Abstract:

Galactic rotation curves 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. Papini established, in the weak field limit, that electromagnetism and gravity can both be placed into the same four vector potential, of course, contains geometrical optics, so gravity and electromagnetism should be treated similarly: optically. Sommerfeld established, in the static limit of electrodynamics and magnetostatics, that they follow the standard rules of refraction and reflection of static forces in geometrical optics. Together then, electrodynamics, magnetostatics, and gravitostatics obey all the same rules of refraction of forces in geometrical optics, in the weak field and static limit. Note: In the static limit, there is no finite 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.

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Derivation of Rotation Curve Model

Model of Centrifugal Acceleration

\[ \frac{d^2 r}{d\theta^2} + \left( \frac{v^2}{r} - \frac{kBC}{r^2} \right) = \frac{A}{r} \]

where \( A \) is the Newtonian Contribution

\( kBC \) is the Optical Model

Using the formula for simple optics:

\[ \frac{d^2 r}{d\theta^2} + \left( \frac{v^2}{r} - \frac{f}{r^2} \right) = \frac{A}{r} \]

where \( f \) is the focal length and the radius of the core

\( S_f \) is the distance from the core to somewhere in the plane of the rim

\( S_r \) is the distance from the source from the other side of the core.

Solve for \( S_f \) in terms of \( f \) and \( S_r \)

Total Distance of refraction \( r' = S_f + S_r \). Thus

\[ r' = \frac{S_f S_r}{S_f - S_r} \]

Multiplying both sides of the Model by \( r \)

\[ r^2 \frac{d^2 r}{d\theta^2} + \left( r v^2 - \frac{kBC}{r} \right) = \frac{A}{r} \]

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

and \( B = \frac{S_f - S_r}{S_f S_r} \)

Using \( S_r = r \) in the two dimensional (2D) lateral magnification

and \( C = \frac{S_f - S_r}{S_f S_r} \)

\[ k = \text{scale factor} \]

Using \( S_f = r \)

\[ r^2 \frac{d^2 r}{d\theta^2} + \left( r v^2 - \frac{f}{r} \right) = \frac{A}{r} \]

Using \( S_r = sf \) (multiples of the radius of the core) it can be shown that

\[ r^2 \frac{d^2 r}{d\theta^2} + \left( r v^2 - \frac{C}{r} \right) = \frac{A}{r} \]

The need for dark matter in galactic systems is now obviated.

References: