Dark matter – calculation and evaluation
A summary

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Objective

In this paper, the calculation of dark matter is depicted in easy to understand graphics. The results are then logically tested, discussed, and compared. On one hand, dark matter is determined with integral calculation methods, already used by Sir Isaac Newton to calculate the masses and orbital speeds of galactic discs (Alonso & Finn, 2000). On the other hand, discrete addition of masses in a galactic plane is used to examine and compare the results of the integral calculation.

The Basics

The determination of forces, masses, and orbital speeds in a galactic plane is a many-body-problem, for a galactic plane contains thousands of suns and other masses. However, Newton made the calculation of gravity, speed, and masses in a galactic plane shaped body possible with the discovery of a simple integral formula.

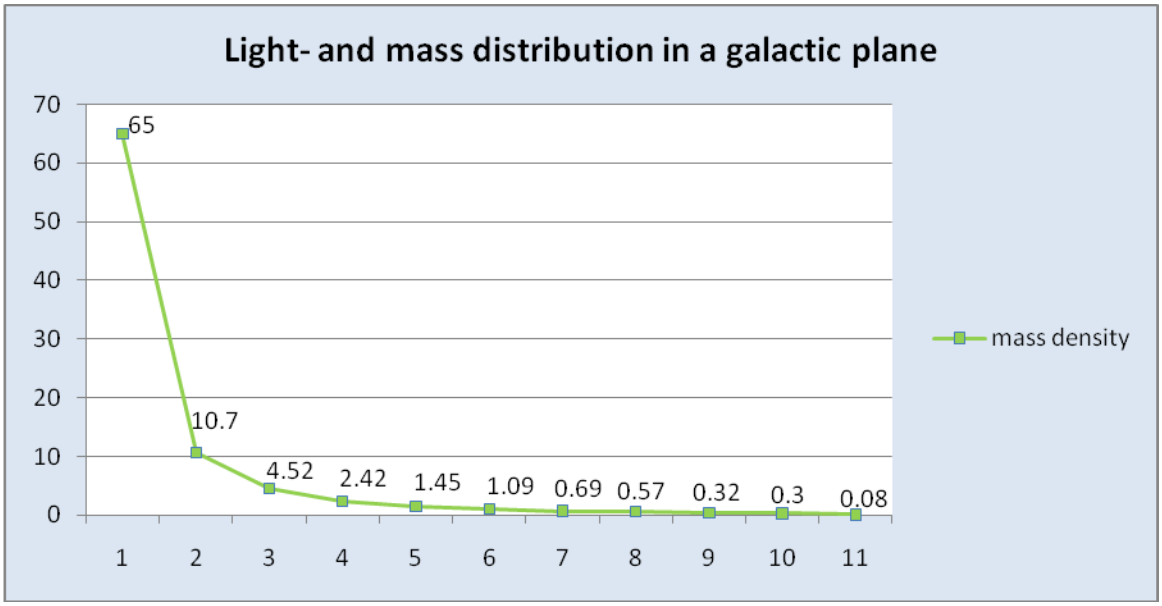
→ The commonly used method to solve galactic problems is the integral formula by Newton. Galactic masses are determined with the help of orbital speed that can be measured in the galactic plane. The masses are thereby combined into a single mass in the center, which turns a complicated many-body-problem into an easily calculated two-body problem.
→ The results of the integral calculation are tested through the addition of masses in a rotation symmetric, gridded, galactic circular plane. It contains 357 mass points in 10 rings around the center.

Both calculation methods ought to verify the existence of dark matter. Though a slight discrepancy between the two methods can be expected because of the grid lining, it should remain below a 1% tolerance.

Calculation of mass in a galactic plane with integral method according to Newton

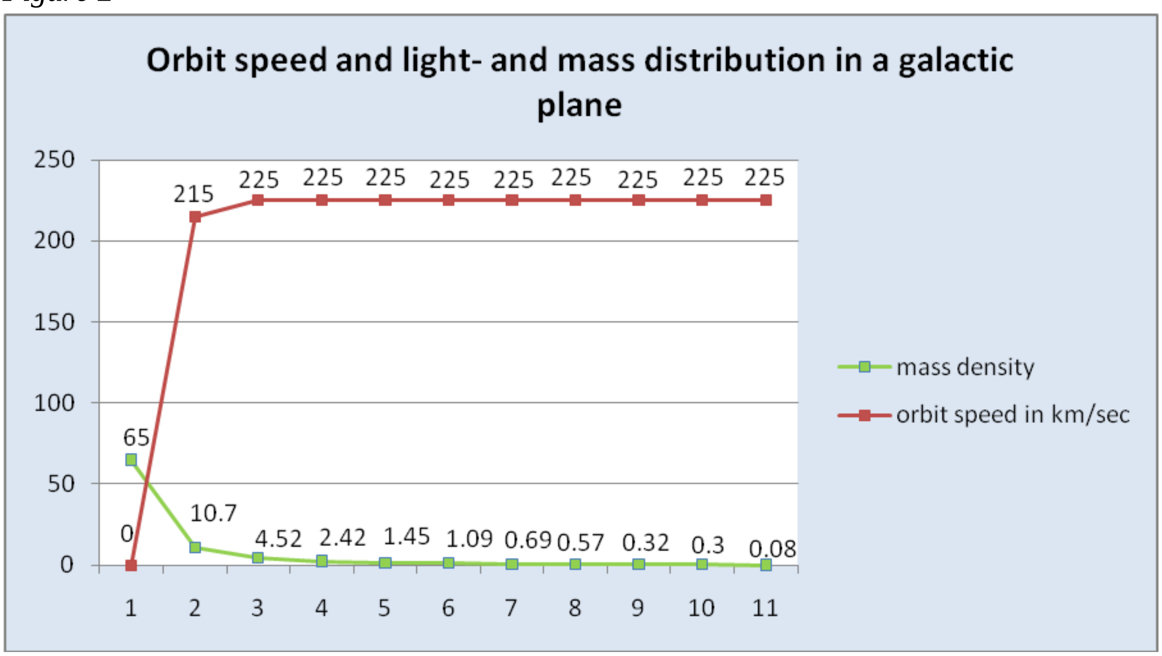
The visible mass density of a galaxy and the actually measured orbital speed of said masses around the center are illustrated in a graph. The process of calculating a mass starts with the mass density of a galaxy as shown in *Figure 1*. *Figure 2* illustrates the orbital speed of masses measured with the red shift of star light. Close to its center a galaxy rotates similar to a solid body. This turns into a flat rotation outside of the center.

