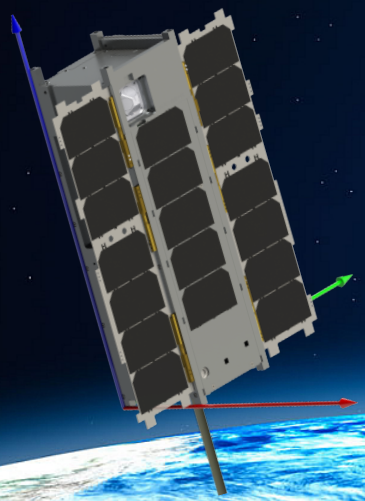
Data Visualization Software for the MinXSS CubeSat



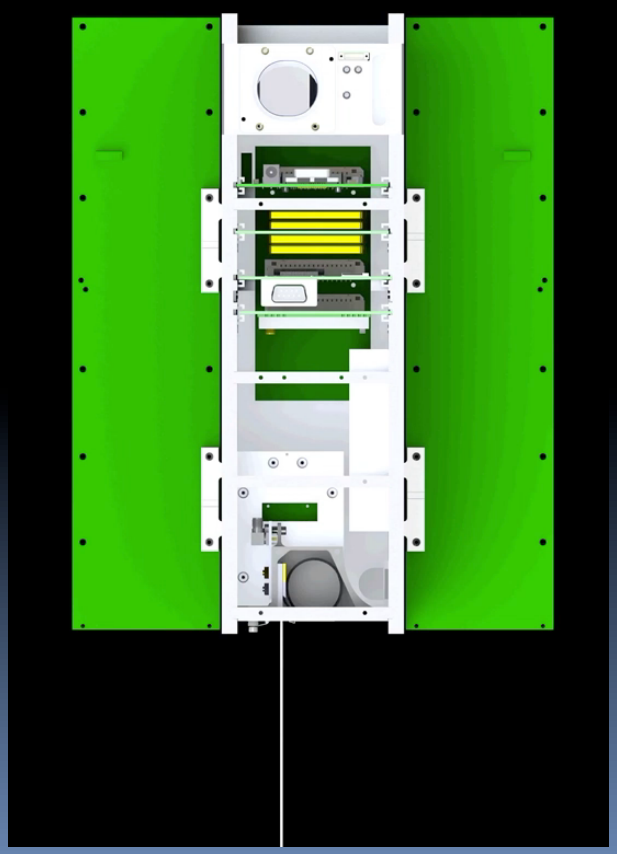
Christina A. Wilson
Wichita State University
Mentors: Tom Woods, Amir Caspi, Andrew Jones, James Mason

What is a CubeSat?

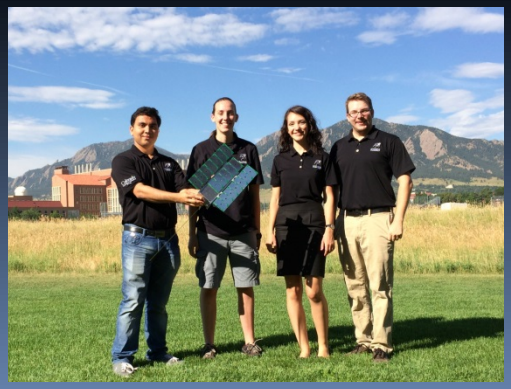
- Very small satellites built to standard dimensions 10cm cubed
- 1U, 2U, 3U, or 6U in size
- Typically weigh less than 1.33 kg (3 lbs) per U.
- Science purposes vary from one to another
- Short life spans

http://nanoracks.com/

MinXSS CubeSat

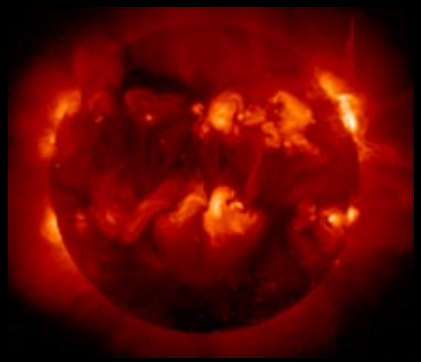


- Second CubeSat build & designed by AES/LASP
- Part of a graduate project course
- 40 students have worked on it
- Performing solar research
- 3U in size

