The common cause of epicycloids and dark matter
- Part 2: the calculated mass of a galaxy -

A paper by: Dipl. Ing. Matthias Krause, (CID) Cosmological Independent Department, Germany, 2007

Objective

The first part of the common cause of epicycloids and dark matter contains the mathematical proof of a connection between pre-Copernicus epicycloids and modern dark matter. This second part concentrates on the measured masses in a galaxy, which are then compared to the calculated masses. The difference between the two, usually called *dark matter*, is evaluated and discussed.

In addition, this essay addresses the issue of two-body-problems always being a hidden three-body-problem, by contrasting the gravitational with the visual rotation point. A mathematical approach shall shed light on the importance of a gravitational rotation point in a two-body-system, and how to calculate such a point. In this context, pioneer anomalies and swing-by-anomalies will be evaluated.

The necessary calculations are added on to this paper, as to not disturb its logical flow.

The typically calculated basic data of a galaxy (NGC 3198)

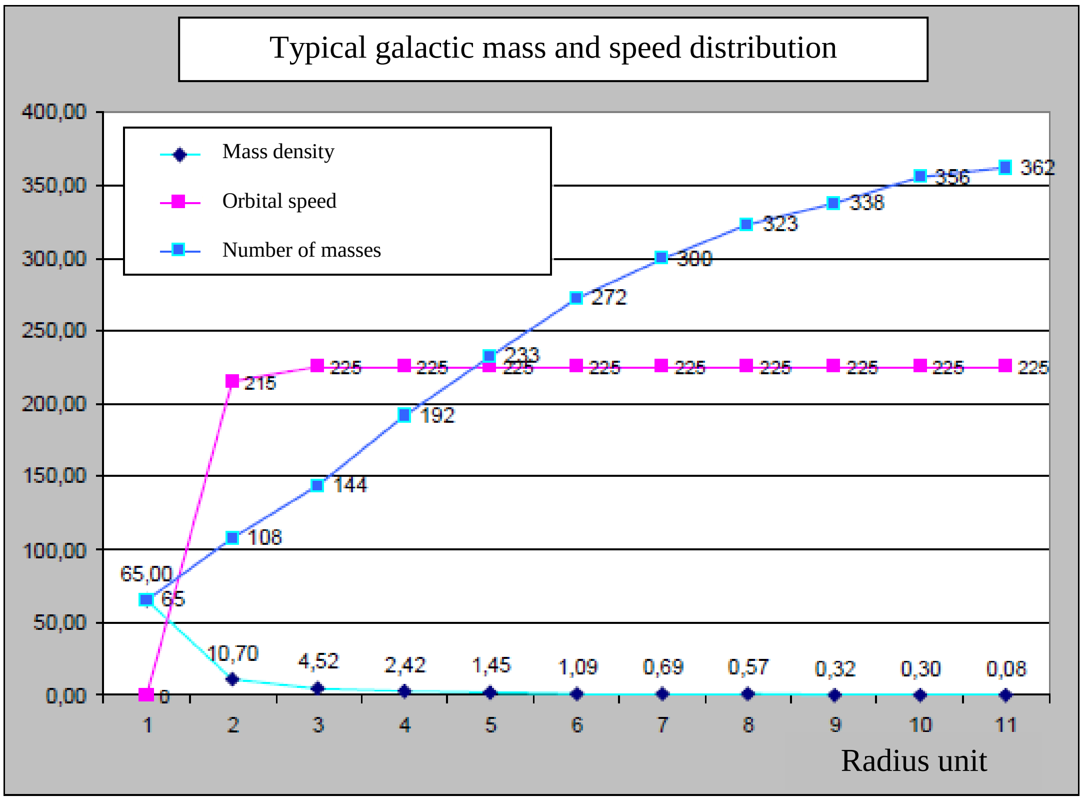
The basic data for this chapter was measured with conventional instruments. None of the parameters in this chapter are calculated. Since different calculation methods sometimes produce different results for the same parameter, it is always important to distinguish between measured and calculated data.

Even though each galaxy is unique in its size, shape, and consistency, some fundamental values can easily be measured in every galaxy in the cosmos:

- *Orbital speeds*
  Orbital speeds are commonly determined with the Fisher-Tuly-Relation. The speed graph of each mass in any given galaxy is even, which means, it remains constant regardless of the mass' location. Typical orbital speeds, including orbital speeds in our milky way, are approximately 230 km/s. Occasionally, masses orbit at a speed of 150 km/s or faster than 230 km/s. Since the 1960s, orbital speeds are measured beyond the visual edge of a galaxy. Surprisingly, the speeds remain constant – even at the 21cm line of neutral hydrogen. (see *Figure 1*)
- *Mass density distribution*
  The mass density distribution of elliptical galaxies is measured with optical-sensory methods. The mass density of each galaxy falls exponentially from the center to its measurable edge. A characteristic galaxy has a mass ratio of 1000:1 from center to edge, which means, the mass density at the edge per unit is 1000 times smaller than in the center. (see *Figure 1)*

- *Number of masses*
  To determine the number of masses, they are added from a galaxy's center toward its visible/measureable edge. A characteristic mass number curve is continuously increasing with a slightly decreasing slope from center to edge. Only visible masses, for example, stars, dust clouds, and gas clouds are added. The mass number curve is the result of a multiplication of concentric units with their concentric mass density distribution. Once all units are added, the combined mass has been determined. It is usually measured in kg or solar masses. (see *Figure 1*)

Figure 1



- *Number of stars*
  Scientific literature provides the photographs of single galaxies for a thorough star count. The number of stars in the Milky Way lies at approximately 200 billion solar masses within a diameter of 200,000 light years. Since the majority of stars are lighter than the sun, their number is even greater than 200 billion.
- *Mass-brightness ratio*
  At this point, the mass to brightness ratio is important. Even though some stars are very bright, they have a rather small mass. At the same time, dull stars can have a large mass. The mass-brightness ratio of the Milky Way is 4.5:1. It produces as much light as only 45 billion suns.

- *Lengths and distances*
  Lengths and distances are measured with the brightness of RR-Lyra and Cepheid. Relatively accurate measurements can thus be found in scientific literature.
- *Amount of hydrogen*
  A substantial part of a galaxy's combined mass is hydrogen, which is measured with radiometric measuring methods. Galaxy NGC 3198 has been extensively researched. Therefore, the determined amount of Hydrogen is well known.

The seven mentioned parameter can be measured for every galaxy. The measurements have been recorded numerous times and are scientifically approved.

Example:

A galaxy has a visible diameter of 100,000 light years (ly), and rotates at a speed of 150 km/s 100,000ly beyond its visible edge. Consequently, its real diameter is 300,000ly. No masses are located past this point. The graph in *Figure 2* shows that at an orbital speed of 150 km/s with the given radius, the mass of this galaxy is 150 billion solar masses. This mass has also been determined by simple measurements of this galaxy with its surrounding hydrogen (warp) and halo.

