420(1): General m Theory for Galaxies

First consider the Newtonian ellipse:

$$r = \frac{\alpha}{1+\epsilon\cos\phi} \quad -(1)$$

with velocity curve:

$$v_N^2 = \dot{r}^2 + r^2\dot{\phi}^2 = mG\left(\frac{2}{r} - \frac{1}{a}\right) \quad -(2)$$

Here r is the distance between m and M, α the half right latitude, ϵ the ellipticity, (r, ϕ) the plane polar coordinate system and G the gravitational constant. The semi major axis is:

$$a = \frac{\alpha}{1-\epsilon^2} \quad -(3)$$

and in the ellipse:

$$0 \leq \epsilon < 1 \quad -(4)$$

From eqns. (1) and (3)

$$a = r\,\frac{(1+\epsilon\cos\phi)}{1-\epsilon^2} \quad -(5)$$

so

$$v_N^2 = \frac{mG}{r}\left(2 + \frac{\epsilon^2-1}{\epsilon\cos\phi+1}\right) \quad -(6)$$

$$\xrightarrow[r\to\infty]{} 0$$

In Newtonian theory the orbital velocity goes to zero at infinite r, i.e the velocity curve goes to zero. Newtonian theory is completely refuted by a whirlpool galaxy.

The Newtonian result (2) is obtained as follows:

$$v_N^2 = \frac{L^2}{m^2}\left(\frac{1}{r^2} + \frac{1}{r^4}\left(\frac{dr}{d\phi}\right)^2\right) \quad -(7)$$

2) and from eq. (1):

$$\left(\frac{dr}{d\phi}\right)^2 = \frac{\epsilon^2}{\alpha^2} r^4 \sin^2\phi = \frac{\epsilon^2}{\alpha^2} r^4 (1-\cos^2\phi)$$

$$= \frac{L^2}{m^2}\left(\frac{1}{r^2} + \frac{\epsilon^2}{\alpha^2}\left(1 - \frac{1}{\epsilon^2}\left(\frac{\alpha}{r} - 1\right)^2\right)\right)$$

$$= \frac{L^2}{m^2}\left(\frac{\epsilon^2}{\alpha^2} + \frac{2}{\alpha r} - \frac{1}{\alpha^2}\right)$$

$$= \frac{L^2}{m^2 \alpha}\left(\frac{2}{r} - \frac{(1-\epsilon^2)}{\alpha}\right)$$

$$= mG\left(\frac{2}{r} - \frac{1}{a}\right) \quad -(8)$$

where we have used:

$$\alpha = \frac{L^2}{m^2 mG} \quad -(9)$$

and

$$a = \frac{\alpha}{1-\epsilon^2} \quad -(10)$$

Secondly consider Einsteinian general relativity (EGR), in which:

$$\frac{dr}{d\phi} = r^2\left(\frac{1}{b^2} - \left(1 - \frac{r_0}{r}\right)\left(\frac{1}{a^2} + \frac{1}{r^2}\right)\right)^{1/2}$$

where a and b are constants and $-(11)$

3)

$$r_0 = \frac{2mG}{c^2} \quad -(12)$$

So in ECE:

$$v^2 = \frac{L^2}{m^2}\left(\frac{1}{r^2} + \frac{1}{b^2} - \left(1 - \frac{r_0}{r}\right)\left(\frac{1}{a^2} + \frac{1}{r^2}\right)\right) \quad -(13)$$

So

$$v^2 \xrightarrow[r \to \infty]{} \frac{L^2}{m^2}\left(\frac{1}{b^2} - \frac{1}{a^2}\right) \quad -(14)$$

Now use:

$$\frac{1}{b^2} = \frac{E^2}{L^2 c^2} \; ; \; \frac{1}{a^2} = \frac{m^2 c^2}{L^2} \quad -(15)$$

to find that:

$$v^2 \xrightarrow[r \to \infty]{} \frac{1}{m^2 c^2}\left(E^2 - m^2 c^4\right) \quad -(16)$$

