420(2): m(r) Theory with $dm(r)/dr = 0$

In general, the equations of motion of m theory are:

$$\frac{dH}{dt} = 0 \quad -(1)$$

and

$$\frac{dL}{dt} = 0 \quad -(2)$$

where

$$H = m(r)\gamma m c^2 - m(r)^{1/2}\frac{mMG}{r} \quad -(3)$$

is the hamiltonian and

$$L = \frac{\gamma m r^2}{m(r)}\dot{\phi} \quad -(4)$$

is the angular momentum. Here:

$$\gamma = \left(m(r) - \frac{v_N^2}{m(r)c^2}\right)^{-1/2} \quad -(5).$$

is the generalized Lorentz factor. The Newtonian velocity is defined by:

$$v_N^2 = \dot{r}^2 + r^2\dot{\phi}^2 \quad -(6)$$

in the plane polar coordinates (r, ϕ). The total relativistic energy in m theory is:

$$E = m(r)\gamma m c^2 \quad -(7)$$

and the potential energy is:

$$U = -m(r)^{1/2}\frac{mMG}{r} \quad -(8)$$

The infinitesimal line element is:

$$ds^2 = c^2 d\tau^2 = m(r)c^2 dt^2 - \frac{dr^2}{m(r)} - r^2 d\phi^2 \quad -(9)$$

which is the line element of the most general spherical spacetime.

2) Computer algebra develops eqs. (1) and (2) into:

$$m(\ddot{r} - r\dot{\phi}^2) = F(r)$$

$$= m\left[\frac{dn(r)}{dr}\left(c^2 m(r) + \frac{MG}{2\gamma^3 r\, m(r)^{1/2}} - \frac{3c^2}{2\gamma^2}\right)\right.$$

$$\left. - \frac{1}{n(r)}\frac{dn(r)}{dr}\dot{\phi}^2 r^2\left(2 - \frac{MG}{2\gamma^2 c^2 m(r)^{1/2}}\right) - MG\left(\frac{m(r)^{1/2}}{\gamma^3 r^2} + \frac{\dot{\phi}^2}{\gamma c^2 m(r)^{1/2}}\right)\right] \quad -(10)$$

and

$$r\ddot{\phi} + 2\dot{\phi}\dot{r} = r\dot{\phi}\dot{r}\left(\frac{1}{n(r)}\frac{dm(r)}{dr}\left(2 - \frac{MG}{2\gamma c^2 r\, m(r)^{1/2}}\right) + \frac{MG}{\gamma c^2 r^2 m(r)^{1/2}}\right) \quad -(11)$$

Eq. (10) is the Leibniz equation in n space and eq. (11) is the conservation of angular momentum in n space. These equations produce an entirely new physics and cosmology, for example forward and retrograde precession, shrinking and expanding orbits, superluminal motion, infinite energy from n space, and much more. Eqs. (10) and (11) can be solved on a desktop but under some circumstances it is an advantage to use a simpler structure obtained by assuming that:

$$\frac{dn(r)}{dr} = 0 \quad -(12)$$

so that $n(r)$ is a constant independent of r:

$$n(r) := \mu \quad -(13)$$

As shown in UFT419 the assumption (12) is enough to produce the orbit of the S2 star.

Under the assumption (12), Eq. (10) simplifies to:

$$m(\ddot{r} - r\dot{\phi}^2) = -mMG\left(\frac{\mu^{1/2}}{\gamma^3 r^2} + \frac{\dot{\phi}^2}{\gamma c^2 \mu^{1/2}}\right)$$ — (14)

and eq. (11) simplifies to:

$$r\ddot{\phi} + 2\dot{\phi}\dot{r} = MG\left(\frac{\dot{\phi}\dot{r}}{\gamma c^2 r \mu^{1/2}}\right)$$ — (15)

where

$$\frac{1}{\gamma^3} = \left(\mu - \frac{\dot{r}^2 + r^2\dot{\phi}^2}{\mu c^2}\right)^{3/2}$$ — (16)

and

$$\frac{1}{\gamma} = \left(\mu - \frac{\dot{r}^2 + r^2\dot{\phi}^2}{\mu c^2}\right)^{1/2}$$ — (17)

Eqs. (14) and (15) govern orbits such as that of the S2 star, and it would be very interesting to graph those orbits as a function of μ.

The Newtonian velocity in eqs. (14) and (15) is:

$$v_N^2 = \dot{r}^2 + r^2\dot{\phi}^2$$ — (18)

and in the limit:

$$v_N \ll c$$ — (19)

it follows that

$$\frac{1}{\gamma^3} \rightarrow \mu^{3/2} \; ; \; \frac{1}{\gamma} \rightarrow \mu^{1/2}$$ — (20)

The limit (19) corresponds to:

$$c \rightarrow \infty$$ — (21)

in comparison with v_N. Note carefully that eq. (21) is meant to convey the fact that $v_N \ll c$. It does not mean that c actually becomes infinite, because c is

4) a universal constant.

