Ab Initio Calculation of Galactic Rotation Curves *in Vacuo*

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Abstract:

Galactic rotation curves[1] appear to become asymptotically flat far from the core, a feature that can be explained with an optical model of gravitational forces. With the core as a central lens, gravity from one side of the galaxy can be focused by the core onto the opposite side, from a central Newtonian Model. Using basic optics, the asymmetric rotational features of galaxies are easily calculated.

Introduction:

The force of gravity is bent as is light by a massive object such as the galactic core.[2] Papini [3] established, in the weak field limit, that electromagnetism and gravity can both be placed into the same four vector potential. The four vector potential, of course, contains geometrical optics, so gravity and electromagnetism should be treated similarly: optically. Sommerfeld [4] established, in the static limit of electrostatics and magnetostatics, that they follow the standard rules of refraction and reflection of static forces in geometrical optics. Together then, electrostatics, magnetostatics, and gravitostatics all obey the same rules of refraction of forces in geometrical optics, in the weak field and static limits. Note: In the static limit, there is no far field diffraction since all optics are in the near field. The trajectories of the geodesics of massless particles that travel at the speed of light in the weak field limit do not depend on the energies of the particles and thus are bent equally[5].

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References

[1] McGaugh, S. et al, High-resolution rotation curves of low surface brightness galaxies: Data,http://arxiv.org/abs/astro-ph/0107326

[2] Wheeler, J.A., et al, Gravitation, pg. 672, 1973, W. H. Freeman, San Francisco

[3] Papini, G.; Chapter in “Quantum Mechanics in Curved Space-Time” (Nato Asi Series, Series B : Physics, Vol 230, Eds: Jurgen Audretsch and Venzo de Sabbata,) Plenum Publishing Corporation, New York and London (April 1, 1991) ISBN: 0306436612

[4] Sommerfeld, A.; “Electrodynamics: Lectures on theoretical physics, Vol III,” Academic Press (January 1, 1952), New York, San Francisco, London, ISBN: 0126546622

[5] Lorentz, H.A., Einstein, A., Minkowski, H., Weyl, H., The Principle of Relativity, (Dover, New York, 1952) pg. 163.

Derivation of Rotation Curve Model

Model of Centrifugal Acceleration

$$\frac{V^2}{r} = \frac{A}{r^2} + kBC$$

$\frac{A}{r^2}$ is the Newtonian Contribution

kBC is the Optical Model

Using the formula for simple optics:

$$\frac{1}{S_1} + \frac{1}{S_2} = \frac{1}{f}$$

where f is the focal length and the radius of the core

S_2 is the distance from the core to somewhere in the plane of the rim

S_1 is the distance of the source from the other side of the core.

