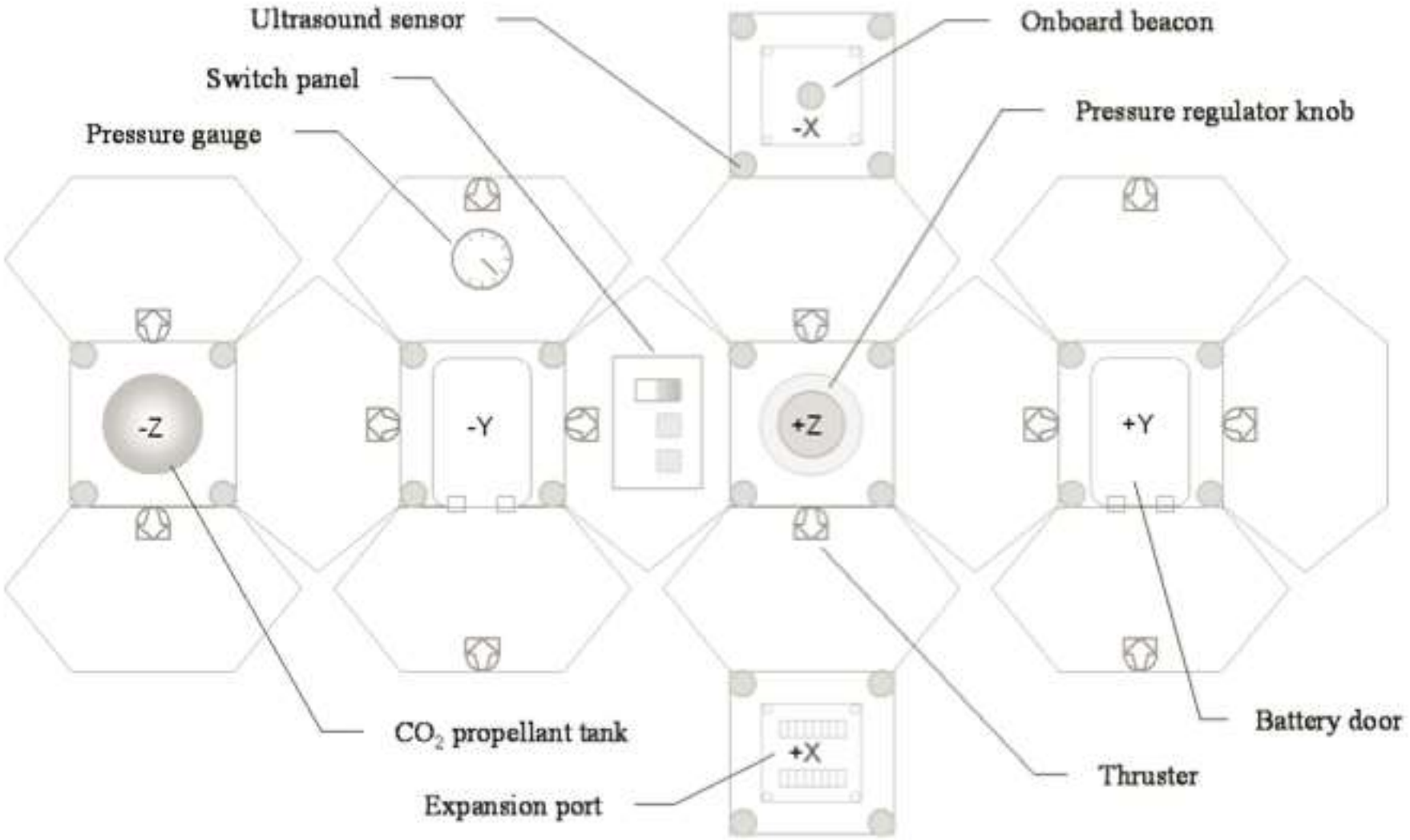
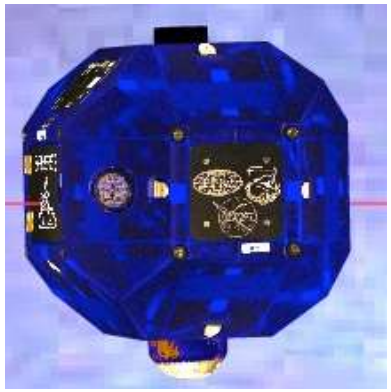
All About SPHERES

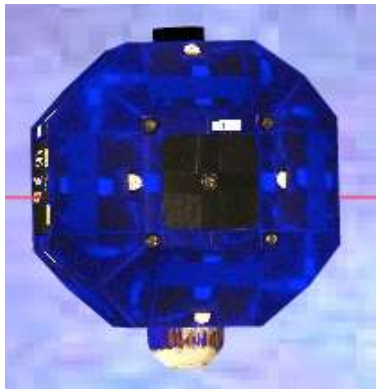
What Are the Parts?



The SPHERES Satellites



+X

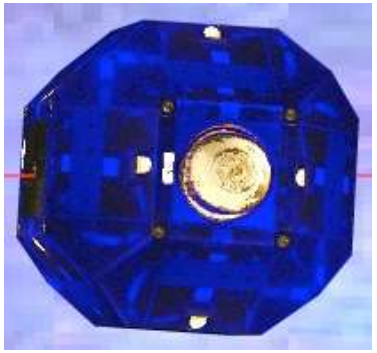


–X

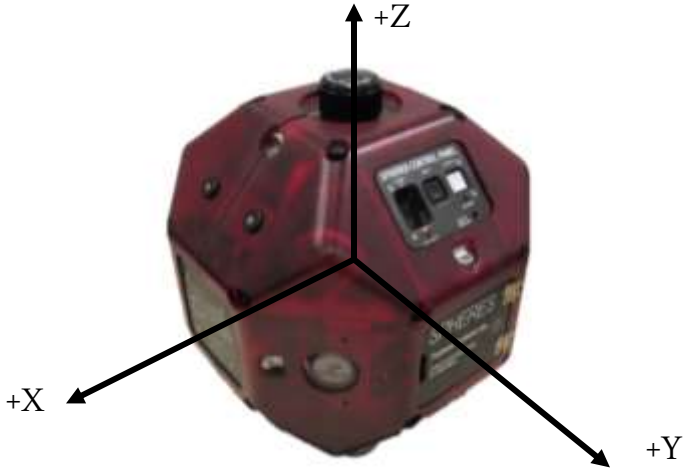
+Y

–Y

+Z



–Z



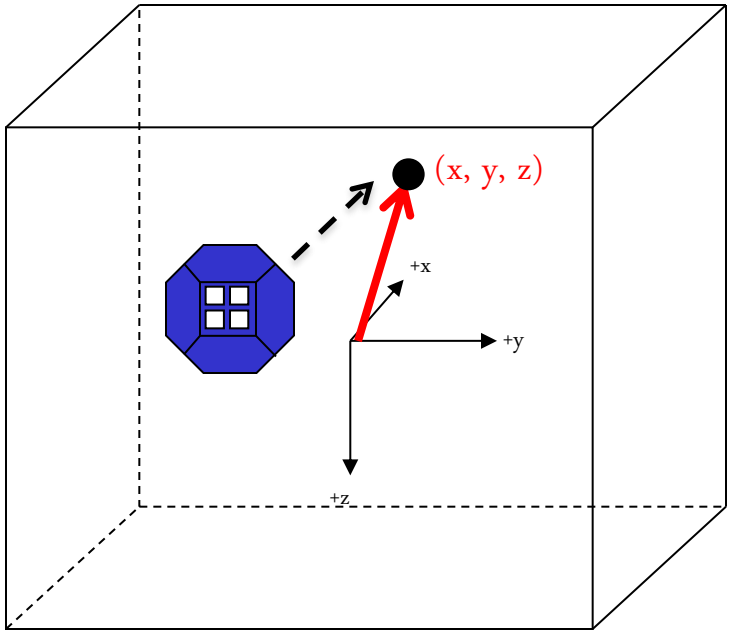
SPHERES Controls Functions

You will use four functions in programming your player:

- **setPositionTarget:** sets target position (x, y, and z position)
- **setAttitudeTarget:** rotates satellite (i.e., specifies a unit vector for the satellite to point toward)
- **getMyZRState:** retrieves ZR state for current satellite
- **getOtherZRState:** retrieves ZR state for second satellite

