

Occams Razor - No Dark Matter in Galactic Halos

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Abstract:

Since several years there is the discussion about dark matter in the halos of galaxies. This is a consequence of observation of halo-velocity curves in dependence of distance which don't fulfill the third Kepler-law. Maybe the ansätze are wrong. Shown is a simple physical model in classical Newton-dynamics which fits qualitative the form of observation curves. Additional Parameters can be used to fit the curves quantitative exactly without the hypothesis of dark matter.

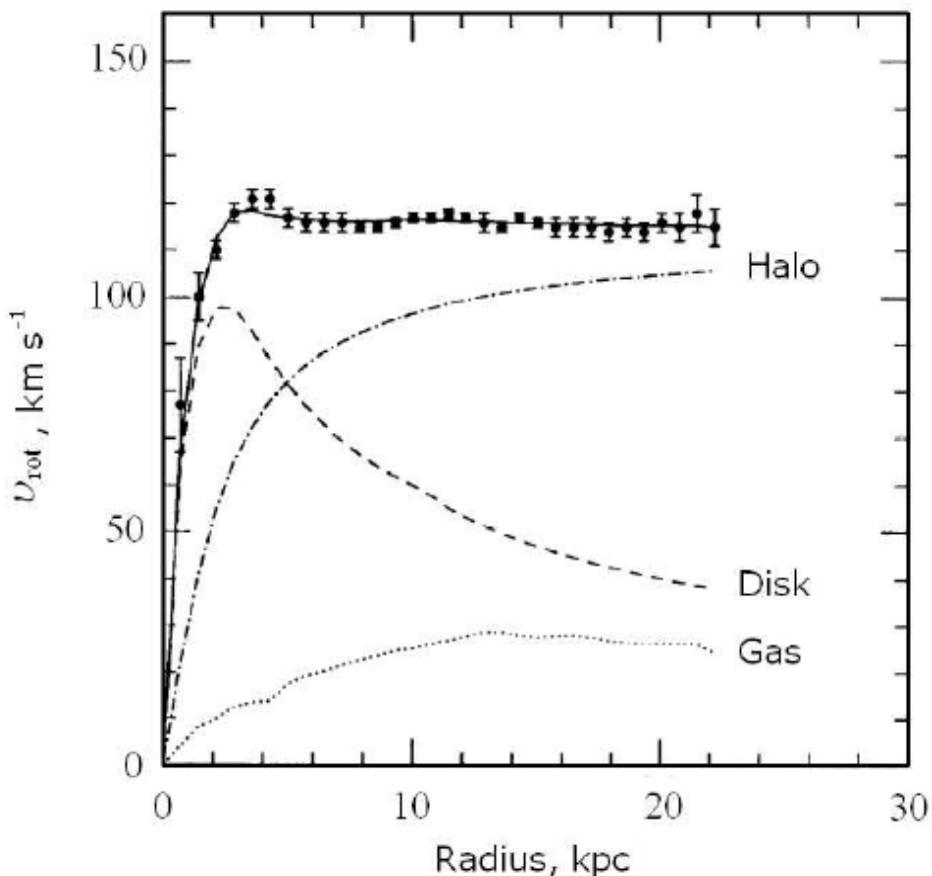
Key-words: dark matter; no dark matter; halo-curves; gravity-forces; galactic core; third Kepler-law; centripetal force; stellar halo- velocity

1. Introduction:

The analysis of the orbital speeds of stars in spiral galaxies by Vera Rubin since 1960 seem to show the problem: The orbital speed of the stars in the halos of galaxies would have to be much lower than it actually is with increasing distance from the galaxy's center after the classical Newtonian model resp. the third law of Kepler. So since several years the existence of a form of "dark matter" is discussed in the scientific literature with some very fantastic explanations and speculations about the reason of this observation like is usual in modern theoretical physics, astrophysics and astronomy [1.],[2.],[3.],[4.],[12.] A few mathematical models are created to clear this problem, some of them modified Newton Dynamics (MOND), Yukawa-like exponential developments or added discussed gravity-effects caused by GRT in large galactic scales (gravity-caused time-dilation at the edge of the galaxies) etc.[5.],[6.],[7.],[8]. Also some Scalar-vector-tensor theories are invented and mentioned (and permuted). But if the principle of Occams Razor in physics is taken seriously there should be a form of trying a short and easy explanation of this phenomenon without going too far into fantastic elaborated models. Sometimes the discussion of this problem looks like the aether-discours in nineteenth century before Poincaré, Lorentz and Einstein ended this by solving it via formulation of SRT. (But on the other hand Ernst Mach denied the existence of atoms, because at his time the experimental data wasn't sufficient, there has to be caution in argumentation) and "dark matter" seems like a spooky ghost of rumour, which was never seen but all speak about it like aether in the 19th century.

