



Lessons Learned from Student Built CubeSats:

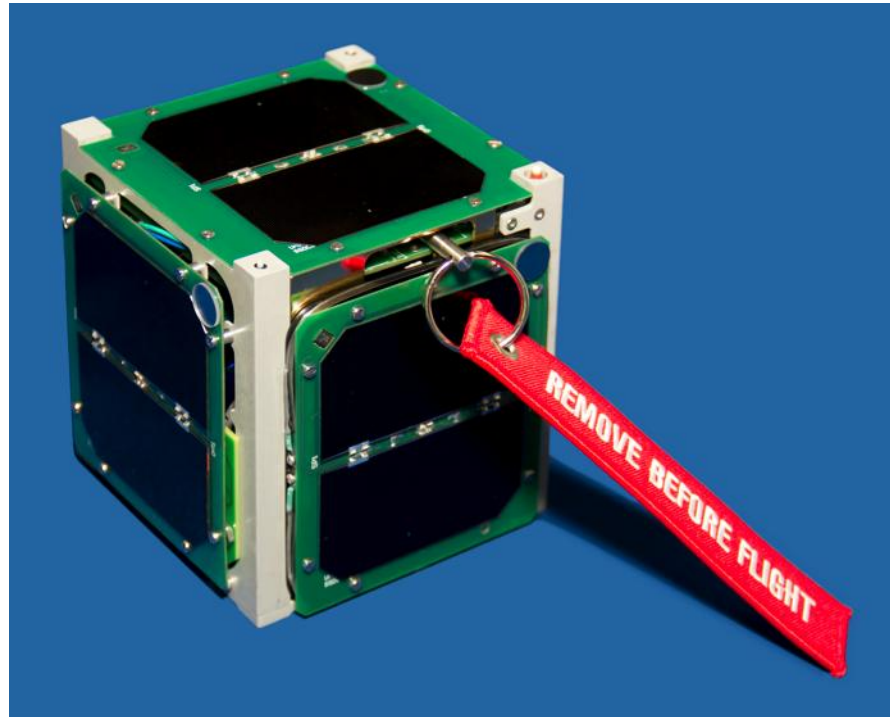
SWAMP SAT

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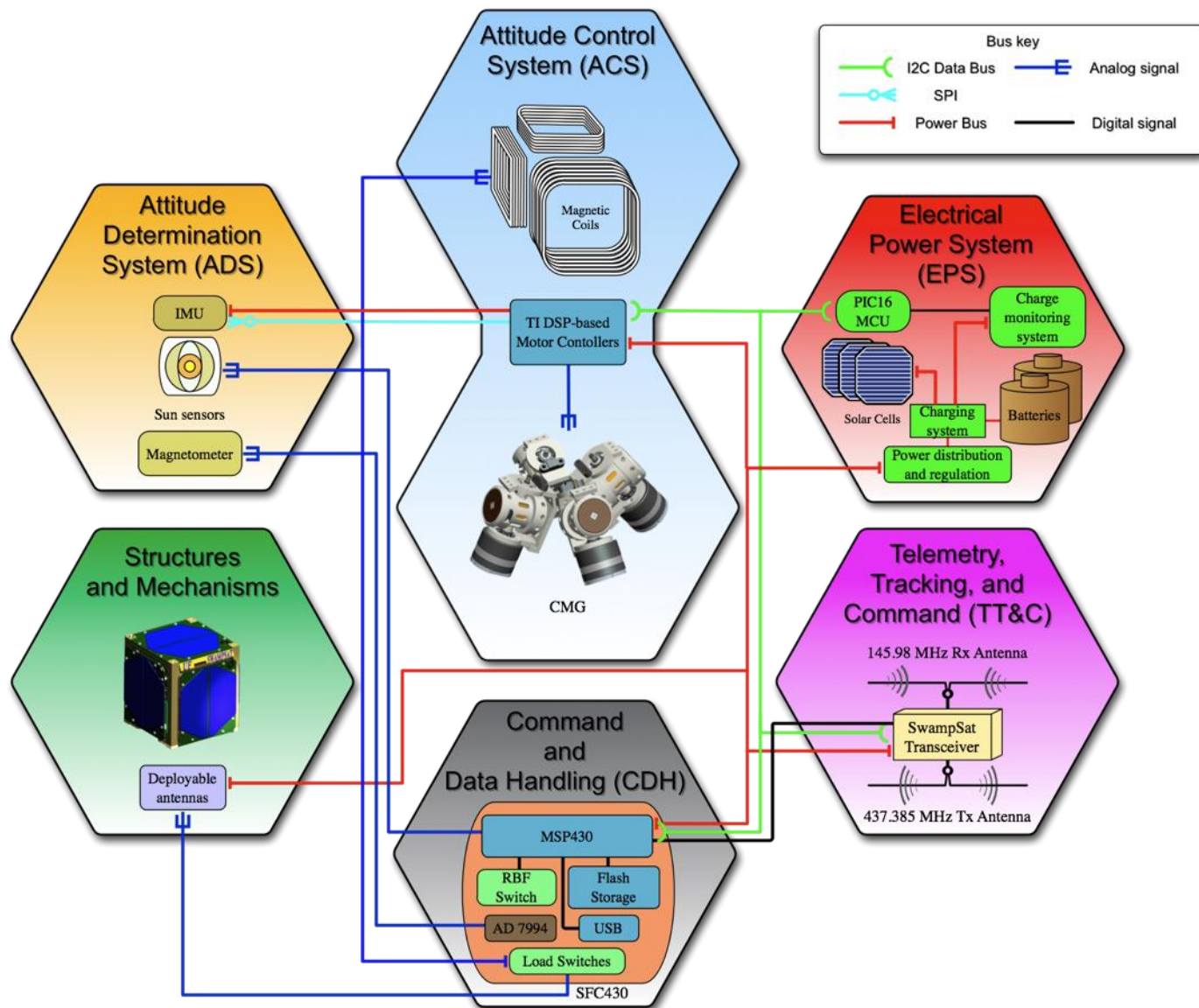
The SwampSat Mission



