial body from a standstill at a very large distance ($r_i = \infty$, $v_i = 0$), which is expressed as the sum of its kinetic and its potential energy, is zero and remains zero during its fall: $mv^2/2 + (- GMm/r) = 0$ [(iii)].
When that accelerating object reaches the surface of the celestial body (r = R), its impact

(ii) The physical nature of gravitation will be analyzed in my paper on 'gravitation'.
(iii) See my paper Part 7 on the physical nature of potential energy.

velocity (which is equal to the escape velocity at that point) is then: $v_{esc} = \sqrt{2GM/R}$.
The essential feature of a black hole is that matter falling into it is accelerated to the speed of light (v_{esc} = c) so that at a distance from the center of the black hole that is known as the Schwarzschild, $R = 2GM/c^2$.
It is the definition of a black hole that its radius is smaller than the Schwarzschild radius, so that not even light can escape from a black hole.

4.2 The fundamental nature of photons

We know from "the Lorentz-FitzGerald contraction" (that was independently established by George FitzGerald in 1889 and by Hendrik Lorentz in 1892) that mass particles that are accelerated to high speeds are submitted to an increasing length contraction in their direction of motion.
According to Hendrik Lorentz and George FitzGerald the length contraction [5] "*is not an observation or a measurement problem, but that it is a real physical distortion no less than for instance the variations of length due to an increased temperature*". This means that mass particles passing the Schwarzschild radius and reaching the speed of light, must necessarily have contracted into their two-dimensional, so-called 'massless' components, which means that they simply have become light particles, with no longitudinal mass, but with transverse mass characteristics [6] (such as variable velocity, linear momentum and gravitational interaction) in a plane perpendicular to their invariable speed, which explains the bright two-dimensional cylindrical ring of high energy photons circulating into a black hole.

- My conclusion that all mass particles are fundamentally built up from massless photons corresponds to the view of Professor Brian Cox, who in his documentary "*Brian Cox's Adventures in Space and Time*" [7], came to the conclusion that in an ever expanding universe, there will be only particles of light and Black Holes. And that by further expansion of the Universe "*even the Black Holes will evaporate and the Universe will become a bath of photons, with no matter left*", which means that according to Brian Cox, all matter must originally be built up from photons and will go finally transform back to photons.

- In section 4.2 of my paper part 8 on velocity, , I have already 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, whereby a particle and an antiparticle mutually transform into photons, which means that the original 3-D mass particles have transformed into 2-D photons.

This conclusion also meets the conditions of the Standard Model, which tell us that the Universe started with massless particles moving at the speed of light, and that shortly thereafter the Higgs boson appeared by which some particles obtained mass (iv).

- This massless beginning corresponds also to the view elaborated in the present quantum field theory with regard to the increasing speed of spin ½ fermions, such as electrons, neutrino's and quarks. The spin angular momentum of quantum particles like electrons, does not change in magnitude, but [8] "*appears to turn toward the direction of the velocity vector*". In that way, as the velocity of the electron approaches the speed of light, its angular momentum vector 's' and its velocity vector 'c' point in the same direction, so that at the

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

speed of light, the (3-dimensional) mass particles turn into (2-dimensional) photons [(v)] of which the spin 's' is always aligned with the velocity vector 'c' (Fig. 10.1).

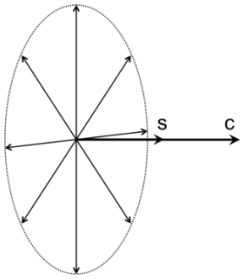

Fig. 10.1

In my paper Part 8 on the physical nature of 'velocity', I have demonstrated that it follows automatically from the length contraction in the direction of motion, that when a mass particle (system) approaches the speed of light 'c', its size 'l_v' in its direction of motion (which is in fact its repetitive internal motion) will have become zero. This means that a 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 [(vi)]! This explains why 'particles' that move at the speed of light (such as photons) [(vii)] have their spin vector aligned with their velocity vector.

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 $R_S = 2GM/c^2$ of a black hole), it simply becomes light! And I concluded already in my paper Part 8 (Velocity), that this is the real, physical explanation of the postulated mass-energy equivalence ($E = mc^2$), which tells us that the total amount of momentum flow 'mv^2' [(viii)] of 'm' unit mass particles, that proceed at the speed of light is equal to 'mc^2'. And this also explains why light is only deflected sideways by a (heavy) mass, because light has only transversal mass characteristics in directions perpendicular to its invariable speed.

> The former examples of the permanent interchange between mass particles and photons as well as their common speed limit, strongly indicates that elementary mass particles are build up from (entangled) photons. The problem is however that photons are Bosons that are not known to easily interact with one another! In 1991, Allan Snyder [9] then head of the Optical Science Centre at the Australian National University, has demonstrated that two intense light beams brought close enough together, may attract or repel each other, depending on whether they are in or out of phase with each other. This interaction between photons is also confirmed by the publication of the paper "*Observation of three-photon bound states in a quantum nonlinear medium*" [10] is which is demonstrated that under extreme circumstances, pairs and even triplets of photons can effectively form entangled photons. Their phase was shifted compared to that of free photons, which means that they were strongly

(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.
(vi) This will be further analyzed in my paper on the physical nature of mass.
(vii) The concept of photons was introduced by Einstein in his paper on the photoelectric effect, for which he received the Nobel Prize in 1921.
(viii) See my paper Part 3 "The physical nature of work and kinetic energy" section 3.1 "The total amound of momentum flow.

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!