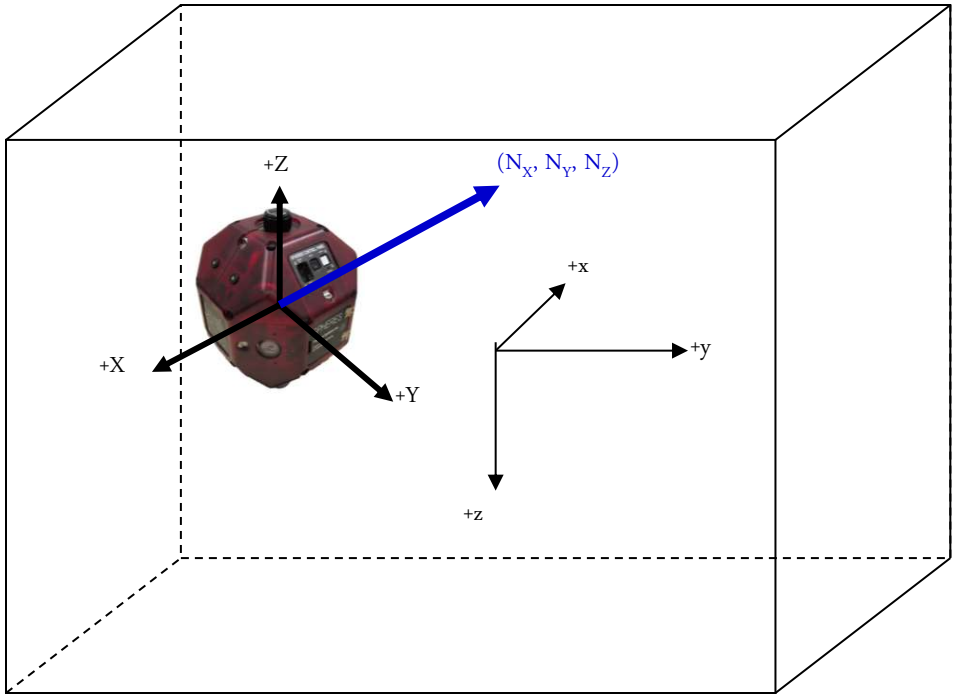
setPositionTarget

- **"setPositionTarget"** allows you to move satellite to a target position
- Input target as an array of three floats (representing its x, y, z coordinates, in meters)
- When position is commanded, satellite will fire thrusters to move to target point, then stop



setAttitudeTarget

- **"setAttitudeTarget"** allows you to set direction for satellite to point its Velcro (-X) face
- Specifies a pointing **direction** (N_x, N_y, N_z) , not a pointing location
- Commanding an attitude target makes satellite fire thrusters to rotate to target direction, then stop



getMyZRState

"getMyZRState" retrieves ZR state information (position, velocity, pointing vector, rates) for current satellite

My_ZR_State			
Position	X: 0.0	Y: 0.0	Z: 0.0
Velocity	Vx: 0.0	Vy: 0.0	Vz: 0.0
Pointing vector	Nx: 0.0	Ny: 0.0	Nz: 0.0
Rotation rates	ωx: 0.0	ωy: 0.0	ωz: 0.0

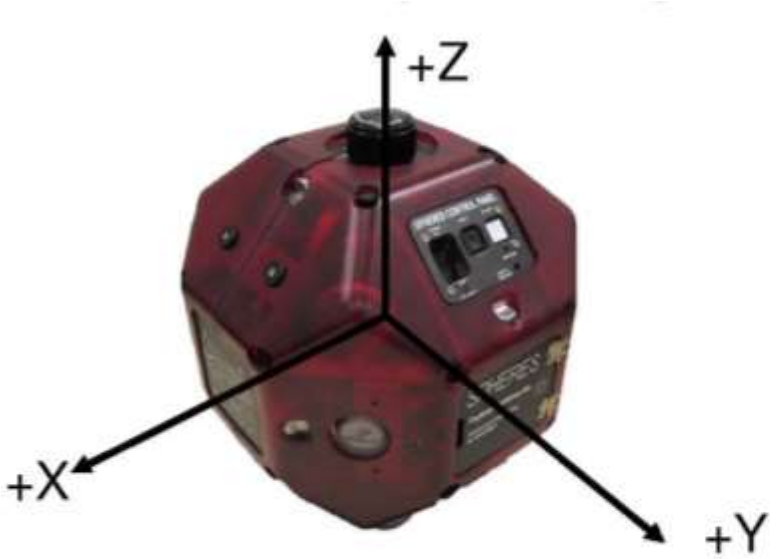
getOtherZRState

"getOtherZRState" retrieves ZR state information (position, velocity, pointing vector, rotation rates) for second satellite