Figure 1



The curve represents a typical mass density distribution that can be measured with the help of the ratio of light intensity versus mass in a galactic plane. (Ort, 1938) The curve in *Figure 1* is not calculated – it is observed. The center of the galaxy is located on the left side, where the largest mass density can be found. Toward the right side, the mass density decreases by 400 – 1000 (Oort & Plaut, 1975). Elvius (1962) includes an accurate graphic depiction of mass density distribution with logarithmic scale. In this example, however, the mass is reduced by the factor 812.

Figure 2



The even distribution of speed (Huette, n.d.), typically observed in all galaxies, is added to the graph in *Figure 1*. The (red) curve indicates that the masses reach their constant speed of 225km/sec very quickly. The curve is idealized. In reality, the values are close to, but not exactly the same speed.

Both curves represent the values usually measured in common galaxies.

The mass of a galaxy can now be calculated with the measured orbital speed. It is assumed that the mass distribution in a plane is equal to that in a sphere. The value of the calculated mass should at least approach the value of the visibly measured mass. The mass of a galaxy is determined with the formula (Masso & Eduard, 1995):

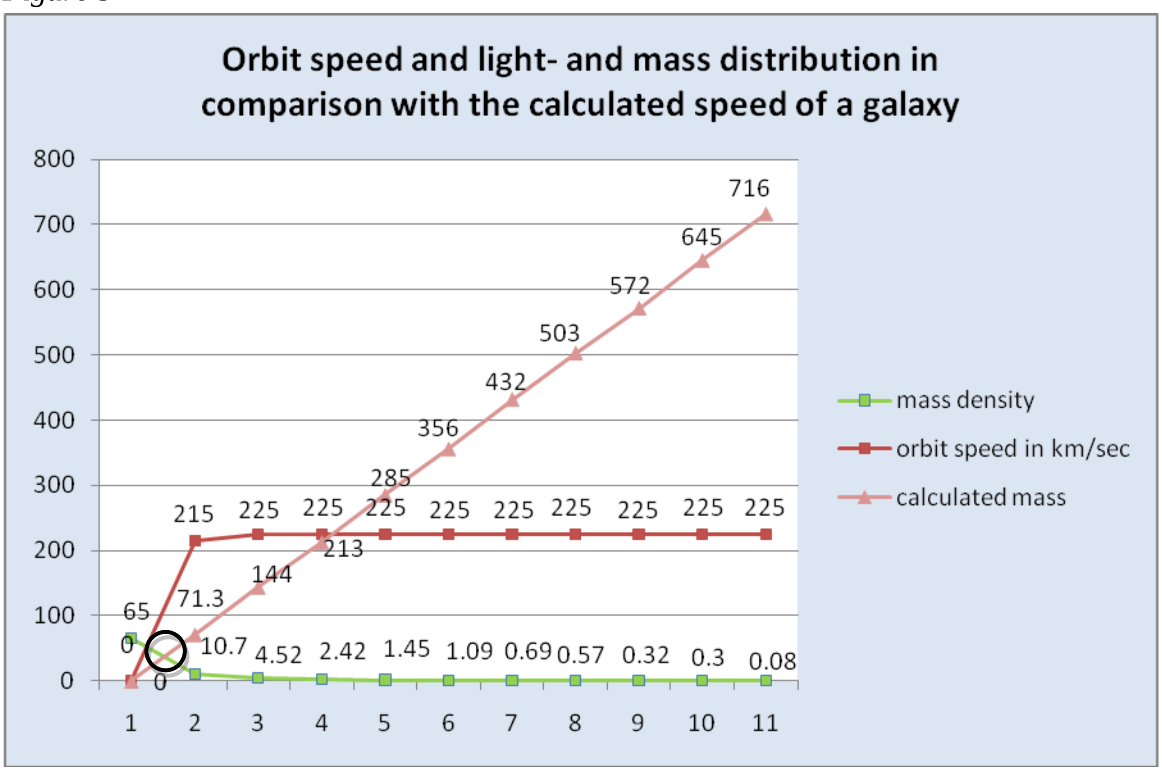
$$v = \sqrt{\frac{\gamma \times M}{r}} \approx \frac{1}{\sqrt{r}} \quad \textbf{(F1)} \qquad \text{with v = constant:} \qquad M = \frac{v^2 \times r}{\gamma} \quad \textbf{(F2)}$$

The predetermined constant speed v in all galaxies causes the, with F2, calculated masses to change only with the radius r. The formulas F1 and F2 are used for plane mass distributions, as well as sphere mass distributions. (1 Mass unit = 1.12E+39kg / 1 radius unit = 9.46E + 19m)

With r = 1, the calculated mass value M of an average galaxy in this example is 71.6 mass units. Consequently, with r = 10, the mass is 716.

The following *Figure 3* includes the calculated mass as a pink curve. This linear mass curve is noted in scientific literature and commonly accepted.

