5.6: Angular Momentum

In analogy with the definition of torque, $\boldsymbol{\tau}=\boldsymbol{r}\times\boldsymbol{F}$ as the rotational counterpart of the force, we define the **angular momentum** $\boldsymbol{L}$ as the rotational counterpart of momentum:

$$\boldsymbol{L}=\boldsymbol{r}\times\boldsymbol{p} \tag{5.6.1}$$

For a rigid body rotating around an axis of symmetry, the angular momentum is given by

$$\boldsymbol{L}=I\boldsymbol{\omega} \tag{5.6.2}$$

where I is the **moment of inertia** of the body with respect to the symmetry axis around which it rotates. Equation 5.6.2 also holds for a collection of particles rotating about a symmetry axis through their center of mass, as readily follows from 5.4.2 and 5.6.1. However, it does not hold in general, as in general, $\boldsymbol{L}$ does not have to be parallel to $\boldsymbol{\omega}$. For the general case, we need to consider a moment of inertia tensor $\boldsymbol{I}$ (represented as a 3×3 matrix) and write $\boldsymbol{L}=\boldsymbol{I}\cdot\boldsymbol{\omega}$. We'll consider this case in more detail in Section 7.3.