Lab ##: Rotating Reference Frames

- 0. Prelab.

(1) Keep prelab for now and hand it in at the end of class.

- I. Spinning table with hoverpuck.

(1) Pass the hoverpuck back and forth to your partner across the table. The grid of the tiles on the lab floor represents the "lab" coordinate system. The grid of black tape on the spinning table represents the "rotating" coordinate system.

(2) Does the puck travel in a straight line relative to the "rotating" reference frame? The "lab" frame? Carefully draw your observation as it appears in each frame.

(3) Are there any forces acting on the puck (after you release it)? In which reference frame does Newton's law hold?

(4) In the frame where Newton's law fails, what pseudoforces can be used to explain the apparent acceleration? In this frame draw a force diagram of a certain instant as the puck moves. Include the vectors representing ω and v and the pseudoforces.

- II. Spinning table with hanging metal cylinder.

(1) Hang the metal cylinder down in front of the tiny person. The perspective of the tiny person represents the "rotating" frame (imagine she doesn't know she's spinning).

(2) Gently spin the table so that the pendulum comes to equilibrium.

(3) Draw the force diagram in the lab frame. Note that in the lab frame the cylinder is accelerating due to its circular motion.

(4) Draw the force diagram in the rotating frame. Note that in the rotating frame the cylinder is at rest and there are pseudoforces (include these).

- III. Bike wheel.

(1) Spin the wheel as fast as you can. Try to swing it like a golf club. Now spin it as fast as you can in the other direction and do the same. Did you feel the difference?

(2) Spin the wheel as fast as you can. Hold it on one end and hold it pointing away from your body, then spin. Now spin in the other direction. Can you make it levitate itself?

(3) In your notebook, record how much fun you just had with the bike wheel on a scale from one to forty.

- IV. Learny-go-round.

(1) Spin on the learny-go-round (LGR). The people standing on the ground represent the "lab" frame. Your perspective when you are spinning represents the rotating frame. Remember, there is no spoon.

(2) Play with the ball on the LGR. Try to pass it back and forth with your group.

(3) Did the ball seem to curve? What determined which direction the ball curved? What forces and/or pseudoforces were acting on the ball?

(4) Assume that the visible tails of a hurricane are clouds carried by high altitude outflow (air flowing radially outward from the hurricane's eye). If a hurricane is in the northern hemisphere, and the dominant lateral force is the coriolis force (rather than a pressure gradient), then which way should the tails spiral? If you have the internet, compare to Sandy and Katrina in the northern hemisphere, and to Tropical Cyclone Eunice in the southern hemisphere, or any of your other favorite hurricanes.