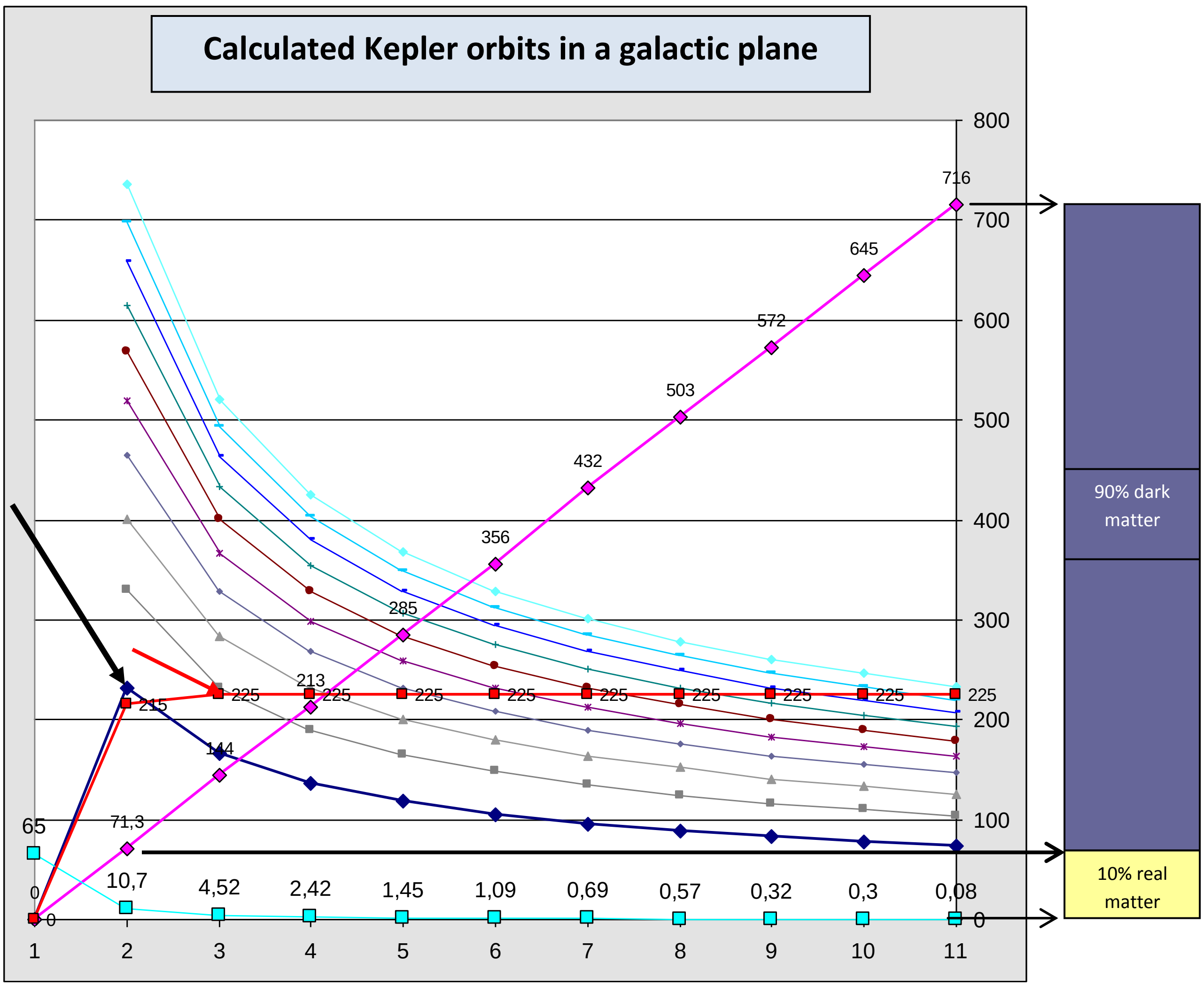
Figure 3



A comparison of the two mass curves reveals a discrepancy. Instead of being similar, they oppose each other. The curve representing the visible mass approaches zero, while the calculated mass continuously increases. The curves cross only at one point, which is marked with a small circle in *Figure 3*.

If the speed of a mass around the center of a galaxy (r = 1) is calculated with F1, the result matches the orbital speed in the graphics. V = 232 km/sec. (A slight discrepancy is intentional to keep the markers from being identical.) Hence, the calculated mass value of a galaxy close to the center is sufficient for the masses to remain on a stable orbit (black arrow).

Figure 4



If this calculated mass (M = 71.3) is used to determine the orbital speed with r = 2, the result is smaller than expected. Should the masses move along Kepler orbits, their speed decreases with an increasing distance to the center. However, in reality the orbital speeds do not decrease, but stay constant at 225 km/sec.

It is a proven fact that the majority of masses are concentrated around the center of the galaxy: "*Because the core region of a spiral galaxy has the highest concentration of visible stars, astronomers assumed that most of the mass and hence gravity of a galaxy would also be concentrated toward its center. In that case, the farther a star is from the center, the slower its expected orbital speed. Similarly, in our solar system, the outer planets move more slowly around the sun that the inner ones. By observing how the orbital speed of stars depends on their distance from the center of a galaxy, astronomers, in principle, could calculate how the mass is distributed throughout the galaxy"* (Rubin, n.d.).

Therefore, to increase the orbital speed in the calculation so that it matches the measured values, the center mass has to be bigger. Since the visible mass cannot be modified, an additional (invisible) mass is needed.

Doubling the mass in the center allows for the mass with r = 2 to orbit at a speed of the required 225 km/sec, which is illustrated with a red arrow. *Figure 4* shows the curves for respective radii r = 3, 4, 5, 6, 7, 8, 9, and 10. Each curve crosses the red orbital speed curve in its radius mark. The resulting group of curves illustrates how a growing center mass is necessary to maintain a constant orbital speed. Consequently, the mass of the entire galaxy increases as well. By assuming r = 1 and M = 71.3 to be the basis for this calculation example, a ten times larger mass is required at the edge of the galaxy to facilitate an orbital speed of 225 km/sec. In 1933, Fritz Zwicky determined that a 400-times larger mass is needed for a constant speed in the Coma-Galaxy, and invented the invisible *dark matter* (Wikipedia, 2007). The same problem appeared in 1960 when Vera C. Rubin examined galactic orbital speeds. Ever since, the expression *dark matter* has played a vital role in modern physical and cosmological sciences.

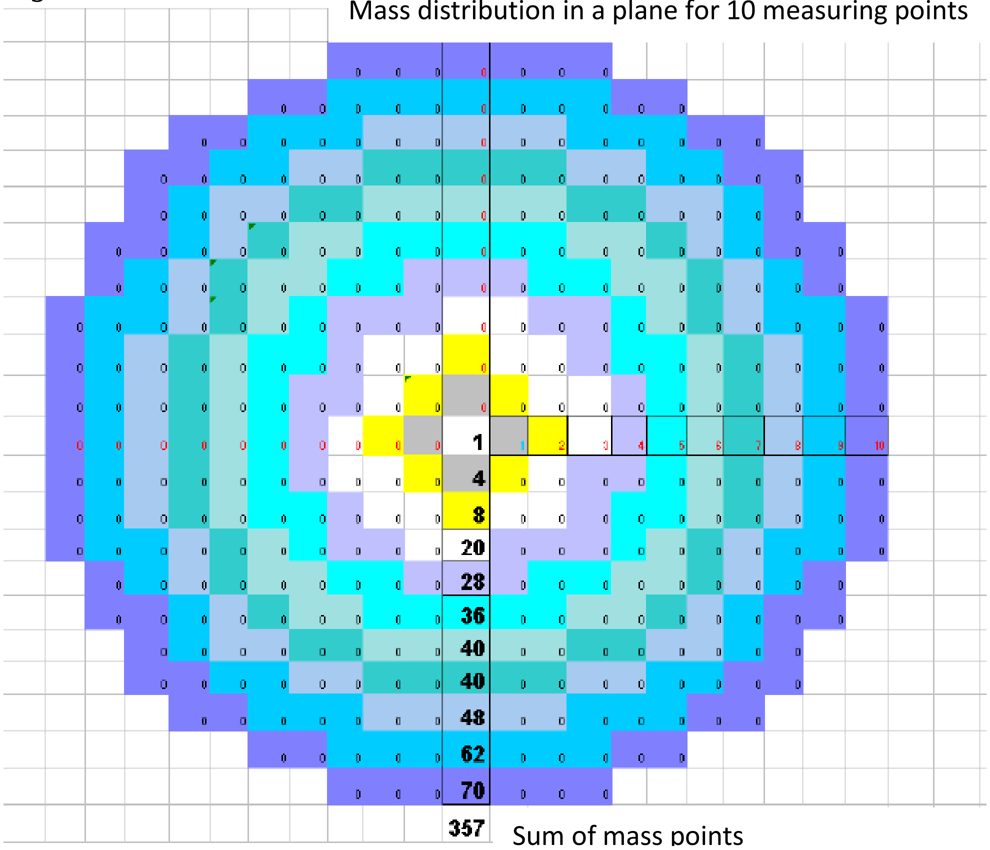
The ratio of visible mass to invisible (dark) mass is 1:10. A galaxy has a ten times larger mass than what is visible. Nevertheless, this ratio varies for 1:5 (Bosma, 2003) to 1:100 (Sterne und Weltraum, 2005).