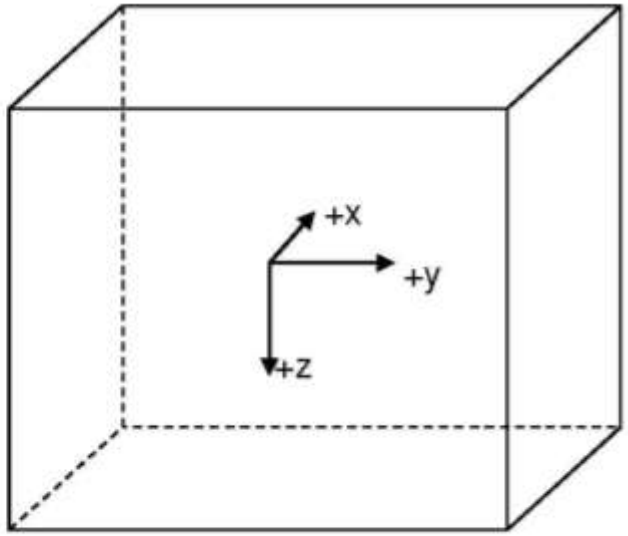
	Other_ZR_State		
Position	X: 0.0	Y: 0.0	Z: 0.0
Velocity	Vx: 0.0	Vy: 0.0	Vz: 0.0
Pointing vector	Nx: 0.0	Ny: 0.0	Nz: 0.0
Rotation rates	ωx: 0.0	ωy: 0.0	ωz: 0.0

Local vs. Global Coordinate Systems

- Two separate coordinate systems for ZR: **Global** and **Local**
- **Global system** refers to entire space that SPHERES move around in
- **Local system** refers to the orientation of satellite itself



Local system

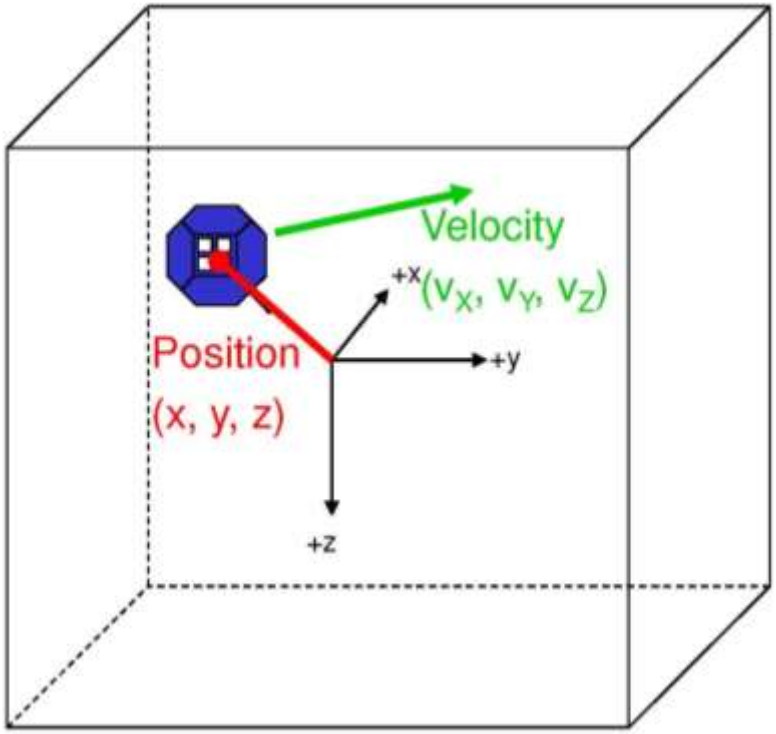


Global system

The SPHERES State

State describes how local coordinate system is related to global coordinate system

- **Position** describes where center of the satellite is in global frame
- **Velocity** describes how fast and in what direction satellite is moving in global frame
- **Attitude** tells where satellite is pointing (describes how local coordinate frame is rotated with respect to global frame—see next slide)

