New Findings Concerning Dark Matter

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SUMMARY.
Dozens of exceeding experiments all over the world were performed with high hopes to find dark matter particles. No evidence for any dark particle could be found despite all these efforts. This is an overwhelming result. Furthermore, one must consider some discrepancy between the theory of dark matter and astrophysical observations.
But there is another theory to explain the galactic rotation curve by calculation, called method of gravity areas, which is based on the gravitation theorem and other well-known facts. Newton's gravitation law remains untouched, and no unknown is needed. At any position there is a single gravitational vector towards the centre and another single vector towards the opposite direction. So the billions-of-masses-problem has changed to a solvable three-component-problem. The summed up gravitational vectors of all near and far away mass within a galactic disc, baryonic mass only, will result in a horizontal gravitation curve, equivalent to a horizontal rotation curve.
The theory of gravity areas is based on well-known physical laws and verifiable parameters. Therefore, the theory can be proved wrong, but up to now it has not been disproved.

INTRODUCTION.

In 2016, accurate near-infrared observations showed a direct correlation between the rotation curves and the baryonic mass only, independent from different morphologies of galaxies. [1]
In contrast, the theory of non-baryonic Cold Dark Matter is predicting a correlation between the rotation curves and different proportions of dark matter within the regarded galaxies. Small galaxies are supposed to include a lot of dark matter corresponding to a lot of “missing mass“.
Obviously the standard theory of dark matter is not compatible with the results of these recent observations.

The so-called “missing mass problem“ within spiral galaxies is traced back to the famous observations of Andromeda galaxy's rotation curve by Vera Rubin. [2]
Before these observations, the velocity of orbiting stars close to the edge of a galaxy was supposed to be lower than close to the bulge. Because the velocity of the planets within the solar system is decreasing according to the Kepler curve, the natural conclusion seemed to expect the same correlation within any galaxy. But the observations of Andromeda showed nearly constant velocity, visible at the horizontal rotation curve. This result of not decreasing velocity was observed over and over again in other galaxies.
The explanation for this result seemed to be some additional, but not visible dark matter, causing

additional gravitation. This assumption seemed to be plausible and seemed to have even an overwhelming evidence – at least on paper. All over the world experiments were masterminded to find the dark non-baryonic matter. Most of astrophysicians were very optimistic to find a clear evidence for a dark matter particle in reality within a few years.

Dozens of excellent experiments were performed with high hopes. [3] For example experiments at the South Pole (IceCube) as well as in the desert (Cherenkov Telescope Array), in space (AMS-02 at the International Space Station, Pamela and Fermi in satellites), deep in the Earth (Dama/Libra in Gran Sasso, CoGent and LUX and innumerable others).
The most famous testing ground is the LHC at CERN, containing a huge ring of 27 km length 100m underground. Some say it is the most elaborate experiment in the history of mankind. The most important argument to realize it was to find the dark matter.
But all these accurate experiments did not find a faintest hint for any dark matter. Even the eminently exact LUX trial reported 2016: No evidence.

It is astonishing that no evidence for any dark matter particle could be found despite all these efforts. This is an overwhelming result.
But why are the dark matter particles so hard to find?

Furthermore, one must take note of some more discrepancy between the theory of the dark matter and astrophysical observations. In 2008 a general inventory came to the disappointing final conclusion that all theoretical computer simulations based on dark matter theory don't fit the observations. [4]
And in 2011, another setback was reported by C. Frenk at the Durham international conference of galaxy formation. Based on computer simulations and on the evaluation of satellite galaxy observations he concluded that these observations were not compatible with the dark matter theory, especially not with the cold dark matter (CDM) assumption. [5]
But these objections did not at all result in a demoralization of astrophysicians. In contrary, every endeavor has been made to find the particles anyway.
Only now and then there is a discreet recommendation like “we should be open for new theoretical ideas“. [3]
Could another theory explain the observations better than dark matter?
The most mentioned alternative theory is the MOND hypothesis, the modified Newtonian dynamics. Starting from the horizontal rotation curve, a modification of Newton's gravitation law on galactic scale was proposed to fit the calculation of the local gravitation to the observations, thus avoiding the mysterious dark matter. [6]
The main objections against the MOND theory are the arbitrary adjustment of the gravitation law to the observations and the deficiency of a plausible theoretical basis.

