ExoCube2 (CP12)

California Polytechnic University – 3U CubeSat

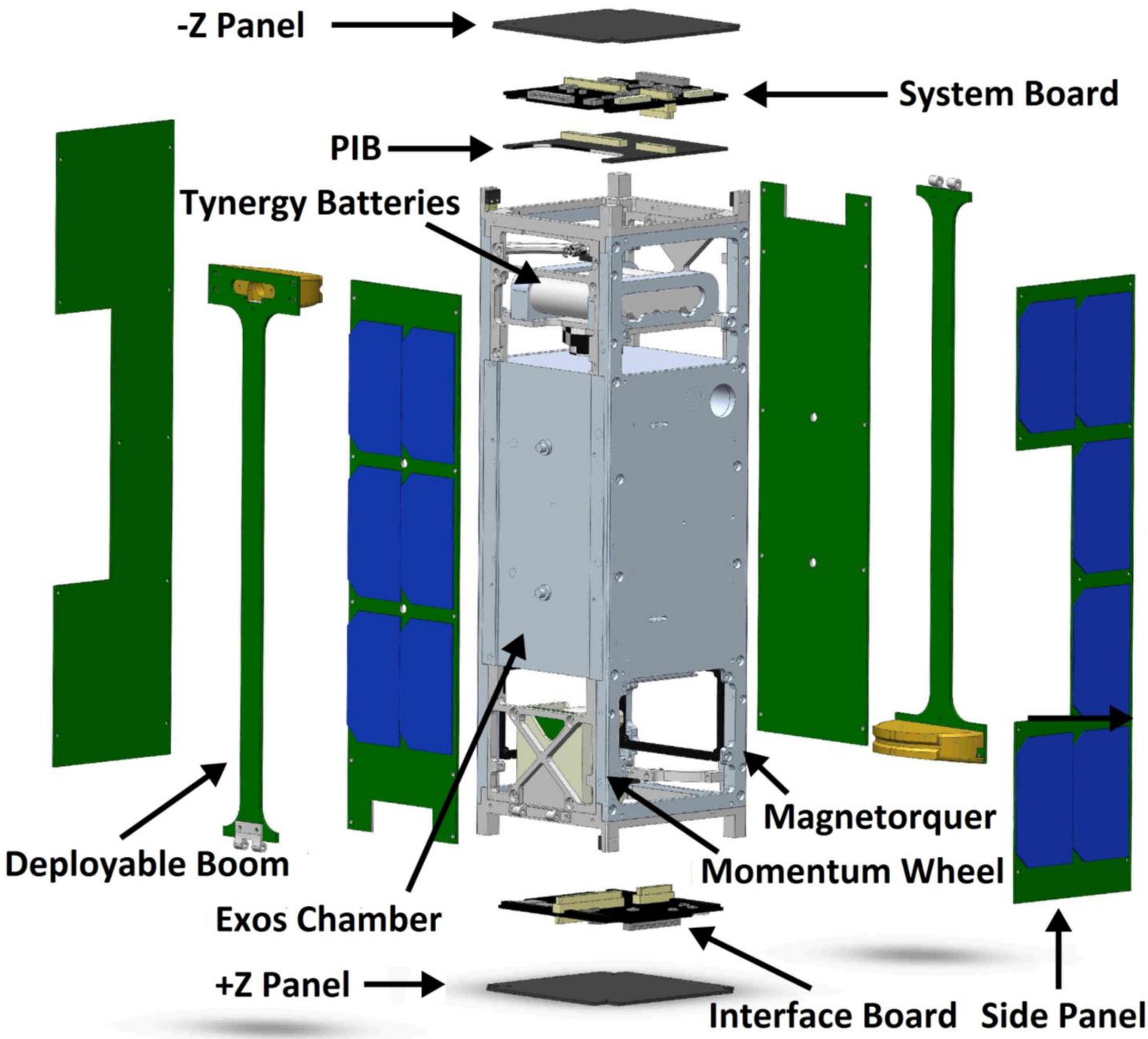

Figure 1: ExoCube2 Expanded View

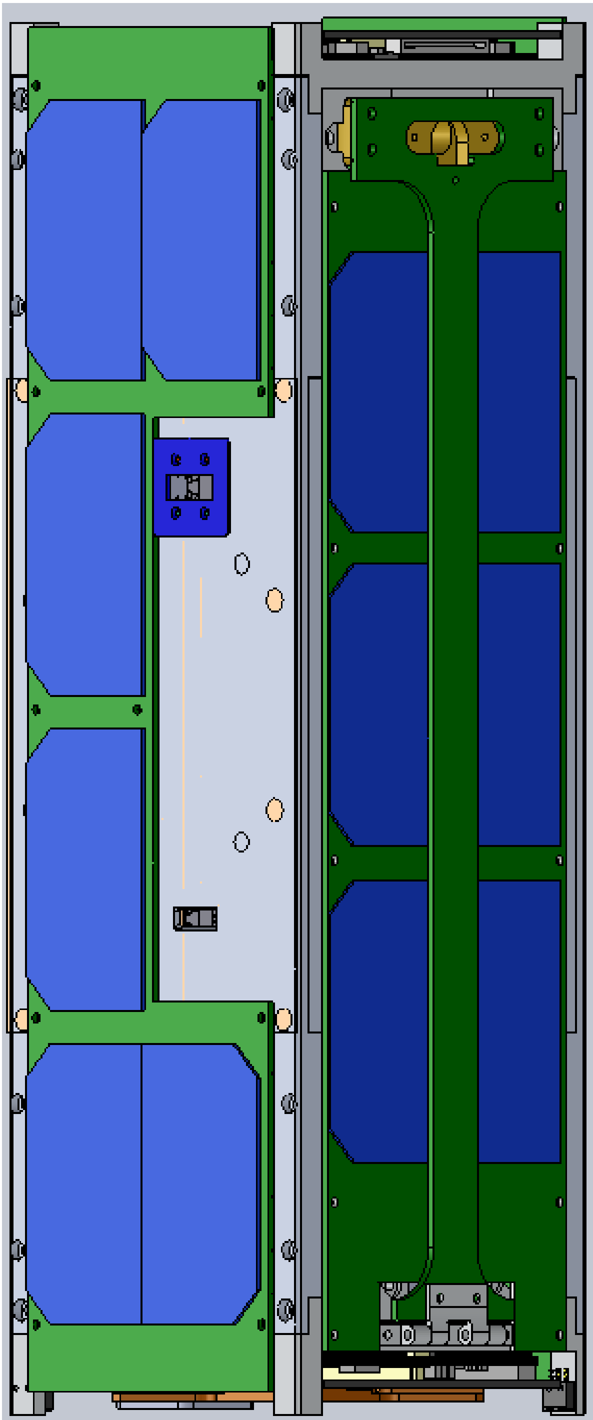

Figure 2: ExoCube 2 Deployables Restrained

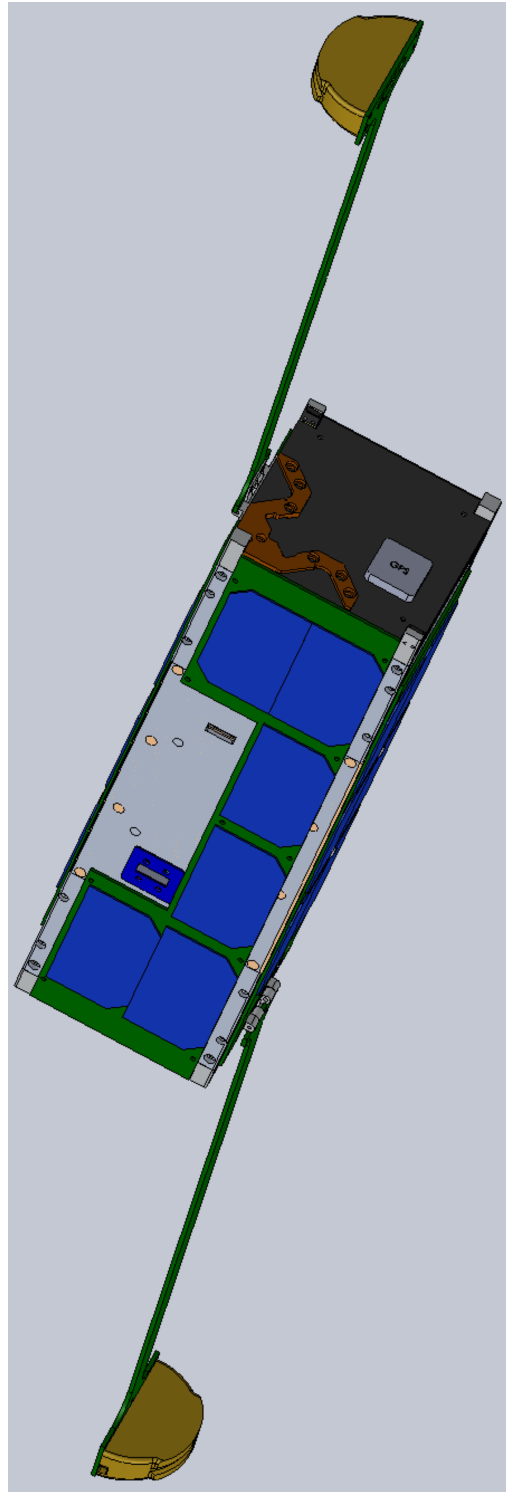

Figure 3: ExoCube2 Deployables Activated

Mission and Experimental Purpose:

ExoCube2 will measure in-situ densities of selected ions and neutrals in the upper ionosphere and lower exosphere. These measurements will be used to characterize the climatology of the upper ionospheric and lower exospheric composition. They will help improve current empirical and climatological atmospheric models. The densities are measured using a gated time-of-flight mass spectrometer designed and built by NASA Goddard. A satellite bus to house the mass spectrometer was designed and built by Cal Poly. The bus includes an environmental chamber to protect the instrument and a 3-axis attitude determination control system (ADCS) that will maintain stable Nadir and Ram pointing necessary for accurate data measurement. The ADCS uses gravity gradient stabilization with deployable booms and a momentum wheel to stabilize the roll axis and Ram pointing. The mission life is expected to be 6 months to a year.

