CHAPTER TWENTY-TWO

The Derivation of the Proton and other Quark Masses:

A Classical Approach Through the Use of Kepler's Harmonic Law

In the previous chapter we empirically derived the mass of the proton using the energy eigenvalues of the Schrodinger equation for a particle in a box and a particle in a sphere. The concept of a particle in a sphere is rather unconventional and its application may give the reader some pause. Also, it was stated at the outset of this paper that the classical laws of physics operate just as well at the atomic and nuclear levels as they do at the macroscopic level. The use of eigenvalues is a concept traditionally rooted in quantum mechanics. Can the mass of the proton be derived using more conventional classical means? The answer is yes. To derive the mass of the proton and its constituent quarks we will begin with Kepler's Law of Harmonics. For a stationary mass Kepler's Law of Harmonics it is mathematically stated as

$$P^2 = \frac{4\pi^2 r^3}{GM} \qquad \textbf{(22.1)}$$

where P is the period, G is Newton's gravitational force constant, and r is the mean distance between the masses m and M. This law states that the square of the period of revolution is proportional to the cube of the semimajor axis or the cube of the mean distance of mass m from mass M and inversely proportional to the sum of the masses.

We start the derivation with Kepler's Law of Harmonics where

$$P^2 = \frac{4\pi^2 r^3}{G[m+M]} \qquad \textbf{(22.2)}$$

and Newton's gravitational force law where

$$F_{gravity} = \frac{mM}{r^2}G \qquad \textbf{(22.3)}$$

Recall that r is the semimajor axis or the mean distance between masses m and M. We will consider one of the more simple examples where two identical masses revolve around their common center of mass. If such is the case then through the law of moments r is simply the radius of the orbiting identical particles and the above equations simplify to

$$P^2 = \frac{4\pi^2 r^3}{G2m} \quad \textbf{and} \quad F_{gravity} = \frac{m^2}{r^2}G$$

Therefore

$$G = \frac{Fr^2}{m^2} \tag{22.4}$$

Therefore

$$P^2 = \frac{4\pi^2 r^3 m^2}{Fr^2 2m} \tag{22.5}$$

$$P^2 = \frac{4\pi^2 r^2 m}{2Fr} \tag{22.6}$$

$$Fr = E = E_{potential} \tag{22.7}$$

$$E_{potential} = \frac{4\pi^2 r^2 m}{2P^2} \tag{22.8}$$

$$E_{kinetic} = \frac{E_{potential}}{2} \tag{22.9}$$

$$E_{kinetic} = \frac{4\pi^2 r^2 m}{4P^2} \tag{22.10}$$

$$E_{kinetic} = \frac{4\pi^2 r^2 m \nu^2}{4} \quad \textbf{where} \quad \nu = \frac{1}{P} \tag{22.11}$$

$$E = nh\nu \tag{22.12}$$

$$\nu = \frac{E_{kinetic}}{nh} \tag{22.13}$$

$$E_{kinetic} = \frac{4\pi^2 r^2 m (E_{kinetic})^2}{4n^2 h^2} \tag{22.14}$$

$$E_{kinetic} = \frac{4n^2h^2}{m4\pi^2r^2} \qquad \textbf{(22.15)}$$

Dividing both sides by 16 yields

$$E_{kinetic} = \frac{4n^2h^2}{16m4\pi^2r^2} = \frac{n^2h^2}{4m4\pi^2r^2} = \frac{n^2h^2}{4\pi m4\pi r^2} \qquad \textbf{(22.16)}$$

Equation (22.6) is exactly identical to equation (21.3), which is the equation for a particle in a sphere, proposed in the previous chapter using the energetic eiegenvalues of the Schrodinger equation. We have now, however, derived this equation strictly through classical means. The inclusion of the factor 1/16 in equation (22.16) confirms once again that the base quark is composed of 16 smaller prime components.

Having once established the existence of the base quark and the prime quark the same deductive reasoning employed in Chapter 21 to empirically derive the mass of the proton quantum mechanically may also be employed, here, only classically. Indeed, Yvonne's law and equation 22.16 illustrate the classical Keplerian foundation of the Schrödinger equation.