Addition of visible masses for the purpose of checking the calculated masses

The mass density in a galaxy is different from its number of masses. While mass density pertains to a single plane unit, the number of masses is the product of the number of plane units multiplied with the mass density. To turn the visible mass density of a galaxy into a comparable number of masses, the plane has to be grid lined. The mass density of every single unit can be determined with concentric grid lining of the plane (the 3rd and 4th rings are not completely concentric because of the number of mass points). Only then is it possible to add up the combined mass of a galaxy.

In this example, a rotation symmetrical circular plane is gridded into 357 mass units. Starting in the center toward the edge of the plane are ten concentric rings. The larger the rings, the more mass units – also called mass points – are present.

Figure 5

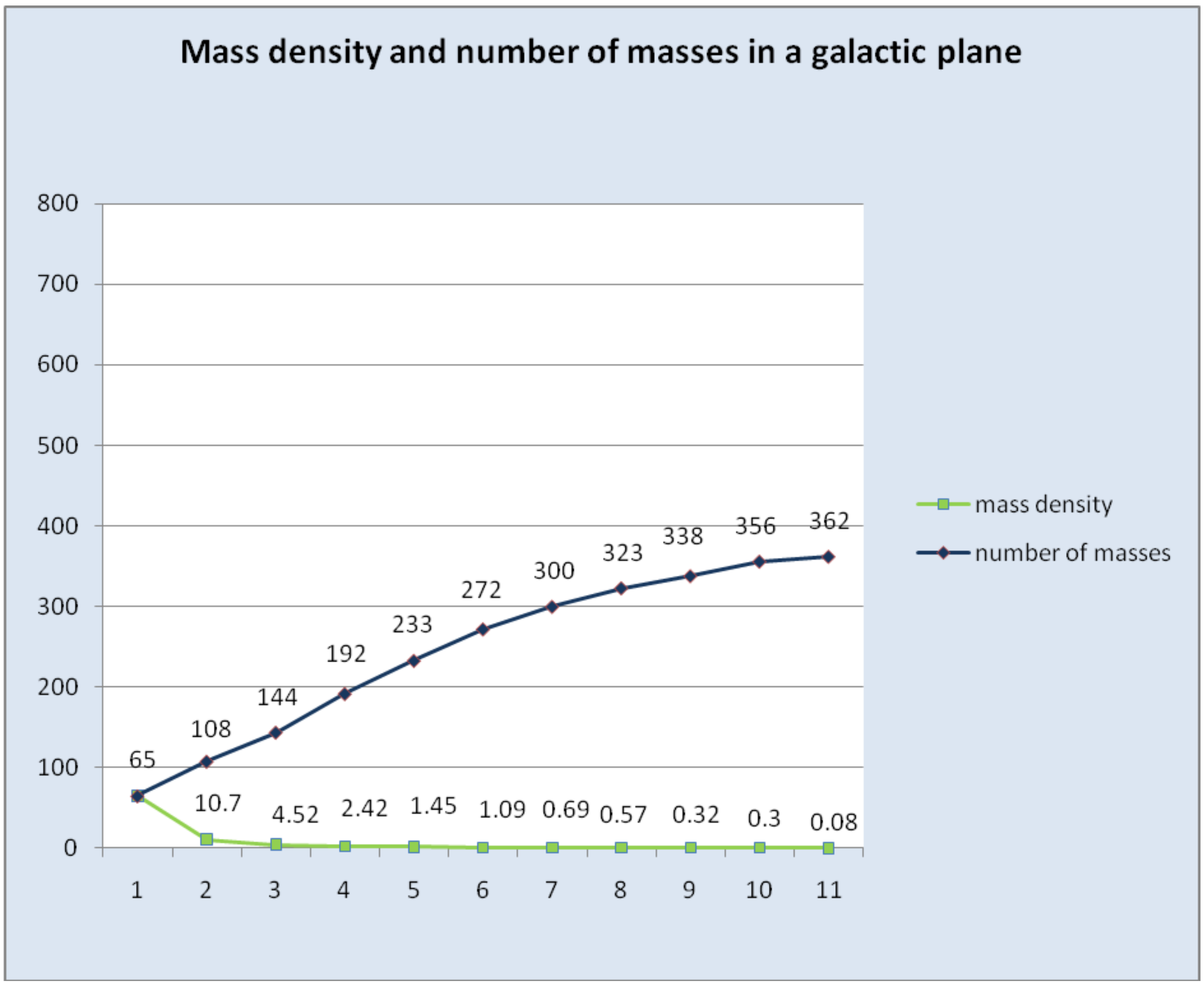


In order to add the masses, the number of mass points per ring has to be multiplied with the measured mass density in the galactic plane. This is done according to the following principle: a point in the center has the mass density 65, which equals 1 x 65 = 65 mass units. This is repeated for every ring.