Operations:

After deployment from the P-POD, the satellite will power on. Approximately 40 minutes later, antenna deployment will occur. Upon verification of antenna deployment, the beacon will be activated and the satellite will acquire with Cal Poly's ground station. The ground station will uplink the current time and TLEs. The detumble process will then begin. Magnetometers and solar sensors will determine orientation and magnetorquers will stabilize ExoCube2. Onboard GPS will acquire lock for position and time keeping. Once spin rates have been reduced, the PD controller and Kalman Filter will be activated and the booms will deploy. The cameras on the –Z and +Z panel will take pictures to verify boom deployment. Once Nadir pointing is acquired, the momentum wheel will begin spinning up. Around 4 hours later, the wheel will be at full speed and the satellite will reacquire Nadir and Ram pointing. The camera on the –Z panel will take pictures to verify the satellite is pointed in the correct direction. Once the correct orientation is verified, the science payload will be powered on. The mass spectrometer will take data over the Earth's poles and several ground stations throughout the mission. Every pass over a ground station (approx. every 12 hours), the satellite will downlink data from the instrument and uplink the current time for the clock and new TLEs to maintain accuracy of the orbital propagator.

Construction and Materials:

The structure is made entirely of 6061-T6 Aluminum. The deployable booms are made of FR4, the tips are constructed from brass. The antennas are made of NiTi and Delrin. The satellite contains mostly standard commercial off the shelf materials, electrical components, PCBs, and solar cells. The cathode inside of the instrument is made of tungsten, but the tungsten is small enough that it burns up during re-entry.

Safety:

There are no pressure vessels, hazardous materials, or exotic materials.

Power Storage System:

There are 4 1-cell batteries on the satellite. They are all Tenergy Li-Ion, 3.7 V 2600 mAh batteries (Item number 30011-02). The UL listing number is MH48285. There is battery protection circuitry and over-charge protection circuitry. All batteries are connected in parallel. These are the same batteries used on CP8.