But there is another theory to explain the rotation curve by calculation, called the method of gravity areas. [7] In the following this plausible interpretation of the rotation curve is recalled, by which a horizontal gravitation curve results from calculations of the local gravitation of baryonic mass within the galactic disc. These calculations by summing up gravitational vectors are exactly fitting the rotation curve of velocity as observed. The causal explanation derives from the gravitational vectors, according to mass and distance. This method of gravity areas is based on the gravitation theorem and other well-known facts, without using any unknown. Newton's gravitation law remains untouched.
This concerns the very basis of the dark matter theory.

GRAVITATION THEOREM.

The first fundamental principle of the gravitation theorem is: **each mass will exert gravitation from its very position.**

The idea of gravitation coming out from the very position of a celestial object is traced back to Newton's gravitation law and even to Johannes Kepler. Nowadays we call it gravitation, Kepler called it "virtus" and showed it was dependent on the mass of an object, and inversely dependent on the square of the distance.[8, 9]

And he described the position between two celestial objects where gravitation is zero by subtraction of the gravitational forces of both objects. In his science fiction novel "Somnium" he described a journey from the Earth to the Moon, and even the equilibrium state of gravitation on the connecting line Earth to Moon, close to the Moon. [10]

Kepler also explained the tides on Earth by the attraction of the Moon. The obvious gravitational effect of the Moon is proving the gravitation theorem.

Seen from the Earth, the Moon is considered as a point mass, attracting the oceans from its very position.

But on the other side, the satellite experiments of GRAIL 2012 showed that an object moving near the surface of the Moon is not attracted by a point mass. There was a clear evidence that any mass will attract other objects from its very position, even single mountains on the surface of the Moon did exert gravitation upon the satellites. [11, 12] That's another proof of the gravitation theorem.

In the solar system, the planets are orbiting the Sun. The velocity of each planet is balanced with the gravitational force of the Sun on behalf of the distance to the planet. As the gravitation of the Sun will decrease by increasing distance, the balanced velocity of a planet will decrease, too. Derived from Kepler's laws of planetary motion, a Kepler curve will define the decreasing of the local gravitation, and also of the velocity of an object in a stable orbit, ideal conditions persumed.

But there are some exceptions where the velocity of an orbiting object is modified by a mass nearby, causing a deviation from the ideal Kepler curve.

For example, two planets approaching each other will interact and accelerate each other by gravitation, though the gravitational force of the Sun is much greater.

In 1846, the planet Neptune was discovered by J. Galle in Berlin, using calculations of U. Le Verrier, who postulated a new planet because of a deviation of the observed velocity of the planet Uranus from the ideal Kepler curve.

The deviation of neighbouring planets according to the effect of near masses shows the gravitation theorem.

And of course, Jupiter's moons and our Moon and all moons of the solar system are bound by the near mass of their planets, according to the gravitation theorem.

Galaxies in great distance may be considered as point masses. Also Andromeda galaxy, seen from the Earth. But we know from all interacting galaxies that approaching masses of galactic discs will act as near masses according to the Gravitation Theorem. One can see for example the disturbed shape of M51, Arp256, NGC2207 and IC2163 and many others. Interacting galaxies will always act as predicted by the Gravitation Theorem. [13]

The interaction of two gravitational objects can be described by Newton's gravitation law.

It is also possible to describe the interaction of three gravitational objects like the Sun, the Earth and the Moon, but it's more difficult. A special case is the tidal wave at new moon, when the Moon and the Sun are positioned in the same direction. The ocean is drawn towards the Moon and in the same direction towards the Sun, by addition of the gravitational forces. The summed up gravitation of the

Sun and the Moon will act as a single vector into the same direction. Thus the vector of gravitational force of the Earth on the ocean is diminished by subtraction of the single vector towards Moon and Sun, resulting in a tidal wave.

The second fundamental principle of the gravitation theorem is: Several masses of different positions will exert gravitation upon a certain position as vectors. So in sum, at any regarded position one will get a main vector of the actual gravitation.
The Sun and the Moon will effect falling tide and rising tide by gravitation, due to the mass and the distance, according to Newton's gravitation law, and due to the direction of the vectors on behalf of the Earth.

