

Lab 3-2: Relative Motion

- Purpose:**
- To be able to define a frame of reference.
 - To observe a tennis ball being tossed up and down from multiple frames of reference.
 - To develop notation for velocity addition between different frames of reference.

Volunteers: 1 Tosser 1 Filmer 2 Pushers

Procedure:

- The volunteers should take a moment to practice moving at constant speed in a straight line. The *Tosser* needs to be able to toss a tennis ball straight up and down and the *Filmer* needs to be able to hold the camera steady while someone else pushes them at constant speed.
- In the charts below, the velocities of the *Tosser* and the *Filmer* are given for the Room Reference Frame. This is what the class sees. Turn the camera on, and do each trial listed. The actual velocities don't matter, as long as they are reasonably constant.
- Once all the trials are done, watch the video for each trial and determine the velocities in the Camera Reference Frame. This is conceptual only, so give answers in terms of "v". The video will be shown as a class.

Data:

Part 1: One Person Moving

| | Room Reference Frame | | | Camera Reference Frame | | |
|---------|----------------------|--------|--------|------------------------|--------|--------|
| | Room | Tosser | Camera | Room | Tosser | Camera |
| Trial 1 | 0 | + v | 0 | | | |
| Trial 2 | 0 | - v | 0 | | | |
| Trial 3 | 0 | 0 | + v | | | |
| Trial 4 | 0 | 0 | - v | | | |

Part 2: Both People Moving

| | Room Reference Frame | | | Camera Reference Frame | | |
|---------|----------------------|--------|--------|------------------------|--------|--------|
| | Room | Tosser | Camera | Room | Tosser | Camera |
| Trial 5 | 0 | + v | + v | | | |
| Trial 6 | 0 | - v | - v | | | |
| Trial 7 | 0 | - v | + v | | | |
| Trial 8 | 0 | + v | - v | | | |

Conclusions:

- In the Room Reference Frame, what was always true about the velocity of the Room?
- In the Camera Reference Frame, what was always true about the velocity of the Camera?
- What was always true about the *Velocity of the Camera with respect to the Room* (V_{CR}) compared to the *Velocity of the Room with respect to the Camera* (V_{RC})?