The summed rotation curve over radius of a galaxy adds from galactic gas, from the galactic disc and the halo-curve [9.],[10.],[11.]. Only the halo observations causes problems with theory in a galaxy so this discussion here is only about the halo-problem. Dark matter between galaxies in greater clouds (observed by Zwicky and later) may be exist and therefore about this form of DM there are no statements in this paper here. Other possible forms of DM, which are used in explaining phenomena at gravitational lenses are not discussed either. Both forms may exist or not. This paper here is only about galactic states of stellar rotation curves.

Example given for the halo-problem in the following picture:



Graph 1: In the picture above shown is the galactic disk which can be described via Keplers 3rd law and "dark matter" means the galactic halo, which curve causes the problem of difference between observation and explanation.

2. The common thinking:

The common explanations are: setting centripetal force equal to gravitational force.

$$F_z = F_G$$

This leads directly to Keplers third law:

$$v = \sqrt{\frac{G \cdot M}{r}} .$$

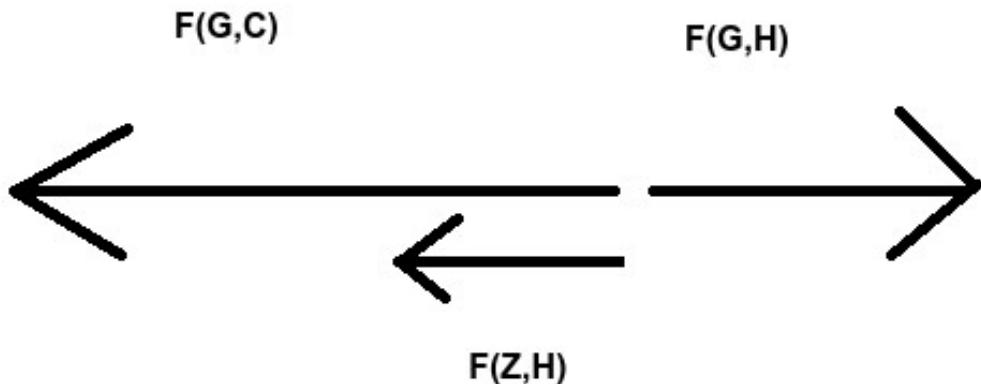
The galactic disc fulfills this law approximatively but the halo doesn't. (For the planets in our solar-system its very exactly fulfilled). Observed is a form of $v \sim r$ or $v \sim r^{1/2}$ instead of the expected

$v \sim r^{-1/2}$. The conclusions are: therefore there has to be a form of “dark matter” in the halos of the galaxies , which causes this effect. Shown is now, that this assumption is unnecessary with the principle of Occams Razor to take the nearest explanation instead of going fantastic like it is modern. Therefore there are now calculations made in the following text with normal Newton Law to fulfill the requirements:

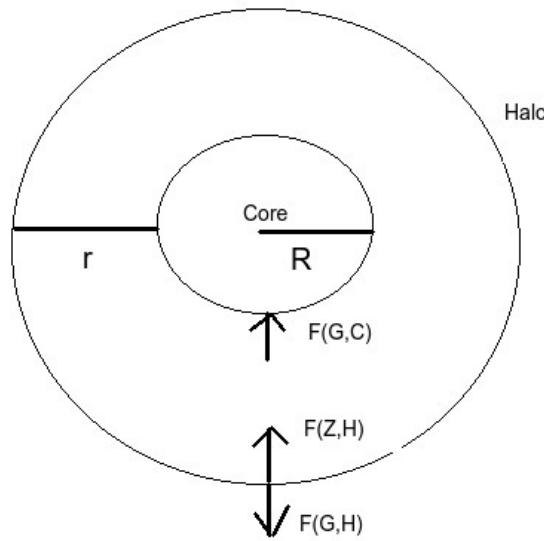
3. Calculation:

3.1. The gravitational Force-model:

Forces are now positioned like $\vec{F}_{G,C} - \vec{F}_{G,H} = \vec{F}_{Z,H}$ with the following force-diagrams as reason why.