Solve for S_1 in terms of f and S_2

$$S_1 = \frac{fS_2}{S_2 - f}$$

Total Distance of refraction $r' = S_1 + S_2$, Thus

$$r' = \frac{S_2^2}{S_2 - f}$$

Multiplying both sides of the Model by r

$$V^2 = \frac{A}{r} + krBC$$

where $B = \frac{1}{r'^2}$ the three dimensional (3D) Newtonian contribution

and $B = \frac{(S_2 - f)^2}{S_2^4}$

$C = \frac{S_2}{S_1}$ the two dimensional (2D) lateral magnification

and $C = \frac{(S_2 - f)}{f}$

$k =$ scale factor

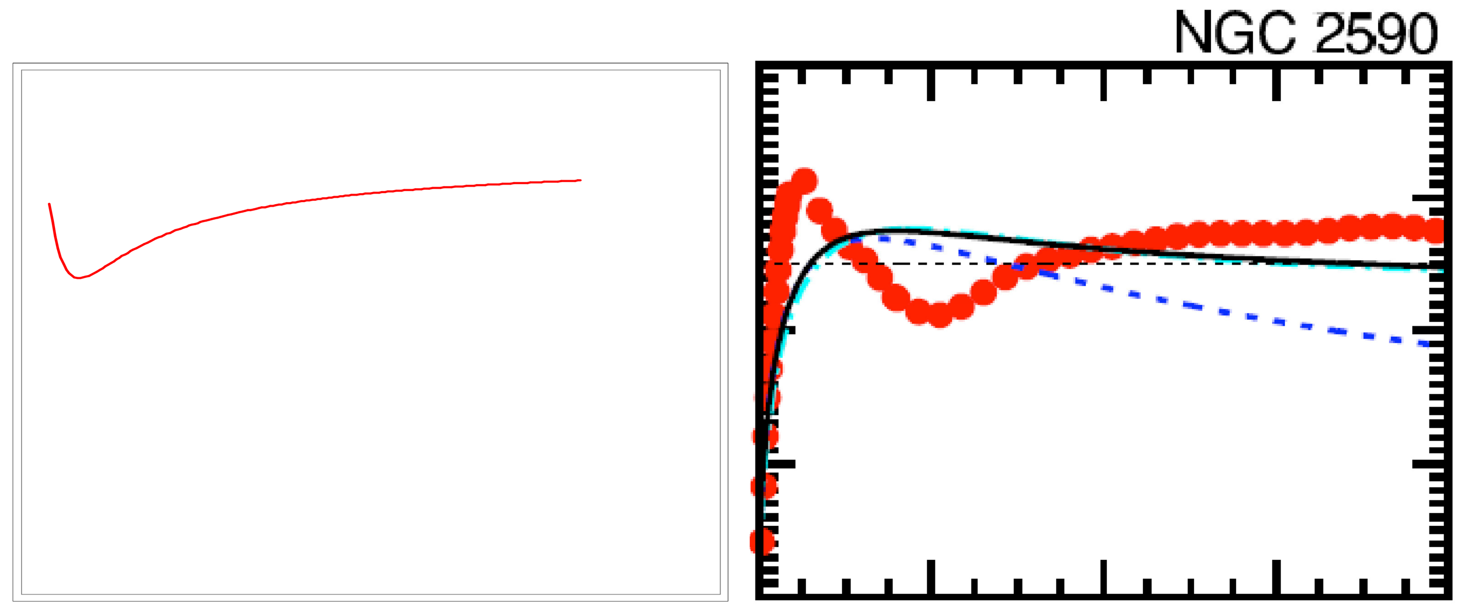
Using $S_2 = r$

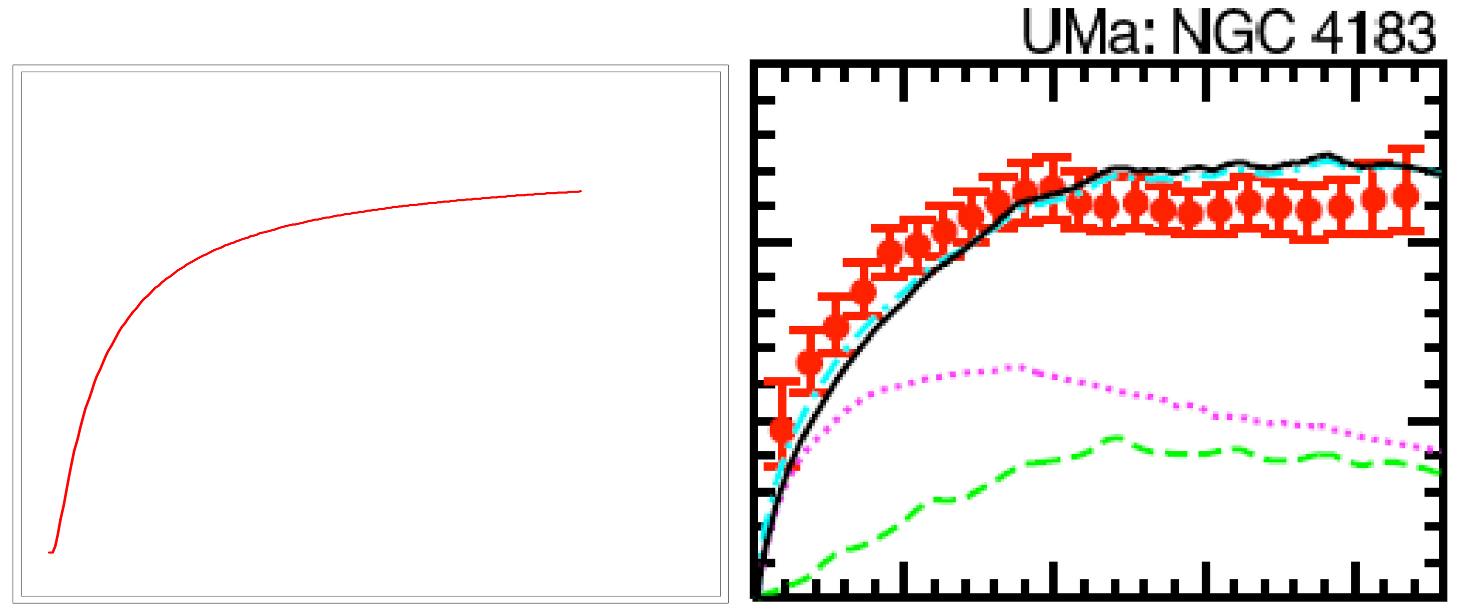
$$V^2 = \frac{A}{S_2} + \frac{k}{f}\left(\frac{S_2 - f}{S_2}\right)^3$$

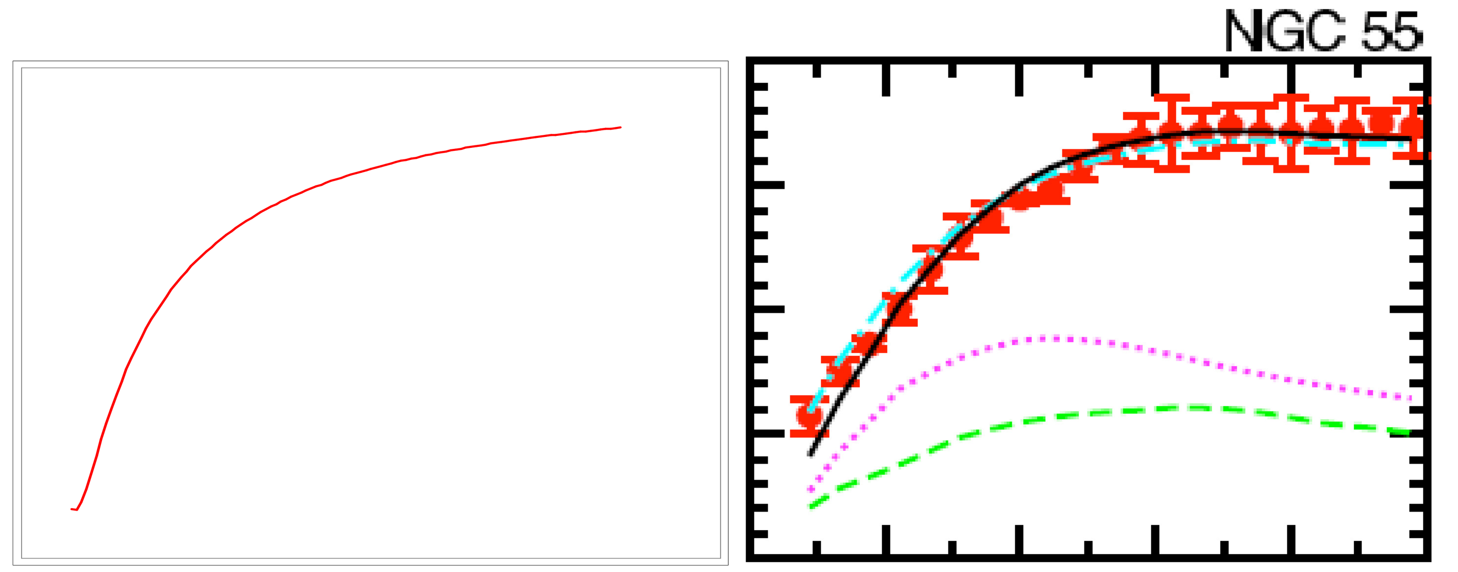
Using $S_2 = nf$, (multiples of the radius of the core) it can be shown that