- SwampSat is a 1U (10 cm³) CubeSat developed by the Space Systems Group at the University of Florida
- The SwampSat mission is an on-orbit validation of a compact, three-axis actuator, capable of rapid retargeting and precision pointing (R2P2) using control moment gyroscopes (CMG) in a pyramidal configuration
- Successful completion of SwampSat will raise the technology readiness level (TRL) of the CMGs which are known as *IMPACT*



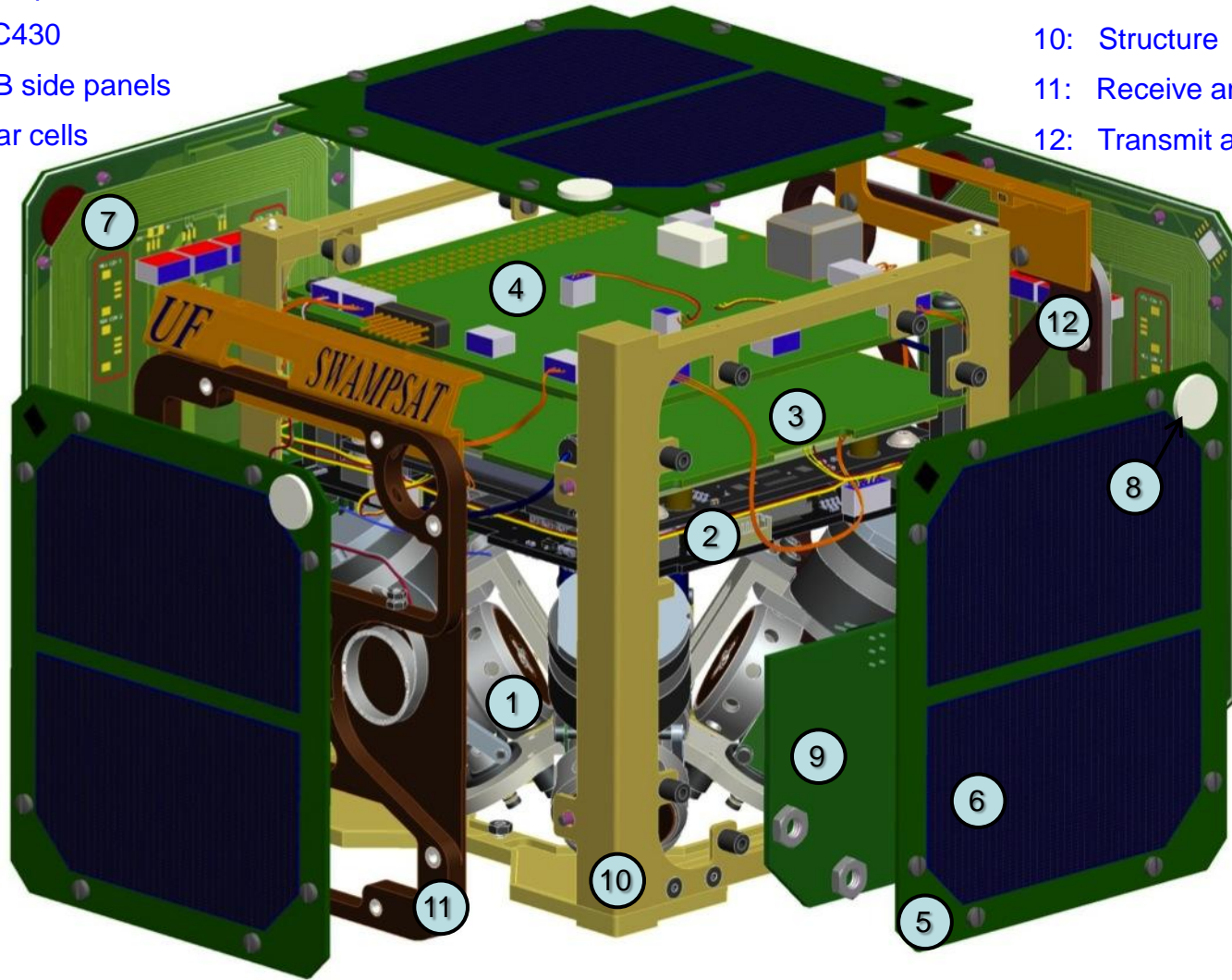
SwampSat Schematic





SwampSat Assembly

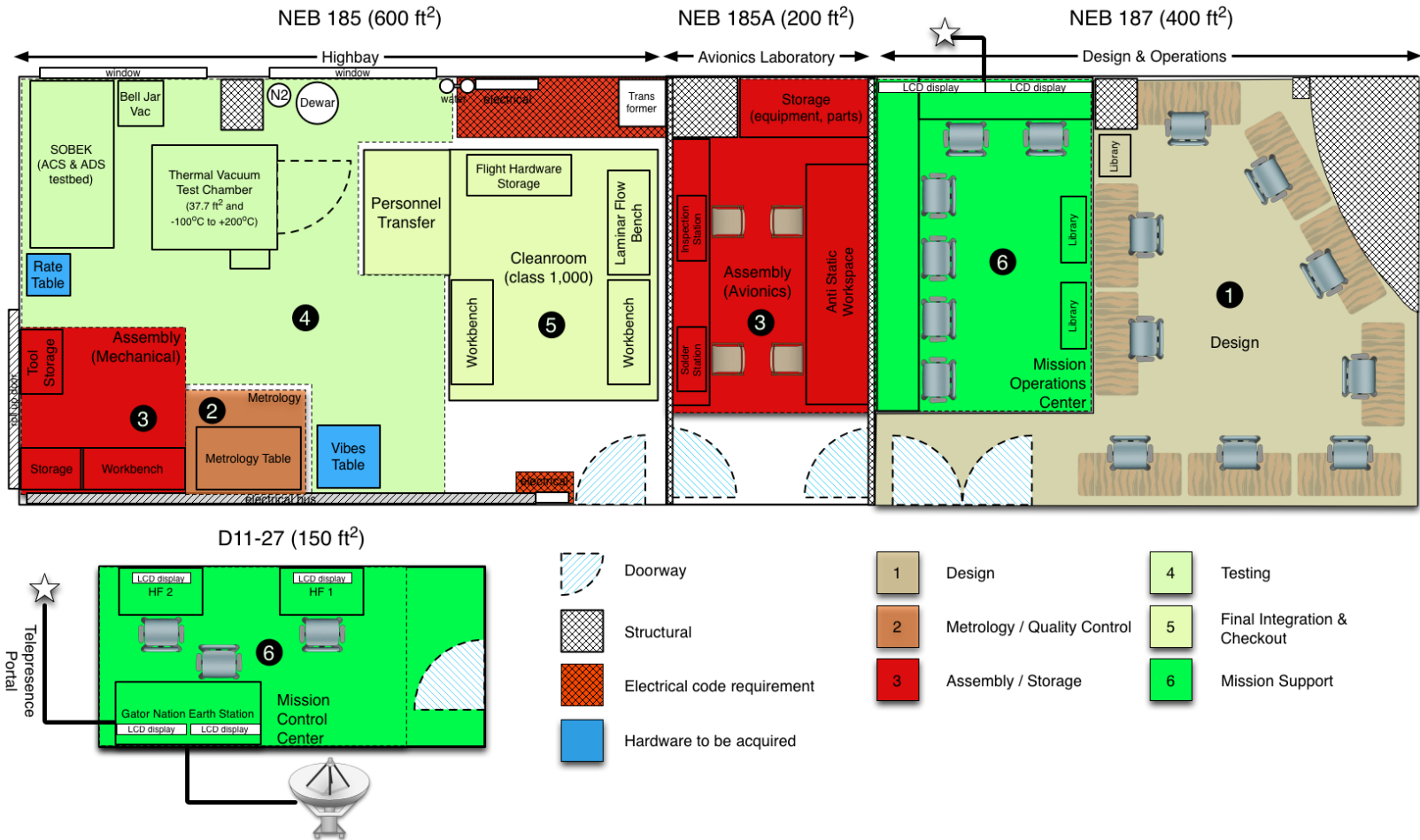
- 1: *IMPACT* 1.1
- 2: Electrical Power System
- 3: SwampSat Transceiver
- 4: SFC430
- 5: PCB side panels
- 6: Solar cells
- 7: Sun sensor
- 8: Sun sensor filter
- 9: Motor driver board
- 10: Structure
- 11: Receive antenna module
- 12: Transmit antenna module





iDEV Facility

- Integrated Design, Engineering, and Validation (iDEV) facility provides an integrated systematic approach to research, development, and maturation of small satellites





Lessons Learned

- SwampSat is the first CubeSat developed by the Space Systems Group
 - Satellite development experience is limited (i.e. few students have worked in industries, however, most students have little or no experience outside academia)
