

16.1: Billiard Balls

“Elastic” means no internal energy modes of the scatterer or of the scatteree are excited—so total kinetic energy is conserved. As a simple first exercise, think of two billiard balls colliding. The best way to see it is in the center of mass frame of reference. If they’re equal mass, they come in from opposite directions, scatter, then move off in opposite directions. In the early days of particle accelerators (before colliders) a beam of particles was directed at a stationary target. So, the frame in which one particle is initially at rest is called the lab frame. What happens if we shoot one billiard ball at another which is initially at rest? (We’ll ignore possible internal energies, including spinning.) The answer is that they come off at right angles. This follows trivially from conservation of energy (in an obvious notation)

$$\frac{1}{2}m\vec{v}^2 = \frac{1}{2}m\vec{v}_1^2 + \frac{1}{2}m\vec{v}_2^2 \quad (16.1.1)$$

and momentum

$$m\vec{v} = m\vec{v}_1 + m\vec{v}_2 \quad (16.1.2)$$

and Pythagoras’ theorem.

This page titled [16.1: Billiard Balls](#) is shared under a [not declared](#) license and was authored, remixed, and/or curated by [Michael Fowler](#).