

# Requirements for Guidance, Navigation and Control of Deep Space Cubesats

Discussion Session Outputs

# Challenges

- Radiation effects → Special Shielding
- Communication at interplanetary distances
- Propulsion System Limitation → Solar Sail, Gravity Effects, Ion Thrusters
- Position Determination → We cannot use GPS
- Reduncy is needed
- Physical Impact → Shielding
- Power Issues
- Least 6u Cubesat
- Launcher → Most launchers go to LEO or GEO

# LEO ADCS Elements

## **Sensors**

- Sun Sensors
- Earth/HorizonSensors
- Star Sensors
- Magnetometers
- Rate Gyros
- GPS

## **Actuators**

- Momentum/Reaction Wheels
- Magnetorquers/Magnetic Control
- Thrusters

# Deep Space ADCS Elements

## Sensors

- Sun Sensors → In the Solar System
- ~~Earth/Horizon Sensors~~
- Star Sensors → Attitude, Position, Angular Rates
- ~~Magnetometers~~
- IMU
- ~~GPS (for some missions, like Moon) →~~ RF sensors, Camera (Vision based), XRAY Pulsar Navigation (Needs Atomic Clock), LIDAR, Laser altimeter

## Actuators

- Momentum/Reaction Wheels
- ~~Magnetorquers/Magnetic Control~~
- Thrusters
  - Water Propulsion (Easy to implement, but lower Isp alternative)
- Solar Sail (Spinning Solar Sail for attitude)

# GNC Automation could be beneficial

- If the communication delays effects control,
- If there is high unknown disturbances like missions to near-Earth objects (NEO),
- Constellation
- Entry, Descent and Landing (EDL)

Thank You!