438(1): Orbit around a Heavy Mass in ECE Theory

With reference to UFT419 and earlier papers the orbit dynamics in ECE theory are governed by the two fundamental conservation equations:

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

and

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

where H and L are the hamiltonian and angular momentum. In ECE theory:

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

and

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

Here γ is the generalized Lorentz factor:

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

and the potential energy is:

$$U = - m(r)^{1/2}\frac{mMG}{r} \quad -(6)$$

in the plane polar coordinate system (r, ϕ). In these equations the mass m orbits the mass M in a plane, separated by a distance r, and G is Newton's constant.

Note carefully that these equations do not depend on the Einstein field equation.

Using computer algebra it can be shown that:

2)

$$\ddot r - r\dot\phi^2 = \frac{dm(r)}{dr}\left(c^2 m(r) + \frac{MG}{2\gamma^3 r\, m(r)^{1/2}} - \frac{3c^2}{2\gamma^2}\right) - \frac{1}{m(r)}\frac{dm(r)}{dr}\dot\phi^2 r^2\left(2 - \frac{MG}{2\gamma c^2 m(r)^{1/2}}\right) - MG\left(\frac{m(r)^{1/2}}{\gamma^3 r^2} + \frac{\dot\phi^2}{\gamma c^2 m(r)^{1/2}}\right) \quad -(7)$$

$$r\ddot\phi + 2\dot\phi\dot r = r\dot\phi\dot r\left(\frac{1}{m(r)}\frac{dm(r)}{dr}\left(2 - \frac{MG}{2\gamma c^2 r\, m(r)^{1/2}}\right) + \frac{MG}{\gamma c^2 r^2 m(r)^{1/2}}\right) \quad -(8)$$

The orbit of m about M is obtained by solving eqs. (7) and (8) numerically. In the Newtonian limit they reduce to:

$$\ddot r - r\dot\phi^2 = -\frac{MG}{r^2} \quad -(9)$$

and

$$r\ddot\phi + 2\dot\phi\dot r = 0 \quad -(10)$$

To initiate the investigation it is possible to increase M to near infinity, and in the first instance solve eqs. (9) and (10) numerically for orbits in a plane. These would be elliptical or hyperbolic, given by:

$$r = \frac{\alpha}{1 + \epsilon\cos\phi} \quad -(11)$$

where α is the half right latitude and ϵ the eccentricity.

The hamiltonian for eqs. (9) and (10) is:

$$H = \frac{1}{2}m\left(\dot r^2 + r^2\dot\phi^2\right) - \frac{mMG}{r} \quad -(12)$$

and the angular momentum is:

$$L = mr^2\dot{\phi} \quad -(13)$$

The half right latitude is:

$$\alpha = \frac{L^2}{m^2 MG} \quad -(14)$$

and the eccentricity is given by:

$$\epsilon^2 = 1 + \frac{2HL^2}{m^3 M^2 G^2} \quad -(15)$$

The orbital velocity is:

$$v^2 = MG\left(\frac{2}{r} - \frac{1}{a}\right) \quad -(16)$$

where

$$a = \frac{\alpha}{1-\epsilon^2} \quad -(17)$$

For an elliptical orbit:

$$0 < \epsilon < 1 \quad -(18)$$

and for the hyperbola:

$$\epsilon > 1 \quad -(19)$$

Using these equations it is possible to graph the orbit as:

$$M \rightarrow \infty \quad -(20)$$

and m remains finite.

From eq. (14), $$\alpha \xrightarrow[M\rightarrow\infty]{} 0. \quad -(21)$$

From eq. (15), $$\epsilon \xrightarrow[M\rightarrow\infty]{} 1 \quad -(22)$$

From eq. (11), $$r \xrightarrow[M\rightarrow\infty]{} 0 \quad -(23)$$

) From eq. (16):

$$V \xrightarrow[M \to \infty]{} \infty \quad - (24)$$

So the elliptical orbit shrinks to a point, and the orbital velocity of m about M approaches infinity. These characteristics could be graphed and / or animated, and are independent of mass m, because the latter does not appear in the equations of motion (9) and (10). So the equations are true for a photon of mass m. This means that a beam of light is captured by an infinite mass M, so observation of space in the vicinity of M would produce a dark area.

All the characteristics of the photograph claiming to have observed a "black hole" can be reproduced by graphics based on the above Newtonian equations.

Once the light is trapped by the pseudo infinite mass M its escape velocity is given by:

$$\frac{1}{2} m v^2 = \frac{m M G}{r} \quad - (25)$$

So

$$v = \left(\frac{2 M G}{r} \right)^{1/2} \quad - (26)$$

So in Newtonian dynamics $\longrightarrow \infty$. The light is trapped and can never escape.

When the complete equations (7) and (8) are considered, as in the next note, a variety of orbital behaviour becomes possible, notably precession, as in UFT419. This will be considered in the next note.