In these limits eqs. (14) and (15) reduce to:

$$m(\ddot{r} - r\dot{\phi}^2) = -\mu^2 \frac{mMG}{r^2} \quad -(22)$$

and

$$r\ddot{\phi} + 2\dot{\phi}\dot{r} = 0 \quad -(23)$$

Eq. (22) is

$$\ddot{r} - r\dot{\phi}^2 = -\frac{\mu^2 MG}{r^2} \quad -(24)$$

and indicates that the effective mass around which m orbits is:

$$M_1 := M(\text{effective}) = \mu^2 M \quad -(25)$$

In the limit

$$\mu \rightarrow 1 \quad -(26)$$

the Newtonian theory is recovered. Eqs. (23) and (24) give an elliptical or conic section orbit with half right latitude:

$$\alpha = \frac{L^2}{m^2 M_1 G} \quad -(27)$$

and ellipticity:

$$\epsilon = \left(1 + \frac{2HL^2}{m^3 M_1 G}\right)^{1/2} \quad -(28)$$

In this Newtonian limit all the orbital characteristics are changed by the choice of m the hamiltonian in space, i.e. by the choice of μ.
The Newtonian limit is:

$$H = \frac{1}{2} m v_N^2 - \frac{m M_1 G}{r} \quad -(29)$$

where

$$v_N^2 = M_1 G \left(\frac{2}{r} - \frac{1}{a}\right) \quad -(30)$$

>) where a is the semi major axis of the ellipse:

$$a = \frac{\alpha}{1-\epsilon^2} \quad -(31)$$

From eqs. (29) and (30):

$$H = \frac{1}{2} m M_1 G \left(\frac{2}{r} - \frac{1}{a} \right) - \frac{m M_1 G}{r}$$

$$= - \frac{m M_1 G}{a} \quad -(32)$$

It follows that

$$|H| = \frac{m M_1 G}{a} \quad -(33)$$

and

$$a = \frac{\alpha}{1-\epsilon^2} = \frac{m M_1 G}{|H|} \quad -(34)$$

The semi minor axis is:

$$b = \frac{\alpha}{(1-\epsilon^2)^{1/2}} = \frac{L}{(2m|H|)^{1/2}} \quad -(35)$$

The distance of closest approach is:

$$r_{min} = a(1-\epsilon) = \frac{\alpha}{1+\epsilon} \quad -(36)$$

and the furthest distance is:

$$r_{max} = a(1+\epsilon) = \frac{\alpha}{1-\epsilon} \quad -(37)$$

The angular momentum is the constant:

$$L = m r^2 \dot{\phi} \quad -(38)$$

From eqs. (27) and (28) it is clear that the half right [illegible] α decreases as M_1 increases, i.e. ϵ as μ increases, and the ellipticity decrease

6) as μ increases. These quantities are sketched as follows:

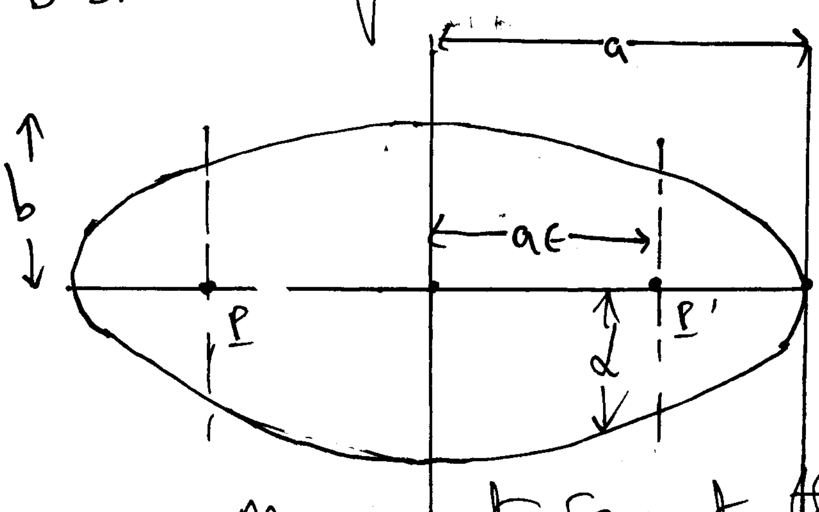

Fig (1)

The effective mass M_1 is situated at the focus P'

Conclusions

1) All orbits are governed by spherical spacetime. The choice of μ determines the orbit.

2) The concept of central mass is defined by spherical spacetime with constant μ, as in eq. (25). If M is regarded as the unit kilogram in S.I. units then the central mass is:

$$M_1 = \mu^2 \text{ kilograms} \qquad -(39)$$

3) Precession is introduced by eqs. (14) and (15).

4) General orbital characteristics are given by eqs. (10) and (11).

5) For whirlpool galaxies the most general orbit that gives a constant v as $r \to \infty$ is, from Note 419(5):

$$\phi = \frac{1}{m}\left(\frac{\mu}{A}\left(\mu - \frac{A}{\mu c^2}\right)\right)^{1/2}\int \frac{dr}{r^2} \qquad -(40)$$

$$= -\frac{r_0}{r}$$

which is a spiral with:

7)

$$r_0 = \frac{1}{m}\left(\frac{\mu}{A}\left(\mu - \frac{A}{\mu c^2}\right)\right)^{1/2} \quad -(41)$$

If the following choice is made:

$$\mu = \mu_1 + \mu_2 + \dots + \mu_n \quad -(42)$$

then the whirlpool galaxy consists of n spirals. This is a straightforward way of explaining why a spiral galaxy has several spirals.

More generally, if:

$$\frac{dm(r)}{dr} \neq 0 \quad -(43)$$

then

$$\phi = \frac{1}{m}\int\left(\frac{m(r)}{A}\left(m(r) - \frac{A}{m(r)c^2}\right)\right)^{1/2}\frac{dr}{r^2} \quad -(44)$$

because m(r) depends on r and cannot be taken outside the integral. In general eq. (44) has to be integrated numerically, but can produce all kinds of galaxies.

If the following choice is made:

$$m(r) = m_1(r) + m_2(r) + \dots + m_n(r) \quad -(45)$$

the number of spiral like features is n.