Figure 2

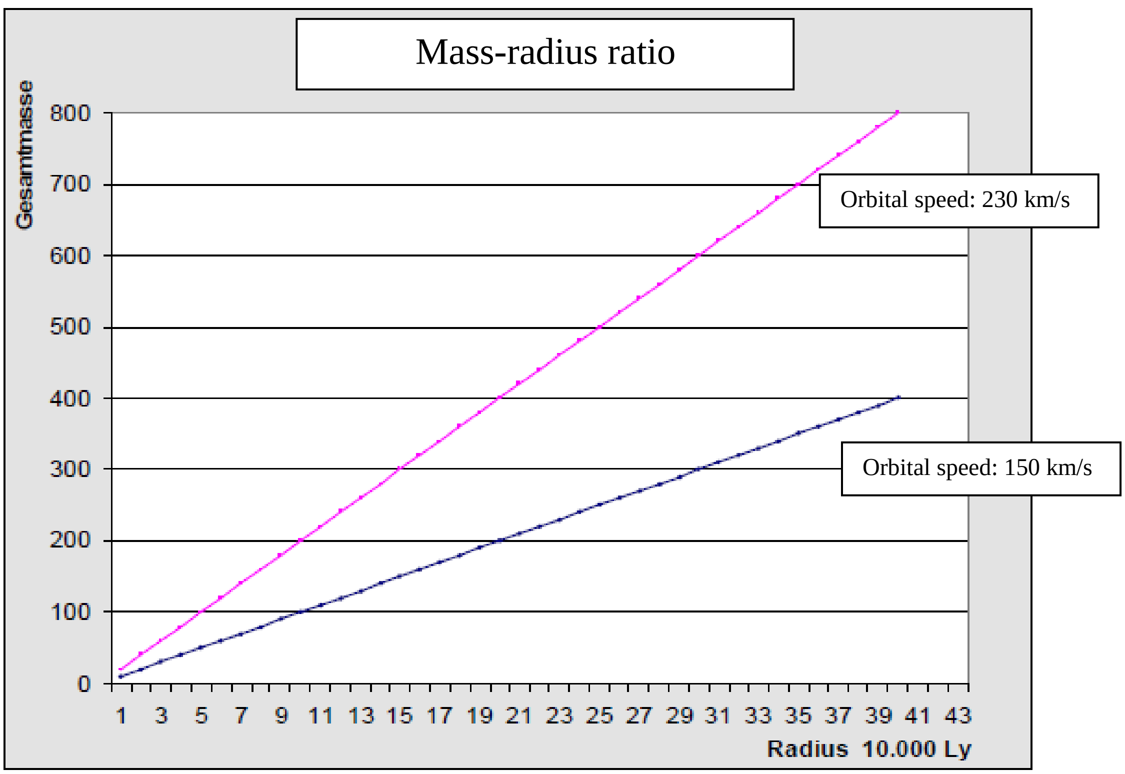
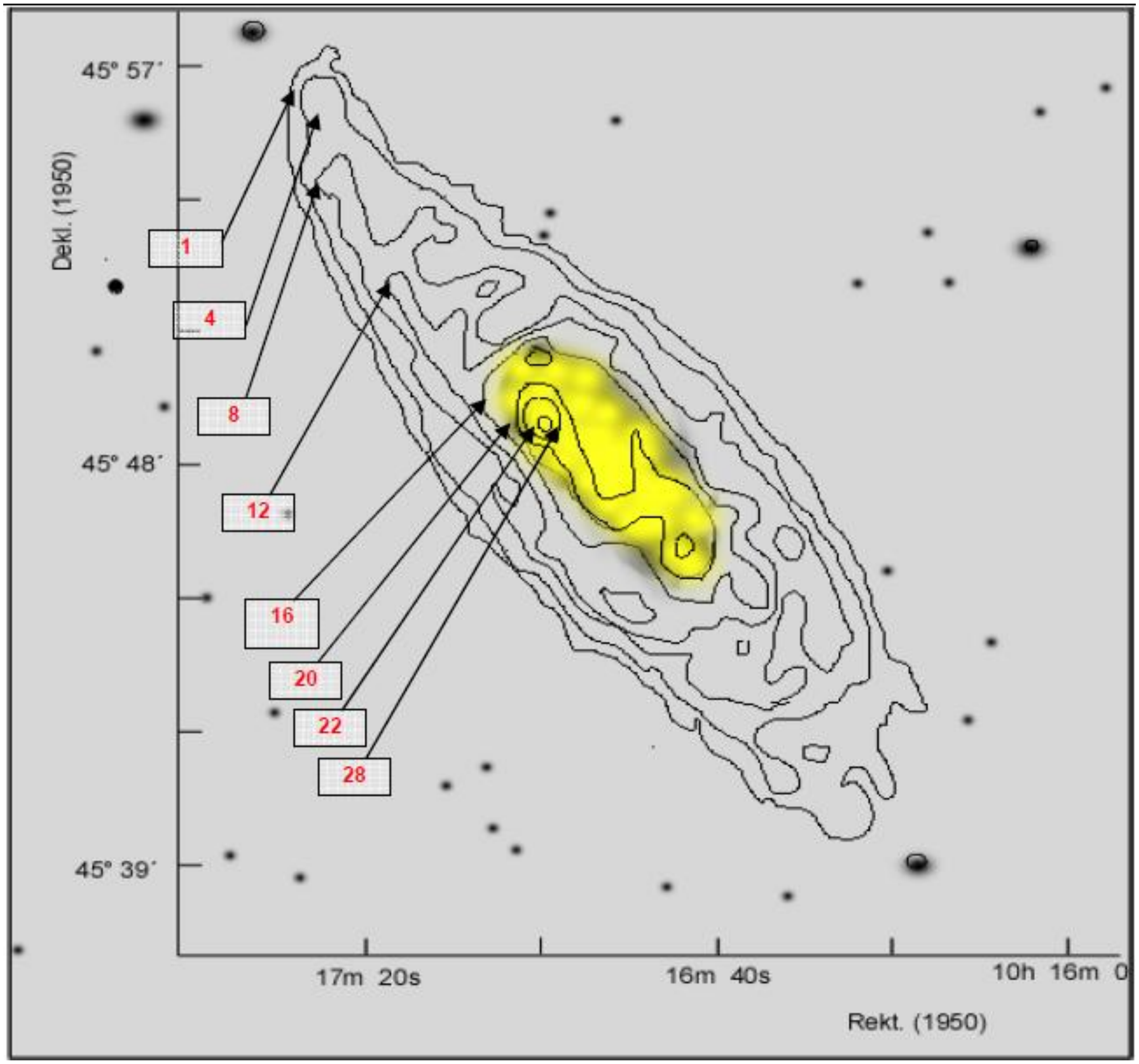


Figure 3 – Galaxy NGC 3198



Neutral hydrogen is easily found, but difficult to measure. Very cold, compact hydrogen molecule clouds often escape measurements. Consequently, the measured mass of a galaxy beyond its line of visibility can seem to be too small.

Figure 3 shows galaxy NGC 3198 with basic data found in scientific literature (van Albade, 1985). The lines show areas of similar mass density (only hydrogen!). The angle expansion of this galaxy is 11.9 radian minutes (diameter: 23.8 minutes), which corresponds with an angle of 0.198 º (diameter: 0.396º). It lies at a distance of 30 million ly, and has an expansion or diameter of 207,600ly.

$$D_{gal} = tan(0.396^{o}) \times 30 \times 10^{6} ly = 207{,}600 ly$$

Hence, size and distance of NGC 3198 are known. The values were taken from Albada (1985) and confirmed. *Figure 3* verifies the diameter of over 20 minutes.
Instead of calculating masses, the measured values are put in relation to light years. The outer most line in *Figure 3* marks a hydrogen density of 1×10^{20} atoms per square centimeter. This density increases toward the center: 4, 8, 12, 16... . The hydrogen surrounds the galaxy up to a distance of 31.8kpc (103,800ly). The visible part of the galaxy has a radius of only 10.6kcp (34,600ly). Nevertheless, Hebbeker (2002) assumes a radius of 20kpc (67,000ly) for NGC 3198. This, however, appears to be two times too large and might be due to a confusion between radius and diameter.

The area outside of the yellow galaxy is called warp. It is angled about 20º of the visible galaxy. The mass density of hydrogen has been measured by J.W. Sulentic and lies at 1×10^{20} atoms per cm^2. The true mass of the warp can be calculated with this measurement and the Avogadro constant:

$$m = \frac{1\times10^{24}\times1.00797}{6.02252\times10^{26}} = 0.00167 \text{ kg per } m^2$$

The edge of galaxy NGC 3198 contains 0.00167 kg of atomic hydrogen per square meter. Since NGC 3198 is a three dimensional galaxy, this value indicates an atomic volume that applies throughout the warp. NGC 3198's distance from Earth makes it difficult to determine the thickness of the warp. If a thickness of 1,000ly is assumed, each cubic meter of warp must contain 100,000 hydrogen atoms. A vacuum with such a small number of atoms can be created on Earth only under enormous technical difficulties.

m^2 *in* ly^2

One light year has the length of 9.46×10^{15} m, if the speed of light is set at 300,000 km/s. A square light year is then:

$$(9.46 \times 10^{15} m)^2 = 89.49 \times 10^{30} m^2$$

The according mass of the warp is:

$$89.4910^{30} m^2 \times 0.00167 kg = 0.149448 \times 10^{30} kg/ly^2$$

In order to determine the combined mass of the galaxy, it needs to be gridded into 357 grid units, each of which is the length of 10 radius units (10,400ly). The grid lining includes the galaxy and its warp.
The size of each unit is therefore

$$(104{,}000 ly)^2 = 108.16 \times 10^6 ly^2$$

And the combined mass of each unit is

$$108.16 \times 10^6 ly^2 \times 0.149448 \times 10^{30} kg/ly^2 = 16.164296 \times 10^{36} kg$$

or 8.164×10^6 solar masses of pure atomic hydrogen.

