Chapter 2. Special Relativity: The Geometry of Flat Spacetime

Note. Classically (i.e in Newtonian mechanics), *space* is thought of as

1. unbounded and infinite,

2. 3-dimensional and explained by Euclidean geometry, and

3. "always similar and immovable" (Newton, *Principia Mathematica*, 1687).

This would imply that one could set up a system of spatial coordinates (x, y, z) and describe any dynamical event in terms of these spatial coordinates and time t.

Note. Newton's Three Laws of Motion:

1. (*The Law of Inertia*) A body at rest remains at rest and a body in motion remains in motion with a constant speed and in a straight line, unless acted upon by an outside force.

2. The acceleration of an object is proportional to the force acting upon it and is directed in the direction of the force. That is, $\vec{F} = m\vec{a}$.

3. To every action there is an equal and opposite reaction.

Note. Newton also stated his Law of Universal Gravitation in *Principia*:

> "Every particle in the universe attracts every other particle in such a way that the force between the two is directed along the line between them and has a magnitude proportional to the product of their masses and inversely proportional to the square of the distance between them." (See page 186.)

Symbolically, $F = \dfrac{GMm}{r^2}$ where F is the magnitude of the force, r the distance between the two bodies, M and m are the masses of the bodies involved and G is the *gravitational constant* (6.67×10^{-8} cm./(g sec^2)). Assuming only Newton's Law of Universal Gravitation and Newton's Second Law of Motion, one can derive Kepler's Laws of Planetary Motion.

Revised: 6/16/2019