

7.2: Newton's First Law

The First Law of Motion, commonly called the “Principle of Inertia,” was first realized by Galileo. (Newton did not acknowledge Galileo’s contribution.) Newton was particularly concerned with how to phrase the First Law in Latin, but after many rewrites Newton choose the following expression for the First Law (in English translation):

Law 1: Every body continues in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed upon it.

Projectiles continue in their motions, so far as they are not retarded by the resistance of air, or impelled downwards by the force of gravity. A top, whose parts by their cohesion are continually drawn aside from rectilinear motions, does not cease its rotation, otherwise than as it is retarded by air. The greater bodies of planets and comets, meeting with less resistance in freer spaces, preserve their motions both progressive and circular for a much longer time.

The first law is an experimental statement about the motions of bodies. When a body moves with constant velocity, there are either no forces present or the sum of all the forces acting on the body is zero. If the body changes its velocity, it has non-zero acceleration, and hence the sum of all the forces acting on the body must be non-zero as well. If the velocity of a body changes in time, then either the direction or magnitude changes, or both can change.

After a bus or train starts, the acceleration is often so small we can barely perceive it. We are often startled because it seems as if the station is moving in the opposite direction while we seem to be at rest. Newton’s First Law states that there is no physical way to distinguish between whether we are moving or the station is moving, because there is nearly zero total force acting on the body. Once we reach a constant velocity, our minds dismiss the idea that the ground is moving backwards because we think it is impossible, but there is no actual way for us to distinguish whether the train is moving or the ground is moving.

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