Since 9% of the interstellar gas is helium, about 36% of the calculated mass has to be added. Furthermore, 10% of the gas consists of molecular hydrogen, which requires the mass to be multiplied with 1.5. The thus calculated mass can be too small, but definitely not too large, because dust particles, for example, iron are not taken into consideration.

With these numbers, the outermost unit has a mass of 12.246×10^6 solar masses, and the remaining masses per unit are simply added to find the combined mass of galaxy NGC 3198. However, the inclination of NGC 3198 plays an important role in determining the mass of the galaxy, because at an angle of 71º toward Earth, the visible mass appears 3 times bigger than at an angle of 0º. The density ratio is 3.32 : 10.07. Therefore, the mass value has to be multiplied with the factor 0.33. Please note that the galaxy's halo is an exception, because it is assumed to be a sphere.

Figure 4

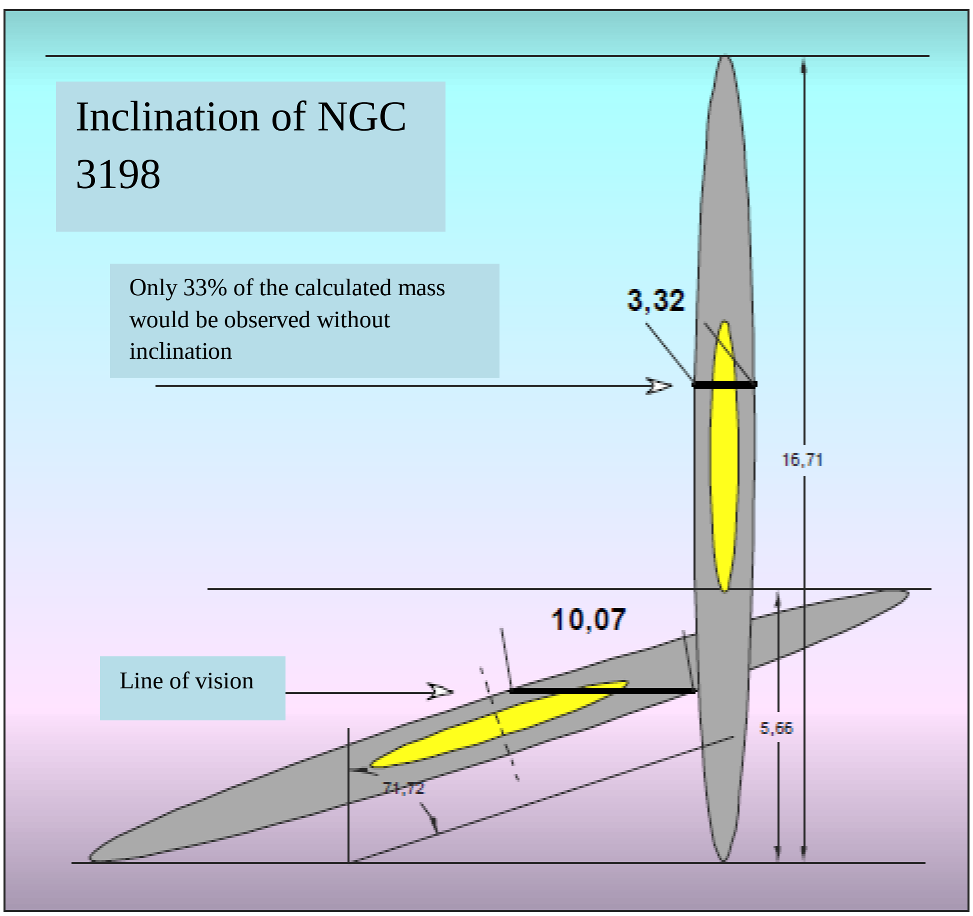


Table 1

Anzahl der Raster-Massen Flächen / Halokugel		Gemessene Massendichte im Warp In M sol Exponentielle Massenverteilung		Massenmenge pro Kreisring /Kugelschale in Mlliarden Sonnenmassen	Faktor Inklination für die Fläche (disc + warp)	Addition der Kreisring /Kugel-schale Massenmenge Sichtbar	Warp	Radiuseinheit in 10.400 Ly
Gezählte Massenmengen der sichtbaren Sterne in der Disc								
1	x	3000*12,246 * 10^6	=	36,76	X 0,33 = 12,13	12,13		Zentrum
4	x	430*12,246 * 10^6	=	21,08	X 0,33 = 6,96	19,09		1
8	x	208*12,246 * 10^6	=	20,40	X 0,33 = 6,73	25,82		2
20	x	72*12,246 * 10^6	=	17,64	X 0,33 = 5,82	31,64		3
Gase und Sterne im Halobereich (Kugel)								
74	x	6*12,246 * 10^6	=	5,44		5,44		2
98	x	4,1*12,246 * 10^6	=	4,92		10,36		3
250	x	2,5*12,246 * 10^6	=	7,65		18,01		4
342	x	1,42*12,246 * 10^6	=	5,95		23,96		5
578	x	0,692*12,246 * 10^6	=	4,88		28,84		6
586	x	0,41*12,246 * 10^6	=	2,92		31,76		7
914	x	0,157*12,246 * 10^6	=	1,76		33,52		8
990	x	0,125*12,246 * 10^6	=	1,52		35,04		9
1226	x	0,02*12,246 * 10^6	=	0,40		35,44		10
Gemessene Massenmengen des neutralen Wasserstoffes +Helium +H2 im Warp							85,60	
8	x	28*12,246 * 10^6	=	2,76	X 0,33 = 0,91		18,92	2
20	x	26*12,246 * 10^6	=	6,36	X 0,33 = 2,10		18,01	3
28	x	24*12,246 * 10^6	=	8,24	X 0,33 = 2,72		15,91	4
36	x	21*12,246 * 10^6	=	9,24	X 0,33 = 3,05		13,19	5
40	x	18*12,246 * 10^6	=	8,80	X 0,33 = 2,90		10,14	6
40	x	15*12,246 * 10^6	=	7,36	X 0,33 = 2,43		7,24	7
48	x	10*12,246 * 10^6	=	5,88	X 0,33 = 1,94		4,81	8
62	x	8*12,246 * 10^6	=	6,08	X 0,33 = 2,01		2,87	9
70	x	3*12,246 * 10^6	=	2,60	X 0,33 = 0,86		0,86	10

Halo + Area between visible and measurable

Column 1 shows the number of gridded units, and column 2 shows the median mass value per unit. The combined mass of the invisible gas area can be seen as the red value 18.92 billion solar masses. Starting at this gas area, the rest of the galaxy's mass can be calculated, because the mass density distribution increases exponentially toward the center. This value is highlighted in blue. In addition, the different areas of the galaxy – disc, warp and halo - overlap.

The green values for the warp were taken from *Figure 3*, and following the exponential mass distribution and brightness-mass distribution ratio, the other mass values were added in pink. Consequently, the visible mass of all stars equals about 31.6 billion solar masses, which is similar to the values found in modern scientific literature (Burkert, 2006).

