272(9): The Graph of $\ddot{\theta}$ Versus ϕ and θ

In three dimensions:

$$\ddot{\theta} = \dot{\phi}^2 \sin\theta\cos\theta - 2\frac{\dot{r}\dot{\theta}}{r} \quad -(1)$$

and in two dimensions:

$$\ddot{\theta} = 0. \quad -(2)$$

The chain of equations is:

$$r = \frac{d}{1+\epsilon\cos\beta}, \quad -(3)$$

$$\cos\beta = \frac{\cos\phi}{\left(\cos^2\phi + \left(\frac{L_z}{L}\right)^2 \sin^2\phi\right)^{1/2}}, \quad -(4)$$

$$\dot{r} = \left(\frac{2}{m}\left(E - \frac{L^2}{2mr^2} + \frac{k}{r}\right)\right)^{1/2} \quad -(5)$$

$$\dot{\phi} = \frac{L_z}{mr^2\sin^2\theta} \quad -(6)$$

$$\dot{\theta} = \frac{1}{mr^2}\left(L^2 - \frac{L_z^2}{\sin^2\theta}\right)^{1/2} \quad -(7)$$

$$\sin^2\theta = \left(\frac{L_z}{L}\right)^2 + \left(1 - \left(\frac{L_z}{L}\right)^2\right)\left(\frac{\cos^2\phi}{\cos^2\phi + \left(\frac{L_z}{L}\right)^2\sin^2\phi}\right) \quad -(8)$$

2) Case (1)

Express $\dot{\phi}$ in terms of ϕ using eqs. (6) and (8), and express $2\dot{r}\dot{\theta}/r$ in terms of θ using eqns. (5), (7), (3), (4) and (8).

Case (2)

Express $\dot{\phi}$ in terms of θ using eq. (6) and express $2\dot{r}\dot{\theta}/r$ in terms of ϕ using eqs. (3), (5), (7) and (8).

There are many other possible permutations and each may produce orbital like structure