To calculate the gravitational interactions of many objects seems to call for large-capacity computers. Within our Galaxy there are hundreds of billions of solar units, interacting with each other and with the galactic centre.
For hundreds of years centre-referred methods have been used to calculate the gravitational effects of a central mass according to the distance, for example the Kepler curve within the solar system. This means an enormous simplification of the calculation of the local gravitation. However, it is to point out that the centre-referred methods are assuming that all mass within a certain radius will act gravitationally as if all mass were concentrated in the very centre. Thus the gravitation theorem is violated. So the result of any centre-referred calculation has to be justified.
There is a tacid agreement within the scientific community that centre-referred methods will come to the same result as numeric simulations, and will conform to the gravitation theorem. But is this assumption accurate?
It is difficult to calculate the effects of many objects distributed within a certain space at a certain position, and to compare the result with that of the centre-referred methods. How could a complete numeric simulation of hundreds of billions of solar units of the Galaxy be performed?

SURPRISING RESULT.

Method of gravity areas. In 2011 a method was introduced for calculating the local gravitation within the galactic disc. At any position there is a single gravitation vector towards the centre and another single vector towards the opposite direction. So the billions-of-masses-problem has changed into a solvable three-component-problem. [7]
The method of gravity areas sums up all masses of similar distance and similar direction on behalf of a certain position within the galactic disc, called a gravity area. This way the calculation of gravitational interaction is made easier, maintaining the precision of the calculation.
Thus gravitation vectors are resulting from any gravity area. All gravitation vectors in the same direction are summed up and vectors in opposite direction are subtracted. The result is the effective local gravitation upon a certain position within the galactic disc, for example upon the Sun.

Gravitation curve. For any regarded position the subtraction of both summed up forces, towards the centre and towards the opposite direction, will result in the effective local gravitational force.
Now we may regard the local gravitation at different positions of different distance, from near the bulge until near the edge of the galactic disc. The result is a continuous gravitation curve and this calculated gravitation curve is running horizontal. Because gravitation is balanced with velocity, a horizontal gravitation curve is equivalent to a horizontal rotation curve as it is observed in all spiral galaxies.

Gravity areas. All matter between the Sun and the galactic centre and also beyond the centre pulls the Sun towards the centre.
The very galactic centre and the bulge of the Galaxy, including about 10 billions of solar masses, may be considered as a point mass at the distance of 26,000 ly from the Sun.
The stars and the clouds of gas and dust between the border of the bulge at a radius of about 15,000 ly and the Sun at a radius of 26,000 ly are also exerting gravitation towards the galactic centre. Of course not only the matter on the very connecting line from the Sun to the galactic centre is gravitationally effective, but also the objects neighbouring this connecting line. All matter within a conic space of 45° from the connecting line has to be regarded. (The gravitational effects of the objects in front of an orbiting star and from the rear are cancelling out. Also the gravitational effects from top and from buttom.)

Geometric features of the galactic disc. We know that the position of the Sun is near the plane of symmetry of the disc. And we know by observations the number of solar units in the global space around the Sun. Within a radius of 5 parsec there are about 85 to 90 solar units. Regarding a conic space of 45° towards the centre we recognize that in the beginning the matter filling the sections of the conic will increase corresponding to the three dimensions, until the borders of the disc at top and buttom are reached. Beyond these borders the number of objects will only increase corresponding to two dimensions.

Summing up point masses of different distance. According to Newton's gravitation law the gravitational force will decrease by the square of the distance. The conic space from the Sun towards the galactic centre may be intersected at different distance. All masses within one of the conic intersections may be regarded as a point mass, exerting gravitation starting from the effective point in the middle of the conic intersection. All effective points of the gravity areas towards the centre are upon the connecting line and may be summed up. So we get the sum of gravitation including not only the conic space from the Sun to the border of the bulge, but also the total bulge and the galactic disc beyond the centre.
Despite using point masses, the gravitation theorem will remain in force. For the gravity areas of different distance have a negligible error.
All gravitational vectors of different gravity areas will result in a single gravitational vector.
This method of gravity areas may be used for any radius of a galactic star.

External mass. All matter in the opposite direction will diminish the single gravitational vector towards the centre. First all effects of the gravity areas towards the edge are summarised, then this single gravitational vector of the external mass is subtracted from the single gravitational vector towards the centre.

Gravitation curve. The result of all interacting vectors is the local gravitation at a certain position. And the local gravitation according to the radius of a star in the galactic disc results in a gravitation curve. This gravitation curve is running horizontal. As the velocity of an orbiting star is balanced with the local gravitation, also the rotation curve of velocity must run horizontal.

