Phys Notes

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Chapter 1

1 (Special Relativity.)

1.1 Definitions

- Observer: An observer is an individual armed with measuring equipment like rulers and timers
- Frame of reference: An object/body or collection of bodies that is considered to be at rest
- Coordinate system: a "choice" by an observer on how to uniquely label points in space/time in their Frame of Reference
- Inertial Frame of reference: a frame of reference in which Newton's 1st law holds (inertial means not accelerating! Non inertial means accelerating)(does not accelerate or rotate)
- inertial observer: an observer that is within an inertial frame of reference
- inertial coordinate system: a coordinate system within an inertial frame of reference which uses:
  - an ideal clock for measuring the time
  - a Cartesian (x,y,z) system for locating points in space where things happen
- an event: something which happens at a particular point within space/particular point in time
- Space/time coordinate: An inertial observer using an inertial coordinate system (using (x,y,z) Cartesian system and T for time) will assign to every event a single space time coordinate (t,x,y,z)
  It is also the collection of all possible events, i.e, every (t, x, y, z) is called space-time (Minnoski space)
- Temporal separation (time interval) between events 1 and 2 is given by:

$$\Delta t = t_2 - t_1$$

- Distance between events 1 and 2 is given by:

$$\begin{aligned}&\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2} \\ &= \sqrt{\Delta x^2 + \Delta y^2 + \Delta z^2}\end{aligned}$$

1.2 The Principle of Relativity

- The laws of physics are the same in all inertial reference frames
- The outcome of any experiment is the same when performed with an identical initial conditions relative to any inertial frame of reference

1.2.1 relative quantities/invariant quantities

A relative quantity is a physical quantity which different observers may measure to have different values (e.g I am on a train with a ball moving at constant velocity. I observe that the ball is not moving (v=0) hence its kinetic energy is 0. Another observer outside of the train observes the ball to be moving, hence a non-zero kinetic energy.) In contrast, invariant quantities have the same value for all observers (e.g, mass)

1.2.2 Postulates of Special Relativity

The 2 postulates of **Special Relativity** are as follows:

- Postulate 1: The principle of relativity: The laws of physics are the same in all **non inertial frames of reference**
- Postulate 2: The speed of light: In a vacuum, in all inertial frames, light propagates in a straight line at the same speed, denoted c at all times and in all directions. The speed of light is invariant