 - Due to lack of previous experience in developing CubeSats, more time was required for the team to develop each subsystem, however, it lead to great increase in team work
- Hands-on experience with flight hardware
 - Most students have never worked with flight hardware, however, the SwampSat project allowed the students to gain valuable experience
 - Flight hardware often requires meticulous care in storage and handling to control contamination levels, temperature, humidity. Unknown changes in these conditions can adversely affect the mission
 - Increased responsibility and leadership promotes an environment that fosters professional attitude amongst the students
- Different fields of expertise
 - Industries will have various fields of engineers with experience, however, the students have a limited experience
 - Most of the members of SSG are in Mechanical and Aerospace Engineering, however, lack of members in Electrical and Computer Engineering pose challenges in the software development



Lessons Learned

- Final design is constrained by external requirements
 - Final requirements and constraints (vibration levels, thermal levels, integration procedure, altitude and inclination, etc.) depend on the launch provider, which may be unknown at onset of project
 - To be more robust, a survey of requirements and constraints from potential launch providers may be used as a worst case scenario to design your final system
- Project management
 - Document EVERYTHING: The time period for academia is short, thus, students come and go. In order to pass along the work to the new members, all work **MUST** be documented. Without documentation, it will be difficult to bring the new members up to speed
 - Verification & Validation: Functionality and characterization tests must be performed pre- and post-testing to validate functionality of each hardware. Test procedures should be developed a priori
 - Schedule: Detailed schedule should be created at the beginning of the project
 - Contingency: Failures will occur during development, thus, sufficient contingency must be included in the schedule
 - Project Manager: Project manager should not be a member of the development team – manager needs the flexibility to be effective in schedule management





Acknowledgement

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