$$V = \left\{\frac{1}{f}\left[\frac{A}{n} + k\left(\frac{n-1}{n}\right)^3\right]\right\}^{\frac{1}{2}}$$

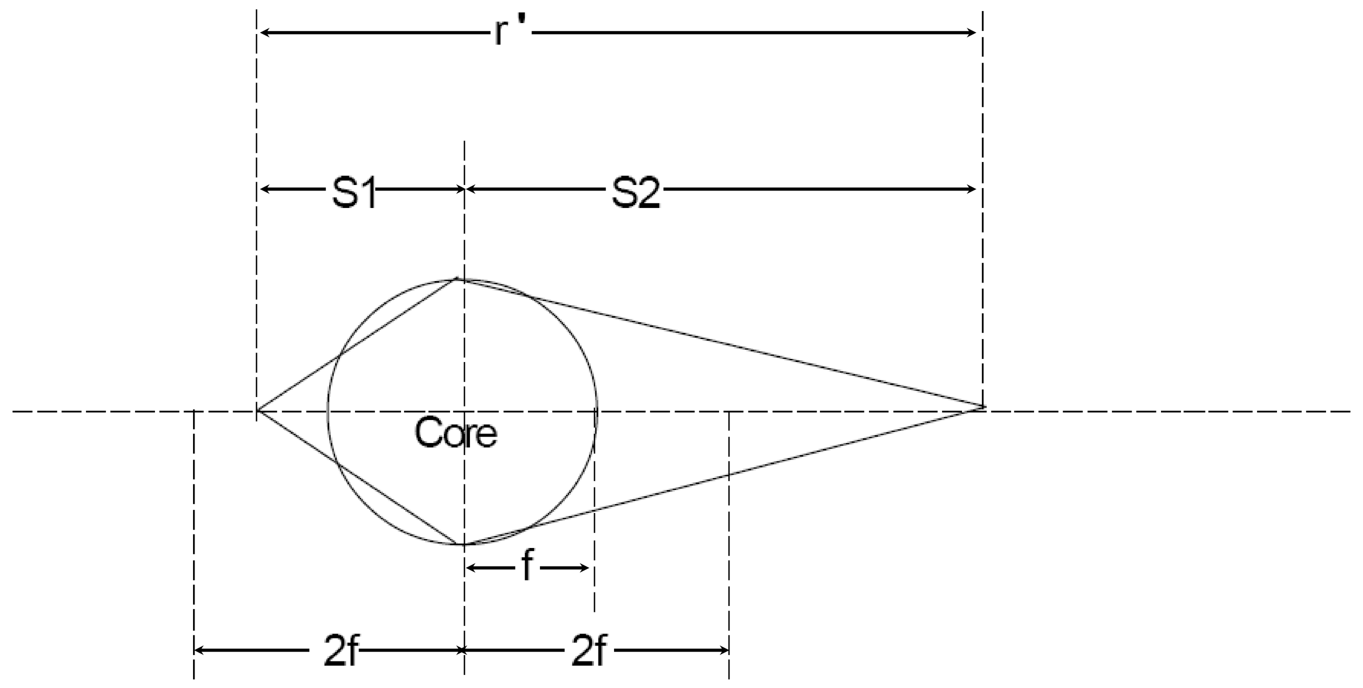
Calculated Rotation Curves for various values of A and k