The exponential mass density distribution is determined via the Lorenz transformation formula

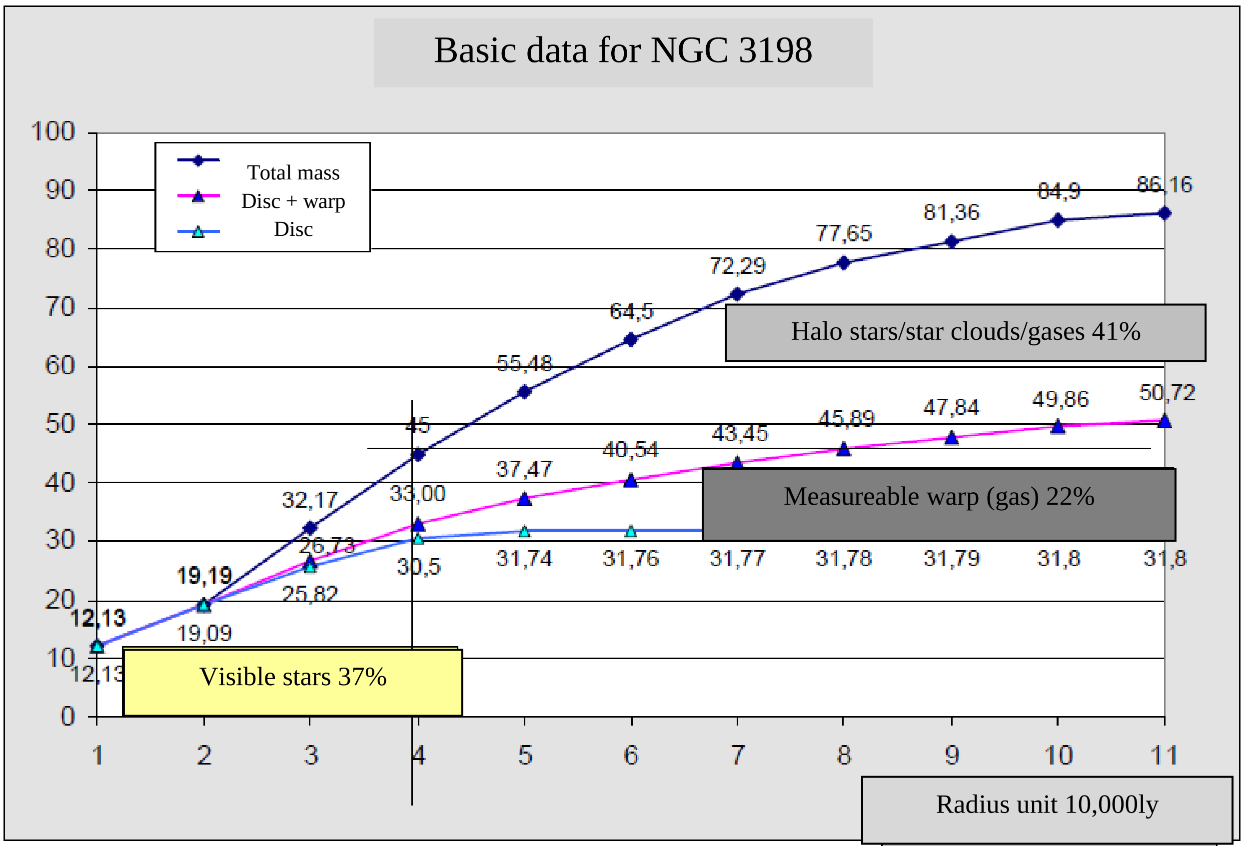
$$\gamma = \frac{1}{1 - \sqrt{\left(\frac{v}{c}\right)^2}}$$

Please refer the *Figure 9* and *10* for the implication of the relativity formula on the masses in a galaxy.

In sum, the following values can be measured for galaxy NGC 3198

Orbital speed:	150km/s even (±10)	combined expansion	
Mass density of area		of measurable disc	207,699ly (63.6kpc)
1-31.8kpc	exponentially falling		equal to 0°23.8’
		Corresponds to radius:	103,800ly (31.8kpc)
M of invisible halo:	35.44 billion solar masses	Distance from Earth:	30 billion ly (9.2Mpc)
Gas area	18.92 billion solar masses	Expansion of visible	
Solar mass of stars:	31.64 billion solar masses	disc (D):	69,200ly (21.2kpc)
Combined mass:	85.60 billion solar masses	corresponds to radius:	34,600ly (10.6kpc)

Figure 5



Mass values and distances found in reality

Figure 5 illustrates the typical curves for the combined mass of a galaxy, which has its foundation in the exponential mass distribution.

The measured total mass of galaxy NGC 3198 is approximately 86 billion solar masses

The total/combined mass consists of:

- Visible star disc: about 1/3 of the entire galaxy, contains 31 billion solar masses (37% of total mass), ends at the vertical line in *Figure 5*
- Invisible gas disc: also called warp, approximately 22% of total mass, weight consists of 50% atomic, measurable hydrogen, 40% helium, and 10% molecular hydrogen
- Halo: includes single stars, star clouds, and compact hydrogen clouds, masses are sphere shaped and thinly spread, about 41% of total mass, mass density is about 10 to 100 times thinner than that of warp, turns into interstellar matter (ISM) at outside edge

The approximate visible star mass of NGC 3198 is 32 billion solar masses, which is equal to the measurements by Burkert, and the mass of gases is 19 billion solar masses, which is confirmed by Sulentik. These two measured values can thus be assumed as true. Since the masses contained in the halo are not visible, and the warp could certainly be extended into the halo, the measured 35 billion solar masses could increase by 20%. Consequently, the value for the halo has a 20% tolerance. The values of NGC 3198 correlate to those of the Milky Way, which is assumed to be double its size.

Conclusion

If the previously measured values of galaxy NGC 3198, especially its mass distribution, are now tested for plausibility, the results (80 to 100 billion solar masses) of a discrete calculation only confirm them. Even calculation 3.4 in the first part of the epicycloids with its rough grid lining delivers a result that lies within the 20% tolerance.

a. All masses of a galaxy move on libration tracks – not Kepler orbits
b. The central, visual rotation point is independent from the gravitational rotation point
c. The measured mass of a galaxy is equal to the calculated mass, as long as it is calculated over the gravitational rotation point
d. The so called dark matter is nothing but a calculation error

Comments on the referenced scientific literature

Sulentic's basic measured value for the total mass of the warp is 18.92 billion solar masses. Why van Albada concludes that the warp's mass is "4.8 billion solar masses" (Albada, 1985, Vol.295), is mathematically incomprehensible. In his paper, van Albada speaks of "estimating' and "fitting" of masses (van Albada, 1985, Vol.295). Sadly, a comprehensive calculation of masses in the warp cannot be found. Especially, since a warp mass of 4.8 billion solar masses requires a mass density far below the value of interstellar mass in the absence of a galaxy.

This example illustrates the importance of checking the source of data and parameters even in scientific reading materials. A derivation or faulty context harbors the risk that the author has incorporated own ideas and assumption into the context, which could have affected the basic parameters. In order to compare parameter and results, it is imperative to use correct basic data. Unfortunately, tables, graphs, and figures are often tweaked to show what the author intended, instead of portraying reality. Van Albada (1985, Figures 4 and 5), for example, works with figures of galaxies that have a diameter of 100kpc (325,945ly). The highest measured diameter of a visible galaxy in his paper, however, is 10.6kpc (34,600ly), and the highest measured diameter of the measurable galaxy is 31.8kpc (103,800ly).

