

## Mass Dilation

An electron's circular orbit around the nucleus is provided by the electron's electrostatic attraction towards the protons in the nucleus. Therefore,

$$F_c = F_e$$
$$\frac{mv^2}{r} = \frac{ke^2}{r^2}$$

Simplifying and isolating for mass, the above equation becomes

$$m = \frac{ke^2}{v^2 r}$$

At low speeds, the mass of a moving object is negligibly different from its stationary or **rest mass**,  $m_o$ . The above equation suggests that as the radius of orbit becomes contracted at high speeds (length contraction) the mass of the electron becomes dilated.

For the relativistic mass, the equation for length contraction is substituted into the above equation for  $r$  such that

$$m = \frac{ke^2}{v^2 r_o \sqrt{1 - \frac{v^2}{c^2}}}$$

Which simplifies to

$$m = \frac{m_o}{\sqrt{1 - \frac{v^2}{c^2}}} \quad (3)$$

where  $m$  is the relativistic mass (kg)

### **Examples:**

1. Find the dilated mass of a pion of rest mass  $2.5 \times 10^{-28}$ kg if it is travelling at a speed of  $0.99c$ .
2. Determine the increase in mass of a car travelling at 25m/s if its rest mass is 2000kg.