

DEVICE Human Gyroscope Wheels Demonstration

TOPIC Rotational Mechanics

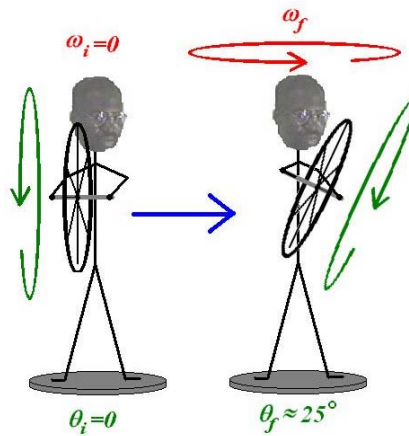
THEORETICAL BACKGROUND The underlying principle here is the conservation of angular momentum, which states that the total angular momentum of a body is constant if the resultant external torque acting on the body is zero:

$$\text{if } \sum \tau_{\text{ext}} = \frac{d\mathcal{L}}{dt} = 0$$

then $\mathcal{L} = \text{constant}$;

$$\mathcal{L}_i = \mathcal{L}_f \Rightarrow I_i \omega_i = I_f \omega_f = \text{constant}.$$

Suppose our lab coordinator holds the axle of a spinning bicycle wheel while standing on a rotating platform. He and the platform are initially at rest while the wheel spins on a horizontal plane. As he begins to rotate the wheel in progressive sessions to 180° about its center, he and the platform begin to rotate. This is due to the fact that the total angular momentum of the system—the wheel, Mr. Robinson, and the platform—must be conserved.



DESCRIPTION The human gyroscope is used to demonstrate conservation of angular momentum. The demo makes use of a free standing bicycle wheel with a diameter of at least 65 cm. The wheel is accompanied with a rotating platform, ideally with low frictional bearings, and a willing volunteer. The wheel should have handles on each end of the axis.

PROCEDURE Performing this experiment may require the aid of a teacher's assistant.

1. Find a clear area in the classroom or laboratory to place the rotating platform.
2. Place both feet firmly on the platform.
3. The TA should begin rotating the wheel at this point. Once a constant angular velocity has been established with the wheel, s/he should hand it to the person on the platform.
4. Begin rotating the wheel clockwise and then counter-clockwise.

SUGGESTIONS We have a dual bicycle wheel in our demo closet, that is there are two wheels attached to the same axis. Perform the above experiment with this wheel set and consider the following questions: What would happen if both wheels spin in the same direction; one spins clockwise while the other spins counter-clockwise?