Number of gridded mass units		Mass density according to the brightness : mass ratio		Number of masses per ring	Addition of number of masses per ring	Radius
1	X	65	=	65.00	65	
4	X	10.7	=	42.80	108	1
8	X	4.52	=	36.16	144	2
20	X	2.42	=	48.40	192	3
28	X	1.45	=	40.60	233	4
36	X	1.09	=	39.24	272	5
40	X	0.69	=	27.60	300	6
40	X	0.57	=	22.80	323	7
48	X	0.32	=	15.36	338	8
62	X	0.30	=	18.60	356	9
70	X	0.08	=	5.60	**362**	10

Then the masses per ring are added up and graphed as seen in *Figure 6*. With the addition of the last ring (the outer most ring), the calculation is complete. The visible combined mass of the average galaxy is therefore 362, which are approximately 200 billion "earthly" sun masses. The number of masses is similar to the visible mass of an average galaxy (Goruma, n.d.). Adding these values to *Figure 1* results in *Figure 6*:

Figure 6



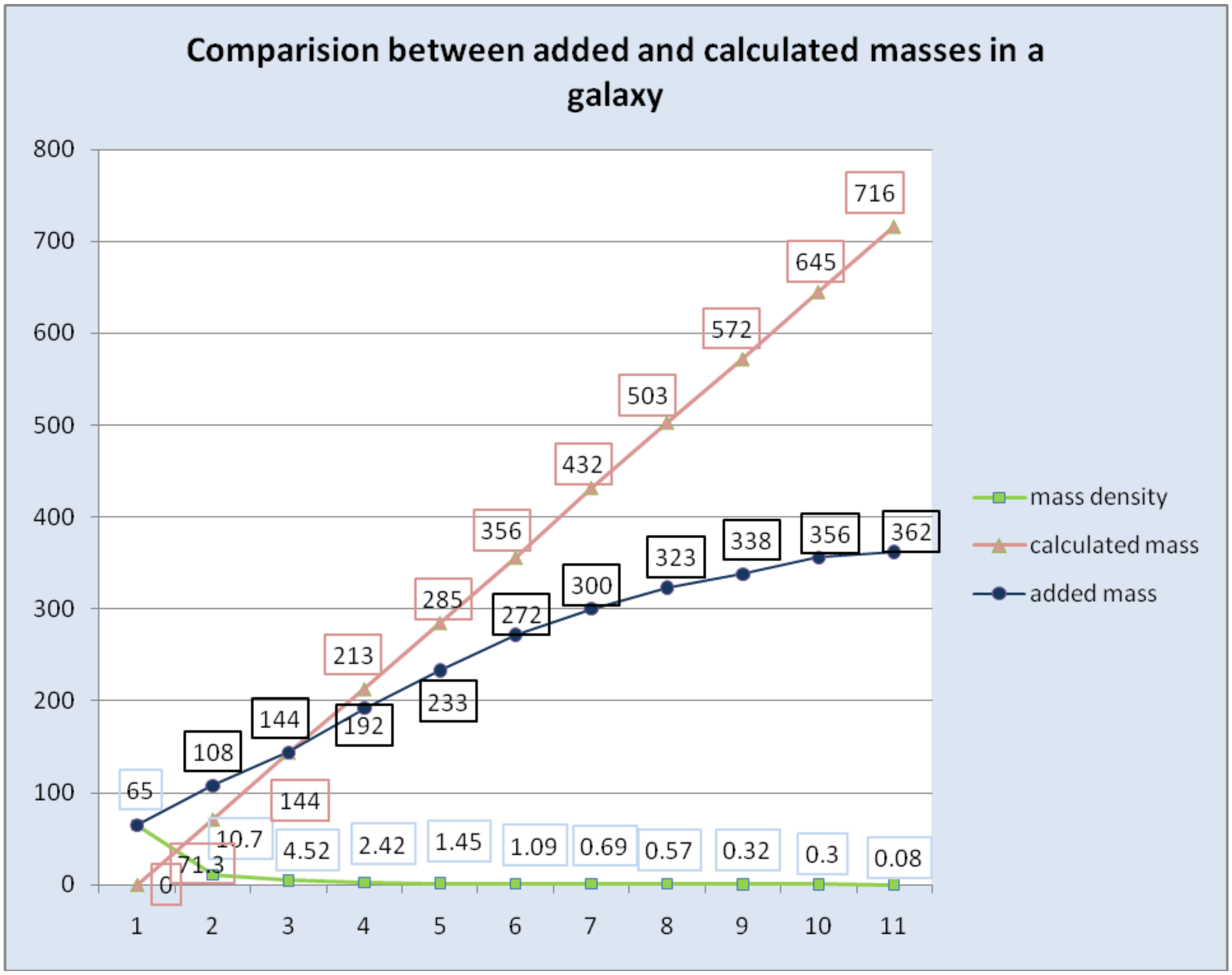
The number of masses increases toward the edge, because with every step, another ring is added to the sum. The combined mass number of the galactic plane can be found at the right of *Figure 6*. It is obvious that the mass density decreases toward the edge, the number of masses, however, increases. The two curves do not oppose each other; the mass density causes the increase in number of masses.

This curve is not listed in the scientific literature as addition of masses, because it is complicated and less elegant. Nevertheless, it provides reliable values. Usually, the number of masses is estimated and varies considerably depending on the basis values.

Comparison of calculated masses with added masses

Once the curve for the added masses (dark blue) is included in the graphic, the values can easily be compared to the calculated masses.

Figure 7



Surprisingly, the comparison reveals that the added number of masses in a galaxy amounts to only about half of the calculated combined mass. The ratio between dark and visible calculated matter and added matter shrinks from 10 : 1 to only 2 : 1.

The added mass as test for the integral calculation provides the only exact value for the *visible* masses! This was not the expected result of 700 mass units of dark matter and 70 units of visible mass. If the calculated 70 mass units are put in relation with the visible 362 mass units, it becomes clear that only 19.3% of the visible masses are calculated with the integral method. Which means that a wrong (too small) mass ratio of 5 : 1 is calculated.

Furthermore, the fact that the center of the galaxy has a bigger added than calculated mass (up to r = 2) indicates that the integral method harbors a fundamental error for the calculation of masses in many-body-problems that were transformed into two-body problems. To be precise, the number of masses is to be calculated in a sphere.

Comparison of calculated masses and added masses in a sphere (sphere shaped galaxy)

Since the integral calculation of masses in a sphere is equal to that in a plane (with formulas F1 and F2), the results are similar as well. Hence, in a sphere, the calculated masses increase toward the outer edge if their speed remains constant. To check these results, the masses only need to be added up discretely. (A sphere has a slightly different mass density than a plane, which required the adjustment of values in the following table.) As before, the orbital speed shall be constant. The sphere in this example has 5065 mass points, because the number of mass points per sphere ring grows at a different rate than that in a plane.