Small galaxies. Less bright galaxies are consisting of less central mass. Calculating the local gravitation in small galaxies will result in a rising gravitation curve, according to the regularly observed rising rotation curve of small galaxies. [1, 4, 7]

Supplements on behalf of the original paper.
In 2011 a prediction was made on behalf of the bumps in the galactic rotation curve. A causal correlation between the more concentrated mass in the spiral arms and the **bumps of the rotation curve** was supposed, and the scientific community was called upon to prove or to disprove the method of gravity areas this way. [7] But the correlation between the spiral arms and the bumps in the rotation curve was already shown in 2004. [14] So this correlation is **no longer a prediction but a confirmation** of the method of gravity areas and the gravitation theorem.

By summing up the solar masses of any gravity area within the conic space you get a point mass at a certain distance. This point mass, the **effective point of gravitation**, was supposed to be in the very middle of the conic area upon the connection line. This supposition is **confirmed because of geometric facts.** [15, 16]
(Within a conic space or intersection, the area and also the mass of any circular area, right-angled to the central axis, will increase by the square of the distance from the starting point of the conic, because the area of a circle will increase by the square of the radius. In the same way the gravitation of any mass will decrease by the square of the distance. So both effects are cancelling out. This means that any circular area beyond the central point of a conic intersection will exert exactly the same gravitation as another circular area ahead of the central point. So the central point is identical with the local effective point of the total gravitation of the regarded conic intersection.)
As aforementioned, the conic space within the disc near the Sun contains masses in three dimensions, but in greater distance the height of the galactic disc is limited, resulting in a truncated conus. But also in this truncated conic space the effective gravitation point is in the geometric centre.

In the original paper, constant mass distribution within the galactic disc was presupposed, knowing the **real mass distribution** is higher towards the galactic centre and towards the plane of symmetry. An **approximation taking this into account, was affirming** that nevertheless a horizontal gravitation curve and rotation curve will result. [17]
More extended calculations are preferable.

Beyond the edge of the visible disc, a huge **halo of normal baryonic matter** is verified. The extension is supposed being several millions of light years, probably even touching the halo of the neighbouring Andromeda galaxy. Of course also halo matter will exert gravitation. Therefore, the **rotation curve will not decrease beyond the edge of the disc**. [17] (It is remarkable that the gravitational effect of the halo matter seems to be not sufficient by using centre-referred methods, but by using the gravitation theorem, however.)

DISCUSSION.
The planets are orbiting the Sun, and the stars are orbiting the galactic centre.
The basis of the dark matter hypothesis is the centre-referred calculation of the local gravitation, without any restriction. That means, it is supposed that the gravitation at any distance is only dependent on this distance and on the total mass within this radius, as if all mass were concentrated in the very centre. Effects of any near mass are not taken into consideration.
The local gravitation and the corresponding velocity of an orbiting star is usually supposed to be dependent on the descending Kepler curve, whereas observations show a nearly horizontal rotation curve.
Calculations are simplified by a centre-referred method, but of course gravitation will be effective coming out from the very position of the mass. A near mass will modify any centre-referred method. According to the gravitation theorem the near masses of the disc will exert gravitation on the base

of mass and position, that means inversely square of distance. That's completely in line with Newton's gravitation law.
Even within the solar system there are well-known exeptions from Kepler's curve due to the gravitation of the near mass of neighbouring planets, that means due to the gravitation theorem. Thus the discovery of Neptune occured, and no one was surprised that the near mass of Neptune was able to accelerate Uranus. And no one troubled over Kepler's laws of planetary motion or over the aberrating Kepler curve of velocity.

It is easy to understand that Jupiter's moons and all the other moons in the solar system are obviously orbiting the near mass of their planets, due to the gravitation theorem.

Nobody was surprised when in 2012 the GRAIL satellite experiments showed the effect of the near masses on the Moon's surface. Other satellite experiments had shown before the same effect on behalf of the Earth (GRACE and some more).

No one worries about the fact that interacting galaxies obviously will change their shape according to the gravitation theorem. But these observations are incompatible with the presupposition of two galaxies as two point masses, as all centre-referred methods are postulating. It's evident that in these cases Newton's shell theorem and Poisson's equation and Gauss' law will not predict the reality. [17]

And finally, within our Galaxy and within any other disc galaxy, the deviation of the rotation curve from the Kepler curve is due to the near masses of the disc, that means due to the gravitation theorem. (Also on behalf of galactic rotation curves there is no need for worrying about the deviation from the Kepler curve, neither for dark matter.)