Graph 2: The vector -diagram of effective forces working at galactic core and halo.



Graph 3: Shown is a simple model of galactic core with vectors of $F(G,C)$ and galactic halo with $F(Z,H)$ and $F(G,H)$.

Explanation: $F(G,C)$ is the gravitational force at the galactic core. $F(G,H)$ is the gravitational force in the halo and $F(Z,H)$ is the centripetal force of the halo.

Therefore there is:

$$\frac{M \cdot m \cdot G}{R^2} - \frac{M \cdot m \cdot G}{(R+r)^2} = \frac{m \cdot v^2}{R+r} \quad (1.)$$

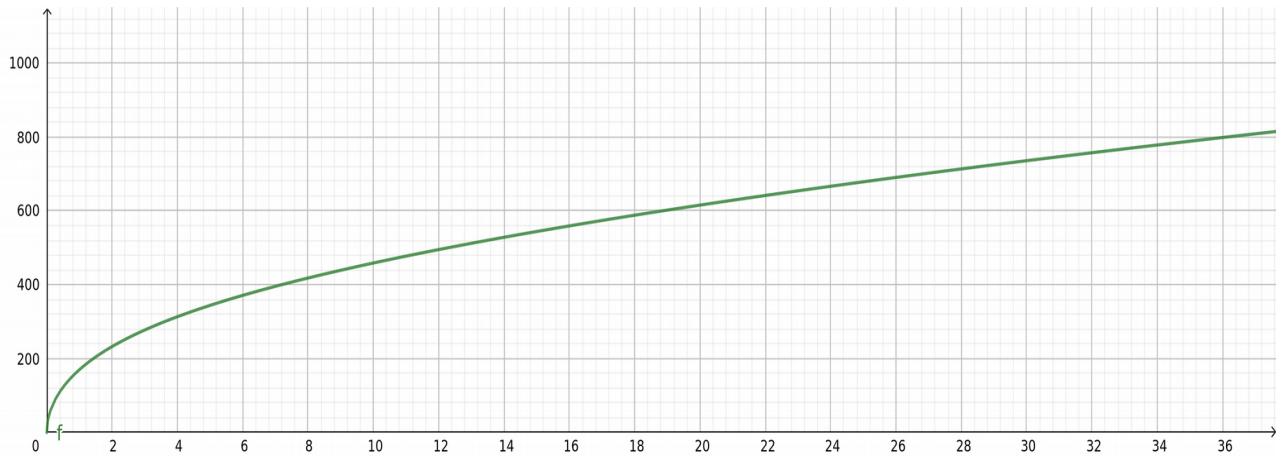
This leads directly to:

$$v(r) = \sqrt{M \cdot G \cdot \left(\frac{R+r}{R^2} - \frac{1}{R+r} \right)} \quad (2.)$$

Here R is core-radius, measured from galactic-center and r is halo-radius, measured from galactic core. $R+r$ is whole halo-radius from galactic center.

Result: there is no halo mass m in this equation (2.). All movements are determined by core mass M .

If the curve of equation (2.) is plotted, there is the result of picture 4:



*Graph 4: this force- curve is plotted for $M=0.9*200*10^9$ sunmasses in the core as function of $v(r)$ over r . Distance r in kpc. Velocity v in km/s.*

Example given: Numerical data for this force- model:

If the sun, which is in the disc ($v_{S,D} = 220 \frac{\text{km}}{\text{s}} \pm 19,8 \frac{\text{km}}{\text{s}}$), were in the halo, its velocity would be:

$$v_{S,H}(r) = 416 \frac{\text{km}}{\text{s}} \text{ after this model.}$$

Data: $R=5 \text{ kpc}$; $r=r_s=8,5 \text{ kpc}$; $M=0,9*2*10^{11}*2*10^{30} \text{ kg}$

R - core radius from galactic center,

r - suns radius from galactic center

M - 90% from galactic mass in sun masses (kg) in core supposed (classical case).

Answer: the model-curve looks qualitatively like the observed halo-curve. But in the limit for $r \rightarrow \infty$ there is no constant value of $v(r)$ but it diverges weak to infinity. So the model has probably to be rejected because it probably doesn't fit with edges of observation curves. But it is a near approximation for r not to great.