Number of gridded mass volume units		Mass density according to the brightness : mass ratio		Number of masses per sphere ring	Addition of number of masses per sphere ring	Radius
1	x	430	=	430	430	
6	x	41	=	246	676	1
74	x	8.2	=	607	1283	2
98	x	3.3	=	323	1606	3
250	x	1.9	=	475	2081	4
342	x	1.1	=	376	2457	5
578	x	0.7	=	276	2733	6
586	x	0.55	=	404	3137	7
914	x	0.33	=	302	3439	8
990	x	0.33	=	327	3766	9
1226	x	0.2	=	245	**4011**	10

Following the multiplication of mass density and number of mass units, the number of masses per sphere ring is added up and graphed in *Figure 8*. The combined mass of the galaxy can be found once all masses are added. In this example, it is 4011 mass units.

1 mass unit = 1.0E + 39kg / 1 radius unit = 19.0E + 19m / orbital speed is constant at 400 km/sec.

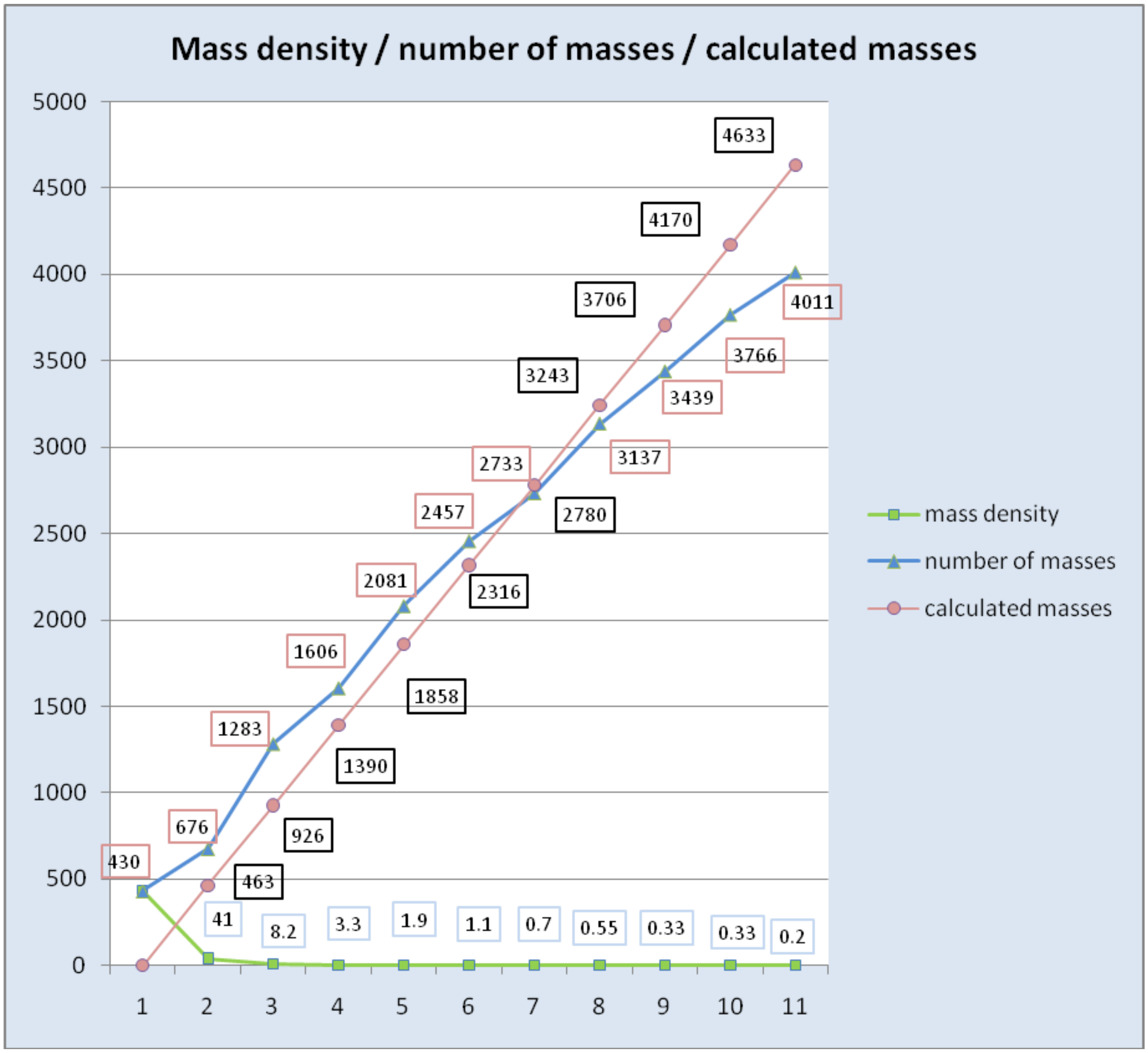
(Note: the galaxy in this example does not exist; however, the values serve the purpose of comparing and contrasting calculated and added masses in plane and sphere. A galaxy with the determined masses would favor a too large elliptical galaxy.)

The added number of masses is illustrated in *Figure 8* by the light blue curve. As a comparison, the calculated mass (with a constant orbital speed) curve is also present as pink curve.

It is clearly visible, that the calculated and added masses at the edge of the galaxy differ by only +15.5%, whereas the values in a plane differ by almost +100%. Close to the center of the galaxy, the calculated masses are smaller (!) than the added values (only 68%). Similar characteristics of curves and values could be seen in the example with planes (66%). (Note: the grid lining of the sphere causes a slight curve variance in the figure.)

Depending on the mass density distribution, the calculated positive and negative discrepancy of values indicates a dynamic median value.

Figure 8



Conclusion

The graphic comparison of calculated and added mass values of plane and sphere galaxies indicates:

- ✓ Discrete calculation of masses lead to correct values in plane and sphere galaxies
- ✓ An additional calculated mass (a dark, invisible) matter is unnecessary in plane and sphere galaxies
- ✓ The masses of sphere and plane galaxies must not be calculated with the same integral formula

The calculation of dark matter is based on at least two mistakes:

- ✓ The integral calculation according to Sir Isaac Newton is not ideal for masses in a plane or field galaxy. Newton used his formula only for the calculation of gravitational forces – never for masses. This even applies to the determination of masses in spheres, because the calculated and added values differed along the curve.
- ✓ The mass density of a galaxy determined with the ratio of brightness and mass is commonly assumed to be equal to its real mass. This error reduces the real mass by almost 90%, and is the main reason for the "existence" of dark matter.