The infinitesimal line element of ECE is:

$$ds^2 = c^2 d\tau^2 = m(r) c^2 dt^2 - \frac{dr^2}{m(r)} - r^2 d\phi^2 \quad -(17)$$

where

$$m(r) = 1 - \frac{r_0}{r} \quad -(18)$$

In the limit

$$r \to \infty \quad -(19)$$

eq. (17) becomes the Minkowski metric:

$$ds^2 = c^2 d\tau^2 = c^2 dt^2 - dr^2 - r^2 d\phi^2 \quad -(20)$$

which corresponds to the Einstein energy equation:

$$E^2 = p^2 c^2 + m^2 c^4 \quad -(21)$$

where

$$p = \gamma m v_N \quad -(22)$$

So in eq. (16):

$$v^2 \xrightarrow[r \to \infty]{} \frac{p^2}{m^2} = \gamma^2 v_N^2 \quad -(23)$$

where v_N is the Newtonian velocity:

$$v_N^2 = \frac{MG}{r}\left(2 + \frac{\epsilon^2 - 1}{1 + \epsilon \cos\phi}\right) \quad -(24)$$

So in EGR:

$$v^2 \xrightarrow[r \to \infty]{} \frac{\gamma^2 MG}{r}\left(2 + \frac{\epsilon^2 - 1}{1 + \epsilon \cos\phi}\right) \quad -(25)$$

i.e.

$$\boxed{v^2(\mathrm{EGR}) \xrightarrow[r \to \infty]{} 0} \quad -(26)$$

Therefore Einsteinian general relativity is completely refuted by whirlpool galaxies, because

$$v^2(\mathrm{galaxy}) \xrightarrow[r \to \infty]{} \text{constant} \quad -(27)$$

Also, EGR is not able to give the spiral arms of the whirlpool galaxy.

Finally consider m theory:

$$v^2 = \frac{L^2 m(r)}{\gamma^2 m^2}\left(\frac{1}{r^2} + \frac{1}{r^4}\left(\frac{dr}{d\phi}\right)^2\right) \quad -(28)$$

It follows from eq. (28), using

$$\frac{1}{\gamma^2} = m(r) - \frac{v^2}{m(r)c^2} \quad -(29)$$

so that:

$$v^2 = L^2\left(m(r) - \frac{v^2}{m(r)c^2}\right)\frac{m(r)}{m^2}\left(\frac{1}{r^2} + \frac{1}{r^4}\left(\frac{dr}{d\phi}\right)^2\right) \quad -(30)$$

So

$$v^2\left(1 + \frac{L^2 m(r)}{m(r) m^2 c^2}\left(\frac{1}{r^2} + \frac{1}{r^4}\left(\frac{dr}{d\phi}\right)^2\right)\right) \quad -(31)$$

$$= \frac{L^2 m(r)^2}{m^2}\left(\frac{1}{r^2} + \frac{1}{r^4}\left(\frac{dr}{d\phi}\right)^2\right)$$

So:

$$v^2 = \frac{\left(\frac{L m(r)}{m}\right)^2\left(\frac{1}{r^2} + \frac{1}{r^4}\left(\frac{dr}{d\phi}\right)^2\right)}{1 + \frac{L^2}{m^2c^2}\left(\frac{1}{r^2} + \frac{1}{r^4}\left(\frac{dr}{d\phi}\right)^2\right)} \quad -(32)$$

where

$$L = \frac{\gamma r^2 \dot{\phi} m}{m(r)} \quad -(33)$$

is the constant angular momentum.

The orbital function $dr/d\phi$ is found from:

$$\frac{dH}{dt} = 0 \quad -(34)$$

and

$$\frac{dL}{dt} = 0 \quad -(35)$$

in which the hamiltonian is:

6)

$$H = n(r)\,\gamma m c^2 + U \quad -(36)$$

where U is the potential energy.

For the inverse square law in m space:

$$U = -n(r)^{1/2}\,\frac{mMG}{r} \quad -(37)$$

The inverse square law in m theory gives many kinds of important new physics and astronomy, but to describe the whirlpool galaxies, an inverse cube force law is needed:

$$F(r) = -\frac{k}{r^3} \quad -(38)$$

giving spiral orbits, the Cotes spirals.

In general, any galaxy can be described with the hamiltonian:

$$H = \gamma n(r) m c^2 - \frac{k}{r^2}\,n(r) \quad -(39)$$

and angular momentum:

$$L = \frac{\gamma m r^2 \dot{\phi}}{n(r)} \quad -(40)$$

The potential energy is now:

$$U = -\frac{k}{r^2}\,n(r) \quad -(41)$$

One can try:

$$U = -\sum_{n=2}^{n}\frac{k_n}{r^n}\,n(r)^{n/2} \quad -(42)$$

or:

$$U = -\sum_{n=1}^{n}\frac{k_n}{r^n}\,n(r)^{n/2} \quad -(43)$$