All of van Albada's figures concerning galaxy NGC 3198 are graphed with a radius of 50kpc. To make the comparison between van Albada's figure and reality easier, *Figure 6* shows *Figure 3* (smaller and rotated) embedded in van Albada's graphic. The small golden disc is the visible part of this galaxy. Concrete values are only available for the area from the center up to a radius of 32kpc. Anything beyond this point is based on assumptions without the support of actual data. A volume comparison clearly shows the size of these assumptions: A halo with a radius of 50kpc has a volume of

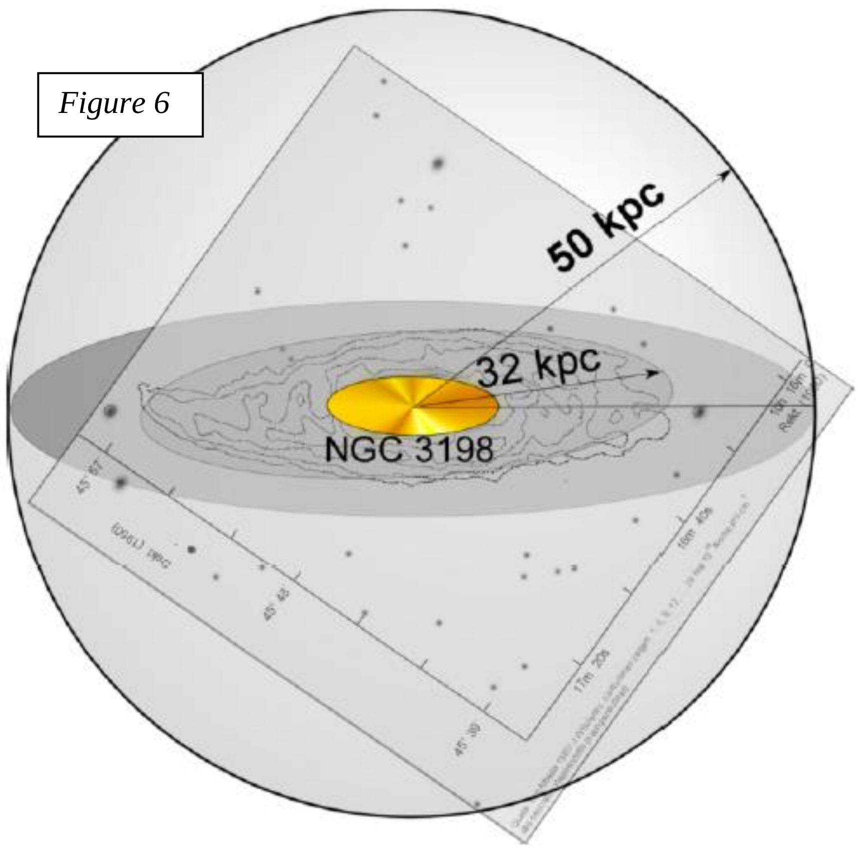


Figure 6

$$V = \frac{4\pi r^3}{3} = 523{,}583 kpc^3$$

A sphere with a radius of 32kpc, on the other hand, has a volume of 133,254kpc^3.

$$\frac{523.6kpc^3 - 133.3kpc^3}{523.6kpc^3} = 0.75$$

→ 75% of van Albada's results about the distribution of dark matter in the spiral galaxy NGC 3198 are therefore based on assumptions. Only 25% are truly founded in facts. This makes van Albada's conclusions less than plausible.

The calculation of the assumed masses delivers a value that is much larger than van Albada's 4.8 billion solar masses. The density of interstellar matter (ISM) is $10^{-4} - 10^{5}$ atoms per cm^3. With the lower value of 2×10^{-2} atoms per cm^3 in the galaxy, this results in a total mass of 86 billion plus 47 billion solar masses. The sum of 133 billion solar masses ensures a constant orbital speed of 150 km/s within and outside of the galaxy.

The amount of interstellar matter within the galaxy alone is 12.4 billion solar masses. A space with a diameter of 100kpc that does not contain a galaxy has a combined ISM mass of 60 billion solar masses. Not even the total mass of ISM between galaxies comes close to the value determined by van Albada (1985) (see *Table 2*).

Table 2

Anzahl der Raster-Massen Halokugel		ISM Massendichte im Halo In M sol Gleichmäßiger Massenverteilung		Massenmenge pro Kugelschale in Mlliarden Sonnenmassen	Addition der Kugelschale Massenmenge in Mlliarden Sonnenmassen	Radiuseinheit in 10.400 Ly	Sonnenmassen / pc $^{-3}$ in der Galaxie (disc+ warp) 10.400 Ly Rasterabsstand	Sonnenmassen / pc $^{-3}$ in der Galaxie (halo) 10.400 Ly Rasterabsstand
Anteil der interstellare Gase im Halobereich (Kugel)								
1	x	0,2*12,246 * 10^6	=	0,00245	0,00245	Zentrum	1,1424	
6	x	0,2*12,246 * 10^6	=	0,015	0,0175	1	0,16374	
74	x	0,2*12,246 * 10^6	=	0,18	0,197	2	0,07616	
98	x	0,2*12,246 * 10^6	=	0,24	0,437	3	0,03245	0,015
250	x	0,2*12,246 * 10^6	=	0,61	1,047	4	4	
342	x	0,2*12,246 * 10^6	=	0,86	1,907	5	5	
578	x	0,2*12,246 * 10^6	=	1,42	3,327	6	6	
586	x	0,2*12,246 * 10^6	=	1,44	4,767	7	7	
914	x	0,2*12,246 * 10^6	=	2,24	7,007	8	8	
990	x	0,2*12,246 * 10^6	=	2,42	9,427	9	9	
1226	x	0,2*12,246 * 10^6	=	3,00	12,427	10	0,0011425	
Gemessene Massenmengen des neutralen Wasserstoffes +Helium +H2 im Halo 12,43 Milliarden Sonnenmassen							ISM	0,000.076.2