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

In my paper Part 8 on the physical nature of velocity, I have demonstrated that a particle system (consisting of massless particles moving about each other), can gradually increase its congruent velocity from zero to the speed of light, by an increase of the degree of congruence of the motions of its massless components. This allowed me to represent the variable velocity of a mass particle-system, by 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, represented by its congruent velocity, and
- in which the imaginary number 'q' indicates the total amount of internal, isotropic motion, represented by its internal RMS-speed 'q'.

In that way the total amount of 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), while the variable velocity 'v' of a particle system as a whole, which is an absolute, physical state of that system, can 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/degree of rectification (α): $v/c = \sin\alpha$.

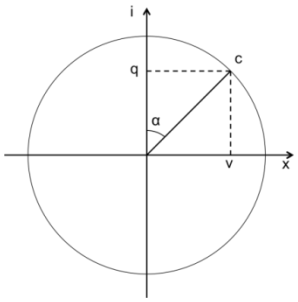

Fig. 10.2

This means that the congruent velocity of such a particle system, consisting of massless components moving about each other, is 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 unit components. This means that a particle system that is a perfect sphere when at rest, will naturally undergo an anisotropic compression in its direction of propagation (x), while it remains unchanged in the directions (yz) perpendicular to its propagation. This means 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 when 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 real physical explanation 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 physical nature of Black Holes

My former conclusions that 3-dimensional matter particles are reduces to 2-dimensional energy particles in black holes is confirmed by the following observations of Black holes:

- In the paper "*X-ray technology reveals never-before-seen matter around black hole*" [11] 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*" [12], 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 Collaboration) shows that the black hole's gravity is so intense that photons can circle the Black hole multiple times so that this photon ring consists of a series of subrings. They don't report the observation of anything else than photons!

- The paper "*Black Hole Movies*" [13] 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 supermassive black hole M87 in the Virgo cluster. They found that the hazy orange-bright glow that was seen, is in fact a cylindrical 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 confirm my view that 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 accelerates to the black hole's event horizon, its velocity approaches the speed of light, while its 3-dimensional mass particles are gradually compressed in their direction of increasing velocity. This means that as they cross the Schwarzschild radius of the black hole, the 3-dimensional mass 'particles' have simply become 2-dimensional high energy gamma-rays that 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 [(ix)]. These transverse mass characteristics deflect the photons around the black hole so that they form in that way a cylindrical ring around the black hole.

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

This affirms my view that when matter is accelerated to the speed of light, it becomes light with transverse mass characteristics, 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.

7. The physical nature of the missing matter

7.1 Modified Newtonian Dynamics

In the paper "*Dark Matter fails key galaxy merger test*" [14], it is demonstrated that in the early universe, galaxies were merging at a up to 10 times more than predicted by MOND. This rate is in line with theories that take into account dark matter making up 85 per cent of all matter. Christopher Conselice at the University of Manchester (UK) and colleagues analysed half a million galaxies up to 18,6 billion light years away. Since the early universe was more compact than today, the galaxies merged faster. Conselice estimates that the merger rate was then 5 to 10 times higher than would be predicted by MOND. According to him, when galaxies orbit each other closely "*dark matter acts like a brake, so that when two galaxies move through it, dark matter particles produce a wake that will decelerate them and eventually lead to the two galaxies merging*". "*Conselice admits that you have to really detect the particles for dark matter, to be absolutely proven*".

On the other hand, our galaxy contains an enormous bar of stars in its center, from which its spiral arms emanate [15]. "*That this bar rotates, but the dark matter is slowing it down by about 13 per cent every billion years*."
Rimpei Chiba (University of Oxford) and Ralf Schönrich (University College London) used observations of stars from the Gaia Space Telescope to demonstrate the galactic bar's gradual deceleration.
By measuring the ages of the stars Rimpei Chiba and Ralf Schönrich determined that the bar's rotation is effectively slowing down by about 13 per cent per billion years! Which is another piece of evidence that dark matter is real says Schönrich.

7.2 The gravitational power of high energy photons

In the former section, I 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 (x).
In April 2021, a new Chinese cosmic ray observatory called the "Large High Altitude Air Shower Observatory" (LHAASO) led by chief scientist Cao Zhen, has found 12 sources of ultra-high-energy gamma-ray photons, with energies of $0,1.10^9$MeV, in which there was even a photon with an energy up to $1,4.10^9$MeV! That is more $1,4.10^6$ times the mass of a Proton or neutron and it is more than 100 times the energy that can be produced by the Large Hadron Collider. The LHAASO lies on the Haizi mountain in the Chinese Sichuon province and when it will be completed, it will probably find more higher energetic gamma rays!

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

This demonstrates that photons are strong enough to survive the most extreme conditions in the universe!

7.3 The physical nature of the so-called 'dark' matter

This means that the increased gravitational attraction in the outer regions of galaxies and galaxy clusters, comes from the transverse mass characteristics of the high energy γ-ray light circulating those galaxies. And it gives 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 thereby explains the irregularities among galaxies that particle dark matter cannot explain, such as:

- 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 undetectable 'dark' matter, is in fact supplied by the transverse mass characteristics of the high energy photons (their linear momentum, their mass and their gravitational interaction) that are circulating the galaxies and galaxy clusters.
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 high energy photons, circulating the galaxies and galaxy clusters, that produce the missing gravitation in the outer regions of galaxies and galaxy clusters.

8. 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 a mass particle is accelerating to a black hole, its length in its direction of motion is gradually contracted. So that while accelerated to the speed of light, its length in its direction of motion has gradually become zero, so that the mass particle is squeezed into its basic constituents: 2-dimensional wave-particles with only mass characteristics, such as variable velocity, linear momentum and gravitational interaction, in the plane perpendicular to their invariable speed.
This led me to conclude that photons stretched in the direction of the black hole have considerable mass characteristics and this also 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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