Appendix

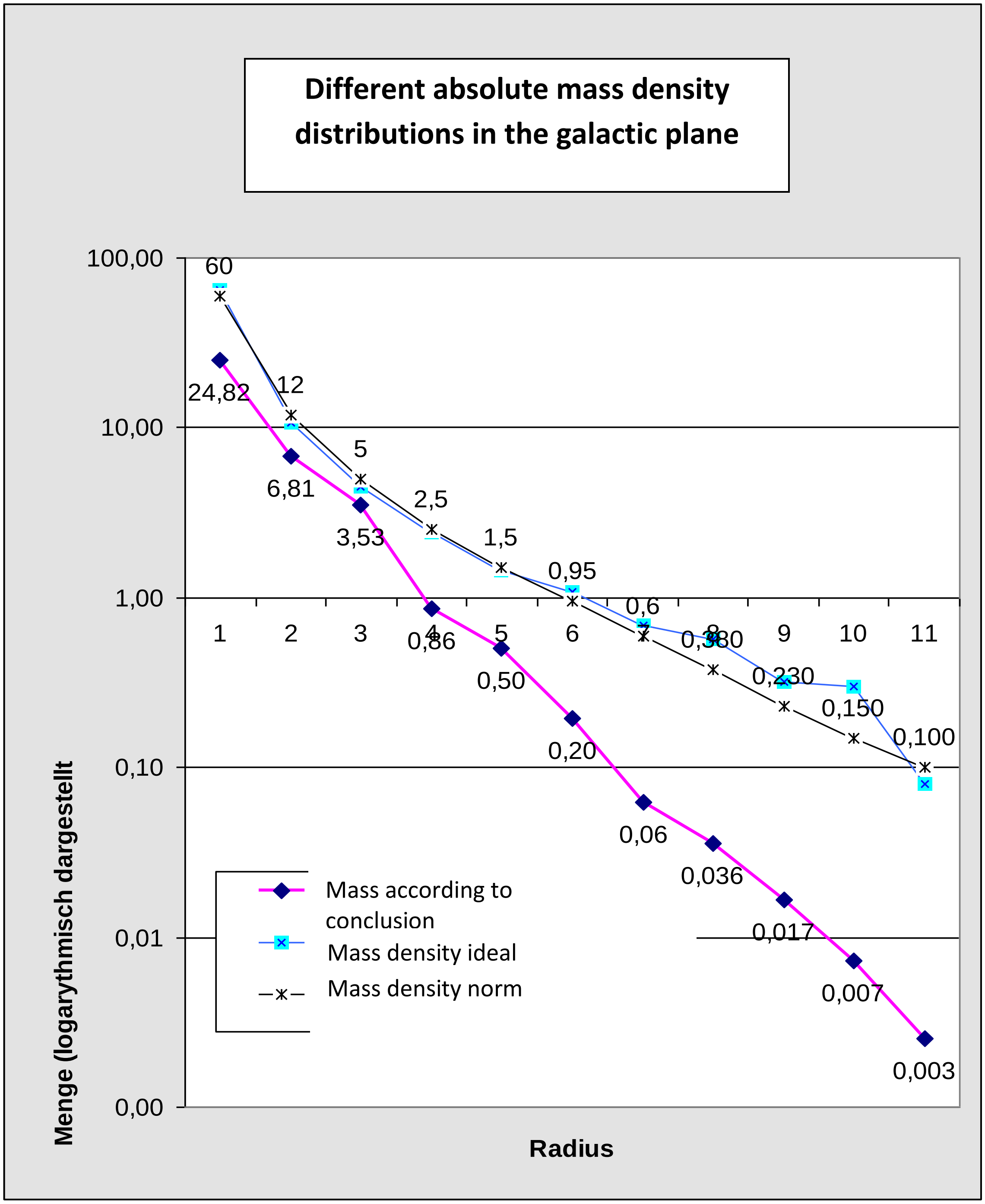
http://www.wissenschaft-schulen.de/artikel/785398

The bases for every galactic mass calculation are two observable values: The **mass density**, measured with the light intensity of suns within a galaxy, and the **orbital speed** of masses, which can be measured with the red shift of a galaxy's light. From the center to the outer edge of a galaxy, this speed is flat and remains constant at about 225km/sec. An average mass density distribution from center to edge of about 1000 : 1 up to 500 : 1 can be found in modern literature.

Figure 9 shows these values as *mass density norm*, as determined by Elvius (1962). The logarithmic scale of the y-axis enables a clear view of the mass distribution at the edge of a galaxy. A similar mass distribution is shown by Holmberg & Flynn (2006).

In addition to the *mass density norm* curve, *Figure 9* includes the mass density found in *Figure 1*, which is now called *mass density ideal.* These two curves are very similar to each other; and both indicate a relatively even speed distribution.

Figure 9



In addition to the two mass curves, a third curve -*mass according to conclusion*- has been added to *Figure 9*. This curve, found in an in-service paper for teachers, was **estimated and assumed** to be correct according to “the brightness distribution in a galaxy” (AkaProjekte, n.d., workshop 4).

This estimation of values is also illustrated as a table, which features the mass addition per ring (also see *Figure 10*). The values highlighted in blue were taken out of said table, while the remaining values were added in accordance with the in-service.

Addition of masses per ring M (kg)	Number of masses per ring (kg)*10^{39}	Recalculation into mass units	Number of gridded mass fields	Mass density according to light intensity-mass ratio	radius	R kpc
27.8*10^{39}	27.8	24.8	1	24.8		<3
58.3*10^{39}	30.5	27.2	4	6.8	1	3
89.9*10^{39}	31.6	28.2	8	3.53	2	6
109.1*10^{39}	19.2	17.1	20	0.855	3	9
124.8*10^{39}	15.7	14.0	28	0.5	4	12
132.7*10^{39}	7.9	7.05	36	0.196	5	15
135.5*10^{39}	2.8	2.5	40	0.0625	6	18
137.1*10^{39}	1.6	1.43	40	0.0358	7	21
138.0*10^{39}	0.9	0.76	48	0.0158	8	24
138.5*10^{39}	0.5	0.45	62	0.00726	9	27
138.7*10^{39}	0.2	0.178	70	0.00254	10	30

The second column shows the number of masses per ring in kg, which is determined by a subtraction from the first column, for example: **138.7*10^{39}** - 138.5*10^{39} = 0.2M (for the outer most ring). Following the calculation of number of masses, the third column shows the absolute mass value of each ring, to improve the comparison between the three different curves. (1 mass unit = 1.12E + 39kg / 1 radius unit = 9.46E + 19m)

If these mass units per ring are divided by the number of gridded mass fields/planes found in column 4, the result is a calculated mass density value, which should be similar to the measured light intensity-mass ratio. The –based on estimates- calculated values are listed in column 5 and have been added to *Figure 9* as a pink curve.