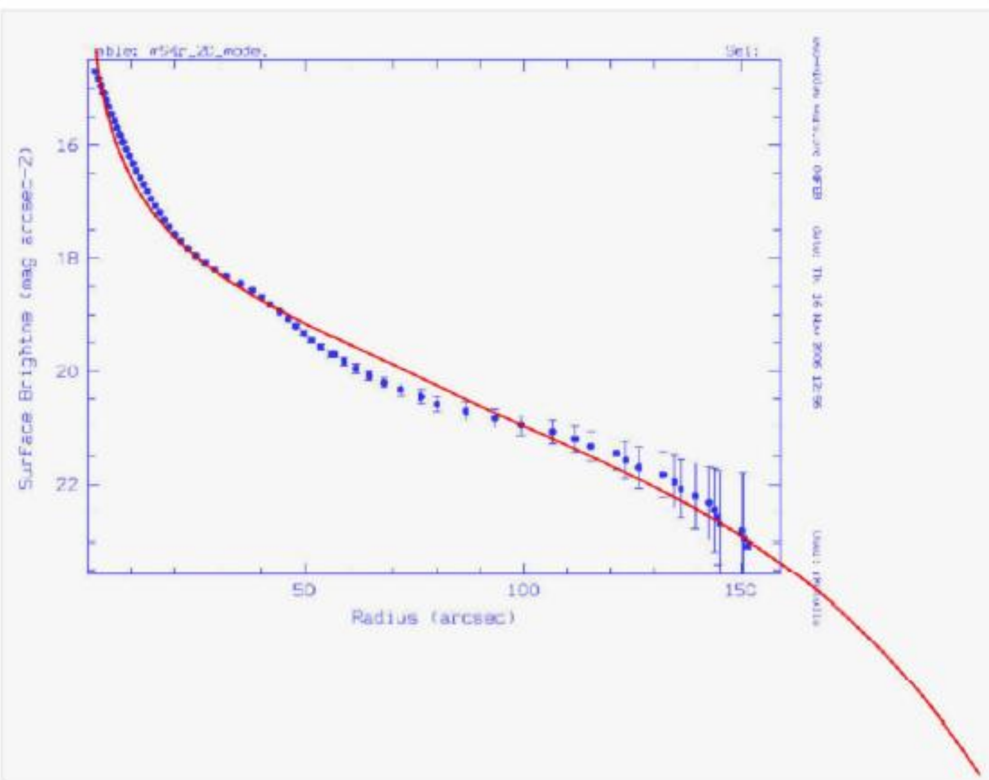
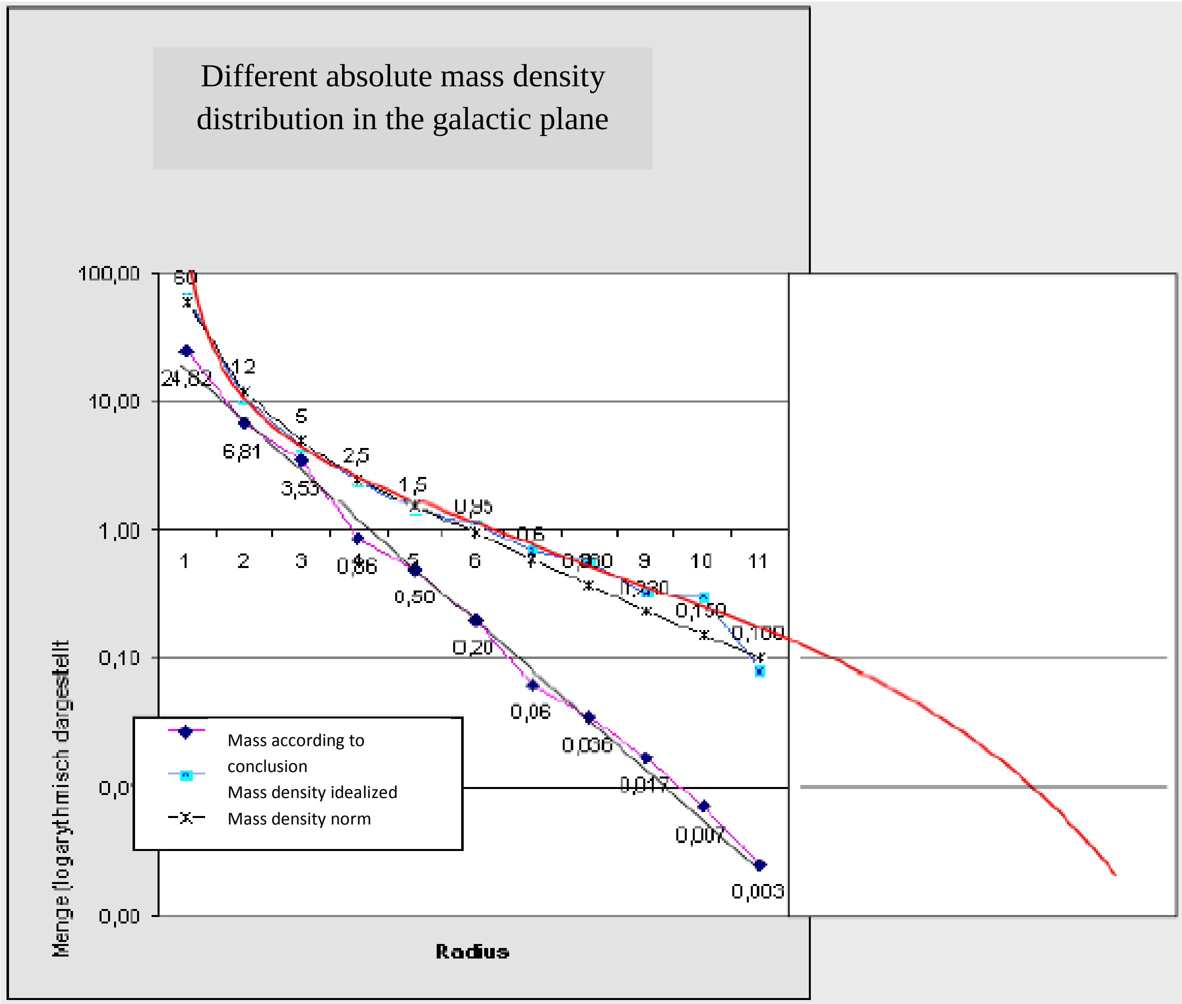


Figure 7

Brightness distribution of a galaxy with the added red relativity curve. This curve is similar to the mass density distribution in a galactic disc from the center over the outside edge to the ISM.

Figure 8



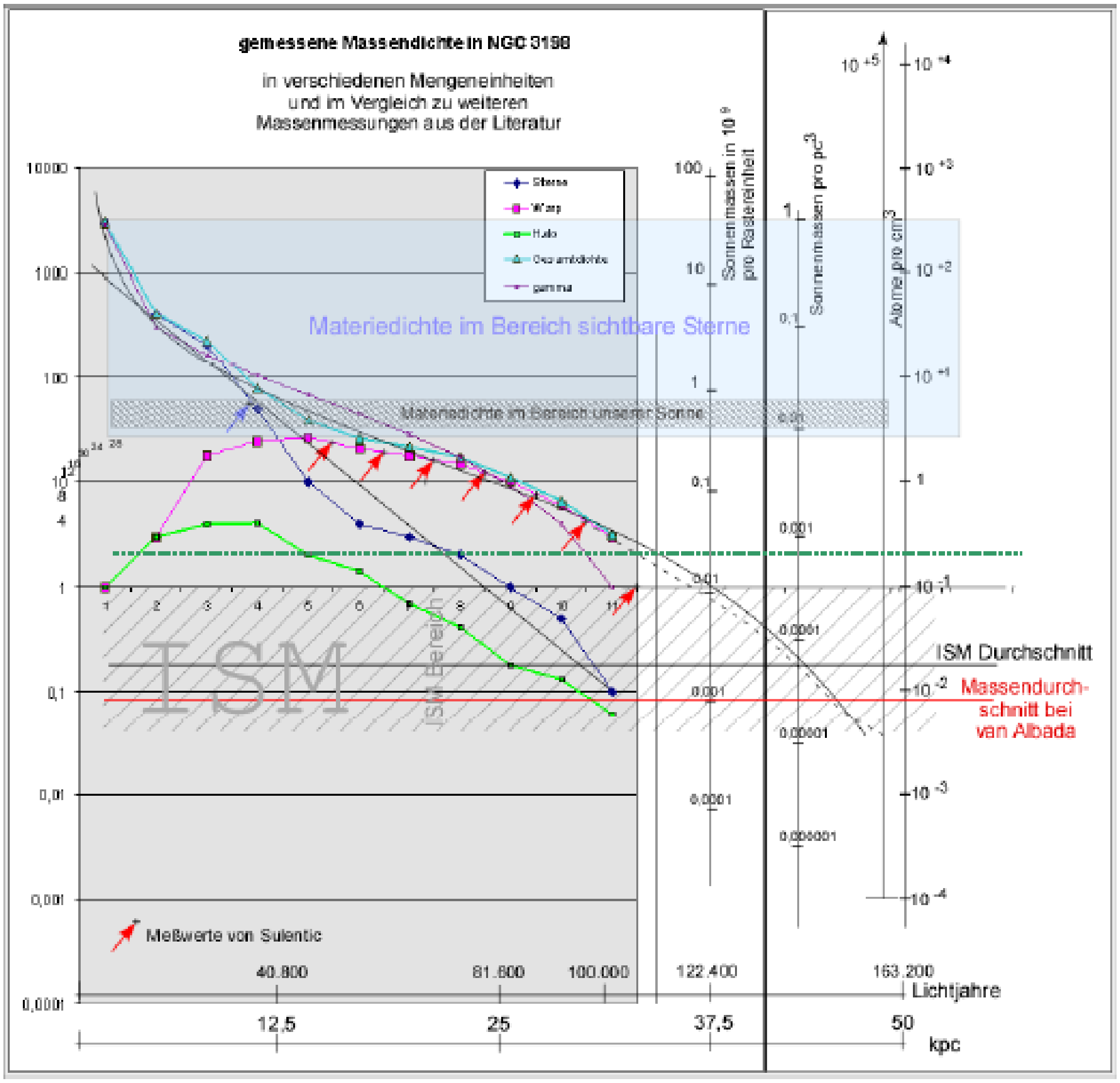
In order to ensure a constant orbital speed, masses within the halo and galactic plane have to follow a definite density distribution. This is illustrated with the help of the brightness distribution of a typical density distribution. Mass derivations from the ideal function are below $\frac{1}{1000}$ *of a galaxy's total mass value.*

The added mass curve according to the "conclusions" of a teacher in-service has the ideal exponential decrease (the logarithmic scale turns the curve into a straight line), but the measured brightness/mass density distribution does not follow a perfect "e-function", and therefore, must be wrong.

The added area to the right illustrates the invisible, but measurable, gas distribution beyond the visible part of the galaxy. This is repeated in the following Figure 9, where the mass density curves can be extended to show interstellar matter outside of the measurable galaxy.

The radio metrically measured hydrogen mass is shown n Figure 9. The values are similar to those found in Figures 7 and 8.