In none of these cases dark matter or any other unknown is required.

Within the solar system we have got a clearly arranged situation. The greater the distance the lower will be the velocity of a planet orbiting the Sun.
The local gravitation decreasing by greater distance according to Kepler's laws of planetary motion seems, at first sight, to be the exclusive reason for the exact local velocity of an orbiting planet in the solar system as well as of an orbiting star in the Galaxy.
However, to use the Kepler curve on behalf of galaxies instead of the solar system is based on a nearby, but incorrect analogy. The crucial difference is that within the solar system there are 99.9 % of all mass concentrated in the very Sun. Whereas the very centre of the Galaxy, the black hole, is supposed to contain about 4.5 millions of sun masses, corresponding to less than 0.01% of the Galaxy's mass. And even within the central star cluster of the Galaxy there are only 1 billion of sun masses, that's less than 1%. In the whole bulge about 10 billions of sun masses are supposed, corresponding to less than 10% of the whole mass, whereas the residual mass is distributed within a radius of 50,000 ly, exerting gravitation according to its very position, this means according to Kepler's gravitation theorem.
In the solar system most matter is concentrated within the very centre, the residual mass of the planets being negligible, whereas in a galaxy most matter is distributed outside of the very centre, a lot of near masses, causing gravitation in a not negligible way. That's the crucial difference.
Therefore the situation in the Galaxy must not be equated with the solar system. [7, 18, 19]

Several papers did prove that symmetrically distributed mass will exert more gravitation upon an external position than an equal point mass, according to the undeniable observations of GRAIL satellites and of interacting galaxies. [12, 15, 16, 20, 21, 22]

Because of Kepler's gravitation theorem the gravitational effect has to be calculated on behalf of the real position of any mass. This way one gets the real gravitational vector. It woud not be correct to calculate first of all the geometric centre of the distributed mass, and second to calculate the gravitation on behalf of this centre. One would risk a simple error of bracket calculation. The inaccuracy of the centre-referred method must be respected **unless** the distributed mass has a great distance to the observer.

There should be another fundamental principle of the gravitation theorem:
Any theory that is claiming to simpify the vector calculation and the gravitation theorem, is obliged to prove its correctness by calculation as well as by observations in reality.

The method of gravity areas is based on well-known physical laws and verifiable parameters. Therefore, the method can be proved wrong, but up to now it has not been disproved. [23]

It would not be plausible to refuse any discussion about the calculation of the rotation curve and about the method of gravity areas. For example by using the argument that we need the theory of dark matter so badly on behalf of certain explanations of the universe. (On behalf of the formation of galaxies and also on behalf of gravitational lensing. Perhaps it would be hard to find another explanation.)

Accepting that dark matter is not essential for the rotation curve, one may claim the theory of dark matter not yet being finished. Any astrophysical theorist may explain why dark matter is dispensable on behalf of the rotation curve of any galaxy, but indispensable on behalf of the big bang theory and the early formation of galaxies.
But there is no great cooperativeness on behalf of new theoretical ideas, or willingness for checking own paradigms. Plans are elaborated for a 100 km ring for CERN instead of now 27 km. (How long should it get, if even 100 km cannot find dark matter particles fitting the theory?)

The basis of the dark matter assumption is the galactic rotation curve. This basis is disproved by the method of gravity areas. [7]
And Zwicky's proof of the dark matter in galaxy clusters? It's also disproved by the near mass, calculated by the method of gravity areas. [7]
And the proofs of missing mass by far away interacting galaxies or gravitational lensing? There is a great uncertainty about the mass estimation, not adequate for a real proof.

What if the whole dark matter of the astrophysical standard theory would vanish? Maybe some astrophysicians will shudder at the mere thought of the non-existence of the non-baryonic missing mass.

In summary it is to emphasize that without any doubt the centre-referred methods are limited by the influence of a near mass.

Kepler's curve and other centre-referred methods will stay in force within the solar system, on behalf of the Moon and the galaxies, **unless** the effect of a near mass will claim an adaptation of the effective force, according to the gravitation theorem.

The answer to the problem of the horizontal galactic rotation curve is:
The summed up gravitational vectors of all near and far away mass within a galactic disc, baryonic mass only, will result in a horizontal gravitation curve, equivalent to a horizontal rotation curve.

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