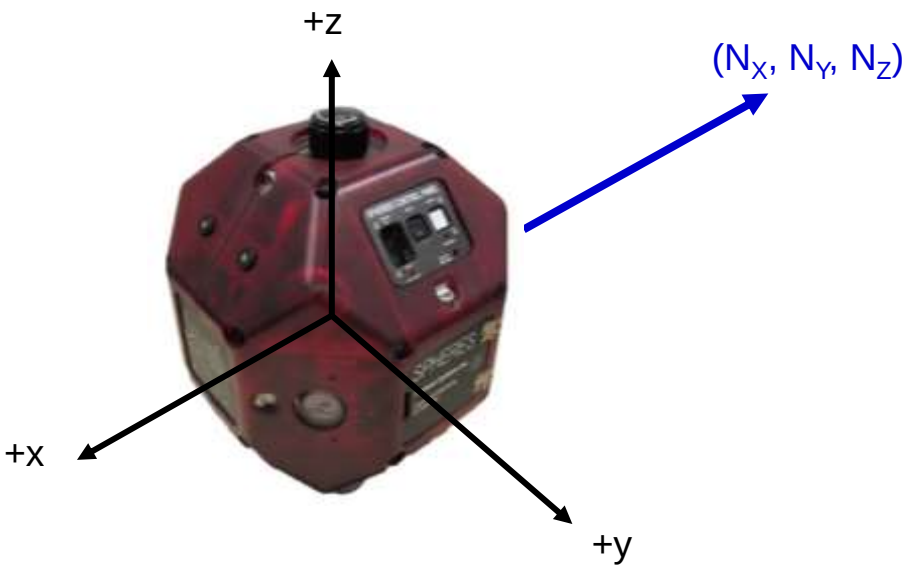


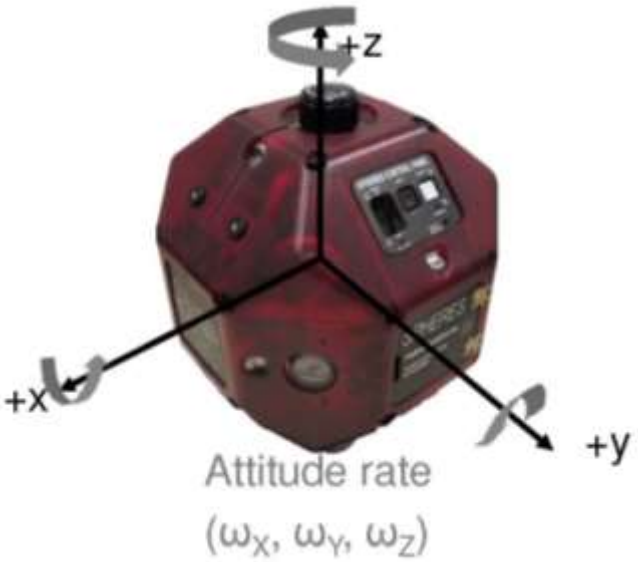
Attitude

- **Attitude vector** (N_x, N_y, N_z) is a unit vector in global frame that points in same direction as -X (velcro) face of satellite

  For example, when satellite is aligned with global frame, attitude vector is (-1, 0, 0)

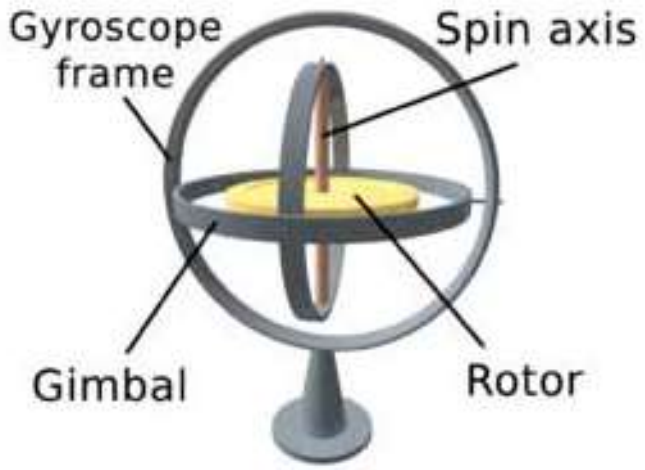
- **Attitude rate** (ω_x, ω_y, ω_z) is how quickly satellite is turning along Local Axis





How Do We Know the Attitude?

- Each SPHERES satellite has three gyroscopes
- Gyroscope is a device that gives information about the rotation of an object
- Tells satellite on which axis it is spinning and how much it is spinning on that axis (rotational motion)



How Can SPHERES Move?

- 12 thrusters on each SPHERES satellite help it move in 12 different directions
- Thrusters propel (move) satellite in a certain direction
- In what direction will each of the thrusters move the satellite?