Figure 9



Summary and comparison of mass distribution values for galaxy NGC 3198 found in different references and in reality. The horizontal mid line on the left shows the hydrogen density of 1×10^{20} *atoms per* cm^2*, in 10,000 ly per unit.*

About Figure 9

The radio metrically measured mass values of the invisible warp (marked with a red arrow) are the foundation for any mass determination of galaxy NGC 3198. The area following the marked curve belongs to the ISM (shaded in gray), which should favor the slightly bend brightness curve found in *Figure 7*. This curve is the basis for the mass distribution of the galaxy.

The relativity formula is also added to the Figure up to 100,000 ly (marked in violet) and up to 150,000 ly (marked in black). This curve is the basis for the mass density distribution of the galaxy. Consequently, the visible masses in the disc (verified by matter density in other galaxies, shaded in light blue) are seamlessly continued by the values measured by Sulentric, and both lean on the curve of the relativity formula. A black hole is in the center of every galaxy; the matter density therefore approaches infinity (according to the relativity formula).

In addition, the masses of visible stars are verified by the data found in our own galaxy close to the sun (gray area with blue arrow). The number of visible stars decreases toward the edge of the galaxy, but the mass of atomic hydrogen increases.

The mass density with the halo (marked in green) is mostly located in the area of ISM. Its median mass density is only one fifth of that found in the outer edge of the measurable gas disc.

Note

Contrary to common belief, the ISM mass increases with growing distance from a galactic disc. The observed volume units, which contain a substantial ISM mass, grow exponentially with their radius. A constant mass in a growing area, as often assumed in scientific literature (van

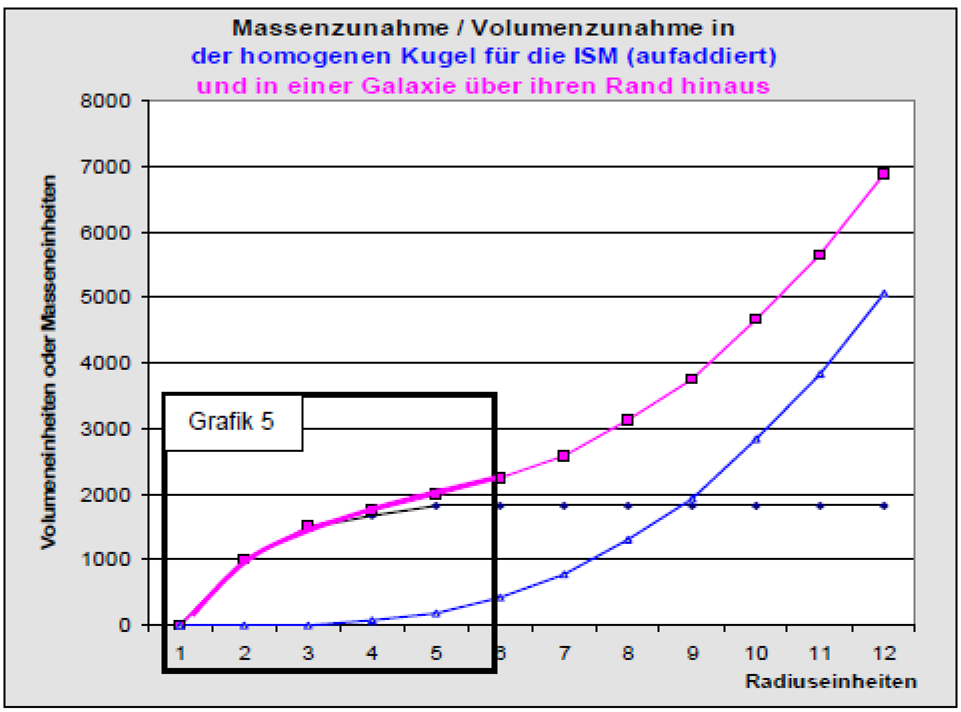


Figure 10
Illustrates the exponential increase of ISM mass with growing radius in a homogenous sphere (blue curve). The black square shows a galaxy with disc, warp, and halo (see Figure 5). The black line portraits the galactic mass that extends beyond the ISM, and the sum of masses is represented by the pink curve. This curve shows the real mass of a galaxy.

Albada, 1985) is therefore wrong. The sum of masses increases exponentially with the radius of the observed volume even past the visible and invisible areas of any given galaxy.

Consequently, the mass distribution of galaxy NGC 3198 is as realistic as possible. The tolerance for the total mass is set at 20%, because the dust within the gas areas of the galaxy was not taken into consideration. Even though it only represents 1% of the number of atoms, its weight accounts for 10%-15% of the total mass. Hence, the real total mass of NGC 3198 is even bigger than postulated in this paper.

Nevertheless, some scientists use a different set of galaxy values, which only creates confusion. The errors in their literature become obvious under a little scrutiny. If, for example, the total mass of galaxy NGC 3198 by van Albada (1985) is tested for his radius of 50kpc, the average mass value per volume unit lies below that of the average ISM. Van Albada's galaxy has less mass than a galaxy free area in space! (compare the horizontal red line with the dotted green line in *Figure 9*) *Figure 9* also includes the example made in an in-service for teachers, which is more an assumption than an actual measurement (Akaprojekte, n.d.).

Comparison of measured values with calculated values

After completing the measurements of values for the galaxy, it is necessary to see if they match the values calculated over the orbital speed of masses. For this purpose, the calculation method described in the first part of this paper is applied (WMAP – many-body-model). The masses and distances have to be increased accordingly.

Figure 11a and *b* illustrate what masses are considered as dark matter. While *Figure 11a* shows the mass actually measured and calculated over the gravitational rotation point, *Figure 11b* shows the fictional masses that were calculated over the visual rotation point of the galaxy. These fictional masses are the dark matter.

Figure 11a

Figure 11b

Conclusion

Every calculation and thought explained in the first part of the paper proves that a calculation of masses over the visual rotation point is not only problematic, but also very wrong. Epicycloids and dark matter are therefore based on a common error:

The wrong rotation point!

The true rotation point of every mass system is always the gravitational rotation point, which is easily calculated.

Calculation of NGC 3198's galactic mass over its gravitational rotation point

A single mass orbiting abound a galaxy is represented by the satellite WMAP. This minimal galaxy consists of only two star or gas rings and one center mass. WMAP orbits around this center mass at the very edge of the galaxy.

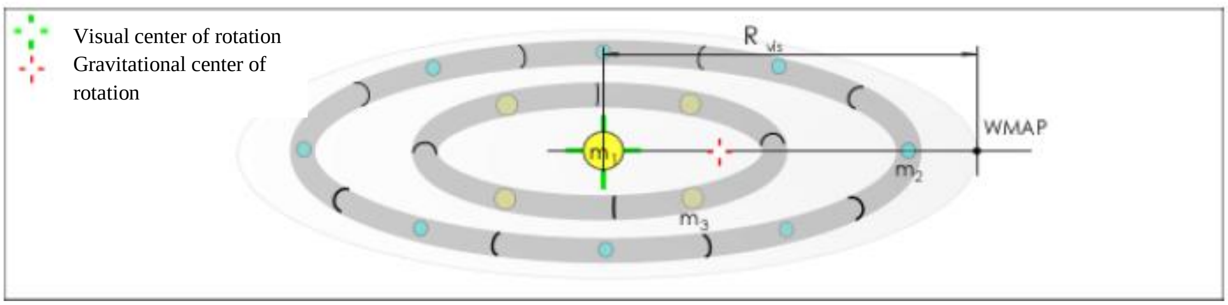
The calculation is equal to that done in the first part of this paper and will not be repeated at this point (calculation 3.4). Please refer to "epicycloids and ark matter – part 1" for any details.