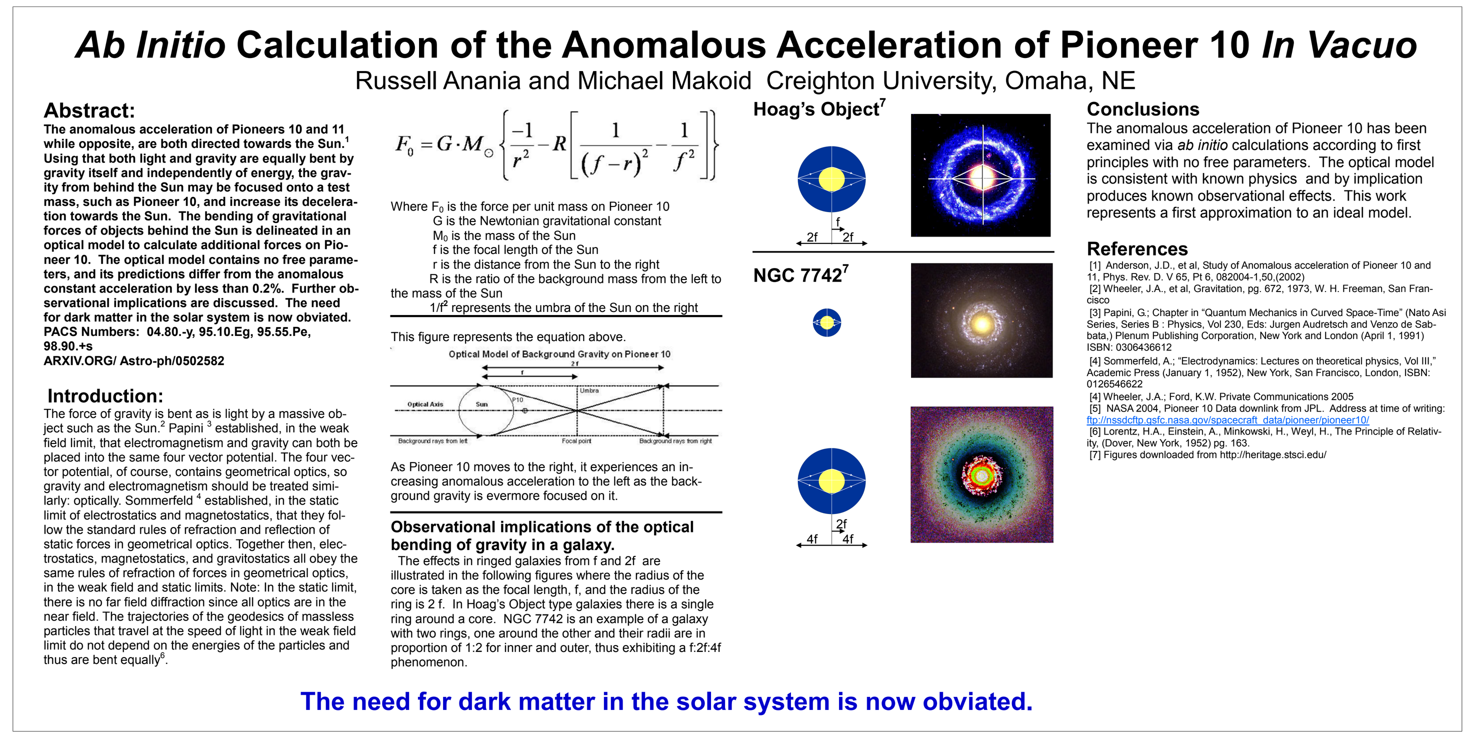






Optical Model for Galactic Rotation




Ab Initio* Calculation of the Anomalous Acceleration of Pioneer 10 *In Vacuo

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The need for dark matter in the solar system is now obviated.

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