11.3: Law of Addition of Velocities - Newtonian Mechanics

Suppose the object in Figure 11.1 is moving; then observers in different reference frames will measure different velocities. Denote the velocity of the object in frame S by $\vec{\mathbf{v}} = d\vec{\mathbf{r}}/dt$, and the velocity of the object in frame S′ by $\vec{\mathbf{v}}' = d\vec{\mathbf{r}}'/dt'$. Since the derivative of the position is velocity, the velocities of the object in two different reference frames are related according to

$$\frac{d\vec{\mathbf{r}}'}{dt'} = \frac{d\vec{\mathbf{r}}}{dt} - \frac{d\vec{\mathbf{R}}}{dt}$$

$$\vec{\mathbf{v}}' = \vec{\mathbf{v}} - \vec{\mathbf{V}}$$

This is called the **Law of Addition of Velocities.**