The mass ratio of all four masses is:

Satellite/Single mass : outside mass : inner mass : central mass

1×10^{-20} : 8.25 : 31 : 137

Figure 12: galactic minimal model



Basic values

- ✓ Gravitational constant — 66.7428×10^{-12}
- ✓ 1x central mass/sun mass m1 — 8.6720216×10^{40}kg
- ✓ 8x outside mass m2 — 5.2222028×10^{39}kg
- ✓ 4x inner mass m3 — 1.9622823×10^{40}kg
- ✓ Distance m2 – m1 — 0.780450×10^{21}m
- ✓ Distance m3 – m1 — 0.390000×10^{21}m
- ✓ WMAP mass/single mass — 1.000000kg

Needed parameters

- ✓ Orbital speed of WMAP around the sun
- ✓ Distance of WMAP to sun
- ✓ Amount of dark matter

Result of calculation

- ✓ Time needed for m2 to complete one orbit around sun (**F4**) — 457,469,432,849.446 days

- ✓ Orbital speed of m2 (**F3**) — 124,061.2982 m/s
- ✓ Orbital speed of WMAP (**F3**/**F2**/**F1**) — 150,571.5336 m/s (150.571 km/s)
- ✓ Time needed for WMAP to complete one orbit around sun (**F4**) — 457,469,400,480.510 days
- ✓ Distance WMAP to m2 — $0.16677163 \times 10^{21}$ m
- ✓ Distance WMAP to m1 — $0.94722163 \times 10^{21}$ m
- ✓ Gravitational radius of WMAP (**F2**/**F1**) — 0.5982443×10^{21} m
- ✓ Calculation of gravitational mass with gravitational radius (**F6**) — 1.7997547×10^{41} kg
- ✓ This is equal to the sum of the reduced mass equivalent of the parallelogram of forces of all masses — 1.7997547×10^{41}
- ✓ Addition of all masses is equal to addition of basis values — 2.0698913×10^{41} kg
- ✓ Mass of NGC 3298 — 3198 104.062 billion solar masses

Summary

The mass value calculated over the gravitational rotation point in this minimal model is 104.062 billion solar masses for NGC 3198. The total measured value is 86 billion solar masses. The difference between these two values is 21%.

104 billion solar masses calculated with minimal model (13 mass points)
80-100 billion solar masses calculated with Excel model (357 mass points)
86 billion solar masses measured in reality

The difference between the mass values lies within the tolerance bracket, which is approximately 20%. Consequently, the calculation over the gravitational rotation point is valid in the many-body-problem of galaxy NGC 3198. A dark matter is not needed.

Calculation of NGC 3198's galactic mass over its visual rotation point

The following calculation is the usual way of determining the mass of a galaxy over the orbital speeds of its masses. Instead of the gravitational rotation point, the visual rotation point or the center of the galaxy is used as a reference for their radius.

- ✓ Calculation of gravitational mass with visual radius (**F6**) — $3{,}2176065 \times 10^{41}$ kg
- ✓ Mass of NGC 3198 — 161.764 billion solar masses

The calculated mass value is **55.45%** higher than the real value!

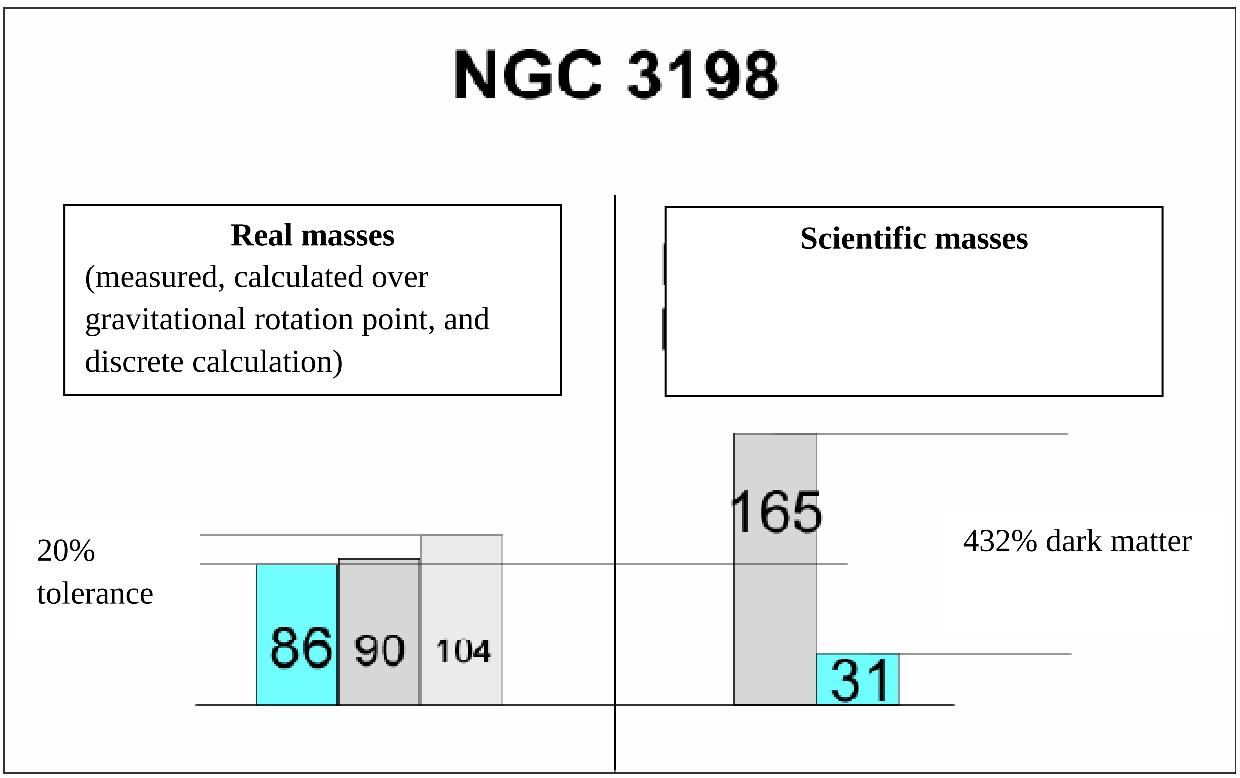
As expected, the amount of dark matter has been confirmed in the galactic, planetary many-body-mass model. (This calculated mass value is **78.78%** above the calculated mass equivalent value!)

Mass value postulated in scientific literature

The values found in the work by van Albada (1985) use a radius of NGC 3198 of 32kpc (Fig.5). The mass of disc and "dark" halo lies at 165 billion solar masses. A comparison to the fictional value calculated for the minimal model, 161.764 billion solar masses, indicates a difference of only 2%. Clearly, the faulty calculation of a galaxy's mass has found its way into the scientific world.

Van Albada's mass value consists of 31 billion real solar masses and 134 billion "dark" solar masses and gas. The ratio of real matter and dark matter is 1 : 4.3. The majority of dark matter is concentrated in the halo, where only 4.8 billion solar masses of gas, but 130 billion solar masses of dark matter are found.

Figure 13



The gray columns represent the calculated masses, and the green columns represent the measured or guessed masses

→ Dark matter is the result of two errors:

1. *The real mass of a galaxy is assumed too small*
2. *A too large total mass is calculated over the visual center*

References

van Albada (1985). *Distribution of dark matter in the spiral galaxy NGC 3198.*

Burkert, A. (2006). Auf der Suche nach dunkler Materie in Ellipt. *Galaxien, Sterne und Weltraum 2006(10), p.23.*

Krause M. (2007). *Die rätselhafte Dunkle Materie auf dem Prüfstand*, CID (Cosmologic Independent Department), 28, Kirchzarten.

http://www.physik.rwth-aachen.de/~hebbeker/lectures/sem02/hoelters2.pdf

http://lehrerfortbildung-bw.de/akaprojekte/didak/wis/workshop4/rotationskurve.pdf

http://www.astro.uni-bonn.de/~peter/Lectures/intro2.pdf

http://de.wikipedia.org/wiki/Molek%C3%BClwolke

http://de.wikipedia.org/wiki/Milchstrasse

http://arxiv.org/PS_cache/arxiv/pdf/0808/0808.3188v1.pdf

http://fr.arxiv.org/abs/astro-ph/0608193

http://arxiv.org/abs/0801.1232

http://www.astro.uni-bonn.de/~peter/Lectures/intro2.pdf

http://de.wikipedia.org/wiki/Milchstrasse