11.1: Introduction to Reference Frames

> *Examples of this sort, together with the unsuccessful attempts to discover any motion of the earth relatively to the "light medium" suggest that the phenomena of electromagnetism as well as mechanics possess no properties corresponding to the idea of absolute rest. They suggest rather that, …, the same laws of electrodynamics and optics will be valid for all frames of reference for which the equations of mechanics hold good. We will raise this conjecture (the purport of which will hereafter be called the "Principle of Relativity") to the status of a postulate, and also introduce another postulate, …, namely that light is always propagated in empty space with a definite velocity c, which is independent of the state of motion of the emitting body.*
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> *~Albert Einstein*

In order to describe physical events that occur in space and time such as the motion of bodies, we introduced a coordinate system. Its spatial and temporal coordinates can now specify a space-time event. In particular, the position of a moving body can be described by space-time events specified by its space-time coordinates. You can place an observer at the origin of coordinate system. The coordinate system with your observer acts as a reference frame for describing the position, velocity, and acceleration of bodies. The position vector of the body depends on the choice of origin (location of your observer) but the displacement, velocity, and acceleration vectors are independent of the location of the observer.

You can always choose a second reference frame that is moving with respect to the first reference frame. Then the position, velocity and acceleration of bodies as seen by the different observers do depend on the relative motion of the two reference frames. The relative motion can be described in terms of the relative position, velocity, and acceleration of the observer at the origin, O , in reference frame S with respect to a second observer located at the origin, O′ , in reference frame S′.