2.5: Conservation Laws in Classical Mechanics

Elucidating the dynamics in classical mechanics is greatly simplified when conservation laws are applicable. In nature, isolated many-body systems frequently conserve one or more of the first-order integrals for linear momentum, angular momentum, and mass/energy. Note that mass and energy are coupled in the Theory of Relativity, but for non-relativistic mechanics the conservation of mass and energy are decoupled. Other observables such as lepton and baryon numbers are conserved, but these conservation laws usually can be subsumed under conservation of mass for most problems in non-relativistic classical mechanics.

The power of conservation laws in calculating classical dynamics makes it useful to combine the conservation laws with the first integrals for linear momentum, angular momentum, and work-energy, when solving problems involving Newtonian mechanics. These three conservation laws will be derived assuming Newton's laws of motion, however, these conservation laws are fundamental laws of nature that apply well beyond the domain of applicability of Newtonian mechanics.