

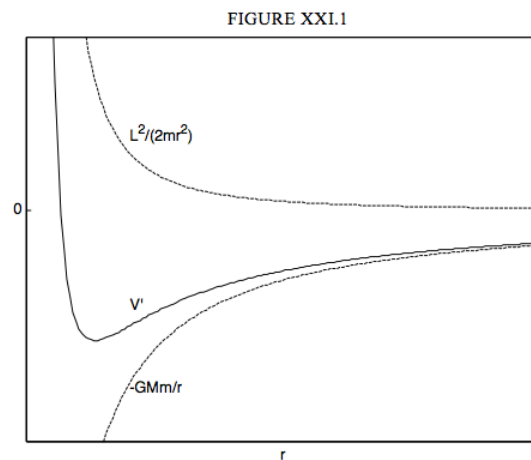
21.3: Inverse Square Attractive Force

This is dealt with in detail in Chapter 9 of Celestial Mechanics. Here we investigate some general properties of the motion.

If $F = -\frac{GMn}{r^2}$ then $V = \frac{GMn}{r}$, and hence

$$V' = -\frac{GMn}{r} + \frac{L^2}{2mr^2}. \quad (21.3.1)$$

I sketch this in Figure XXI.1. The total energy (potential + kinetic) is constant (independent of r) and is greater than (or equal to) the potential energy. If the total energy is less than zero, you can see from the graph that r has a lower (perihelion) and upper (aphelion) limit; this corresponds to an elliptic orbit. But if the total energy is positive, r has a lower limit, but no upper limit; this corresponds to a hyperbolic orbit. If the total energy is equal to the minimum of V' , only one value of r is possible, and the orbit is a circle.



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