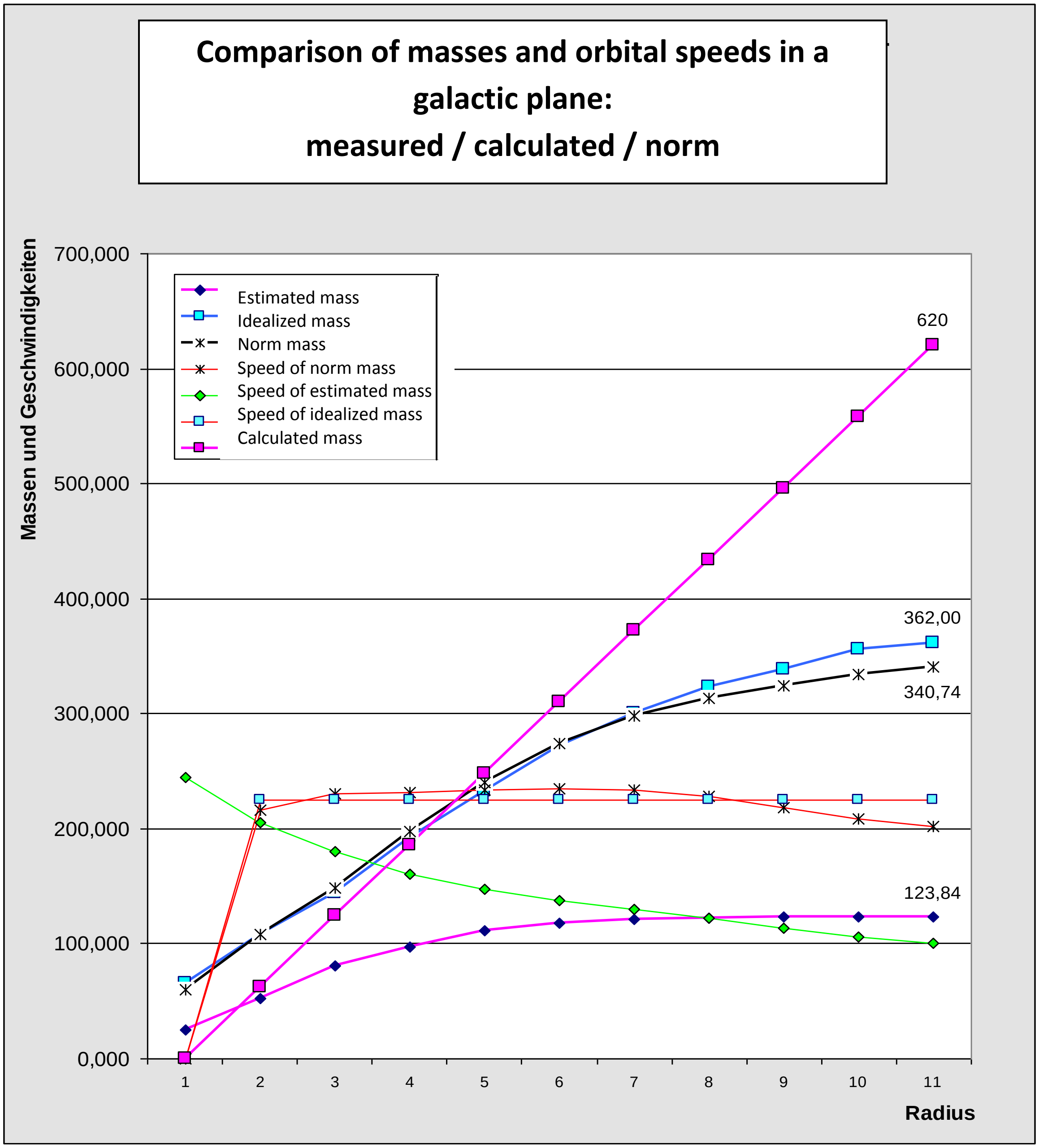
Comparability of mass densities

The basis value for *Figure 9* is the real mass in the center, which is a given value for all three curves. The curves show not a relativistic, but absolute comparison of mass densities.

The *mass density according to conclusion* differs from the two other curves considerably: a 33 times smaller mass value, than that determined with a brightness to mass ratio! The reason for this odd estimate is incomprehensible. *Figure 9* shows a difference of 8273 : 1, which means, according to the conclusion, the edge of a galaxy is almost completely free of stars. This estimated curve stays in contrast to the measured values in a galaxy, and therefore, indicates a random determination of masses in the in-service program for teachers.

Calculating the masses according to the mass densities also shows a difference between the *estimated masses* and the *norm masses*.

Figure 10



In this figure, the norm mass is a black curve that increases from left to right. The blue curve, which represents the idealized masses, is almost identical to this curve. If the orbital speeds of the blue and black curves are discretely calculated, they match the speeds measured in reality.

Both curves for the speed are displayed in red. The slight discrepancies are smaller than 10% and within the normal realm of calculation errors within a galactic plane or field. The curve for estimated values taken from the in-service for teachers, however, is very different from the other curves. It varies up to -59% and -63% from the other two curves. In addition, the increase in masses is smaller than expected, and remains almost constant toward the edge of a galaxy. Consequently, the orbital speed can be expected to decrease toward the edge.

The in-service pamphlet points out, that "the measured rotational speed in a galaxy remains almost constant, which means, that the ratio M(r)/r has to remain constant as well". According to this statement, the curve for the calculated mass should increase linearly toward the edge.

Burkert (2006) also shows mass distributions comparable to *Figure 10*. Furthermore, his figures the radius of the sphere is not in accordance with the orbital speed and its masses.

The combined masses in the teacher in-service calculated with the estimated values is

$$138.7*10^{39} / 1.98*10^{30} = 70*10^{9}$$

The real combined mass of a galaxy, however, is approximately 200 billion suns per galaxy – not 70 billion. Note: with the values found in the in-service, a galaxy is only 1/3 of its original size, because the outer edge is assumed to be almost mass free. In addition, the brightness-mass ratio is not reflected in the estimated values, since they differ almost 97% from the real values.

The estimated mass values found in the teacher in-service are therefore completely wrong. The orbital speeds calculated with the estimated values are supposed to follow a Kepler curve, but do not add up correctly, as the edge value is 100km/sec instead of 65km/sec (green curve, calculated with formula **F1**).

Interestingly, these estimated values are then used to prove the existence of dark matter.

To be precise: once can assume, that the values throughout the curve were made (estimated) 10 times smaller than in reality, to facilitate a larger amount of dark matter. If true start values had been used, the amount of calculated dark matter would have been much smaller.

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