3.2. The energy- model for kinetic and potential energies:

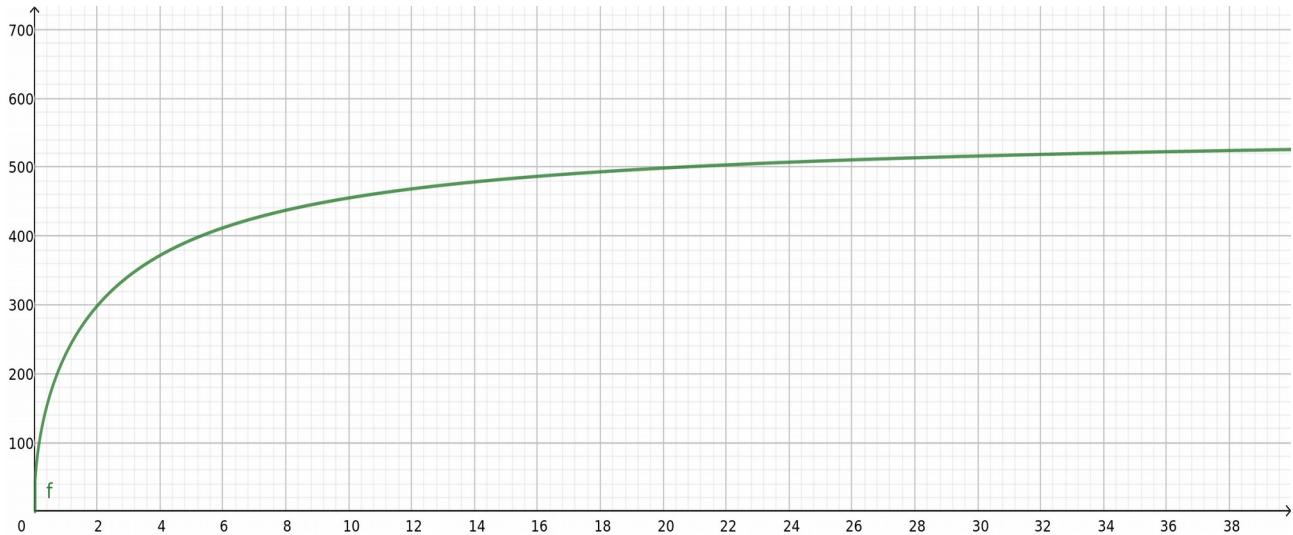
From forces to energy there is:

$$E_{kin} = \left| \int_0^{R+r} F_{Z,H} dr \right| = \left| \int_R^{R+r} F_{G,H} dr \right| = E_{Pot} \quad (3.)$$

This leads directly to:

$$v_H = \sqrt{2 \cdot M \cdot G \cdot \left(\frac{1}{R} - \frac{1}{R+r} \right)} - v_C \quad (4.)$$

If the left side of F_z is integrated from R to $R+r$, then v_c vanishes to zero. This ansatz above is the simplest way of calculating this problem but there are some three others more complicated. All three formulas lead to the same result excepting one which added a numerical factor of 2 in R . If the curve is plotted in $v(r)$, there will be the following graph:



*Graph 5: Qualitative graph of $v(r)$ in km/s from energy conservation-conditions with $M=0.9*200*10^9$ sunmasses for the home-galaxy in the core and distance r in kpc.*

Result: the velocities converge strong and go straight into a constant value for $\lim_{r \rightarrow +\infty} v(r)$.

This constant limit for the home galaxy would be $v_H(r) = \sqrt{\frac{2 \cdot M \cdot G}{R}} \approx 557,7 \frac{\text{km}}{\text{s}}$.

If the sun would be in the halo, the energy-model produces a hypothetical value of

$$v(8,5 \text{ kp}) \approx 443 \frac{\text{km}}{\text{s}} \text{ with same constants as above.}$$

4. Conclusion:

The force-model has probably to be rejected because the velocities are too strong in increasing and have no constant limit like is observed in reality for halo star-systems. The energy-model may be a good explanation for star moving behaviour in the halos of galaxies because it fits qualitatively with observation-curves. It is obvious, that exact measurements from some galaxie-halos are necessary to test the model and to take it seriously or to reject it.

5. Summary:

Two models are put up to explain the moving of halo-stars in galaxies without dark matter. One of the model has probably to be rejected, the force-model, but the other model fulfills at least the quality of the demanded observation laws. Further exact details from measuring values of some

galaxies have to be made to prove the value of this energy-model and to fit it in with observation or to reject it either.

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picture-source: Graph 1.

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All other graphs made by author.