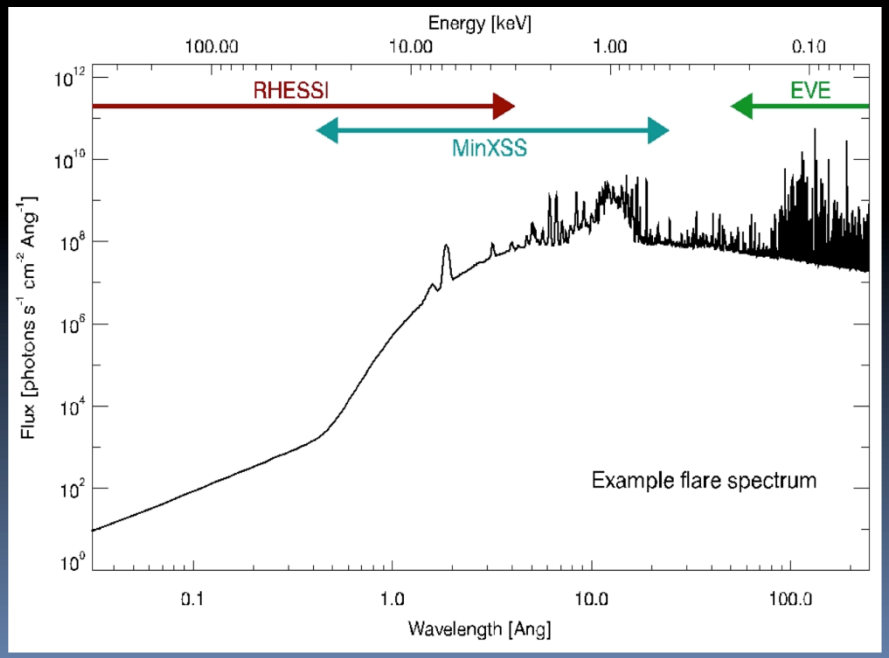


MinXSS CubeSat

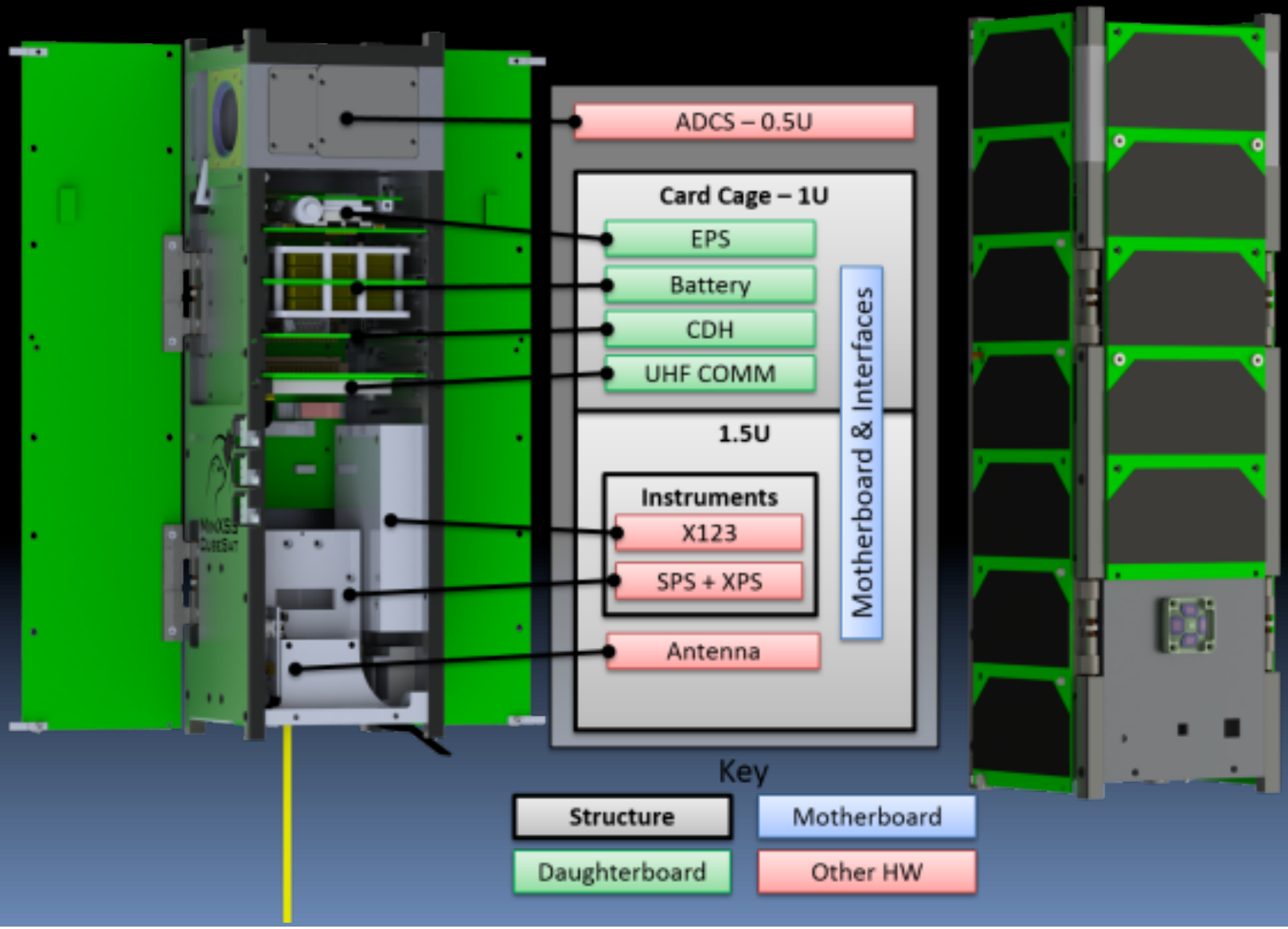
- Science Purpose:
  - To better understand solar flare soft x-ray (SXR) emission of the sun and its effect on the earth's ionosphere, thermosphere, and mesosphere (ITM)



- Resolution better than 0.15 keV full-width half-max.
- Spectral range that hasn't been fully observed

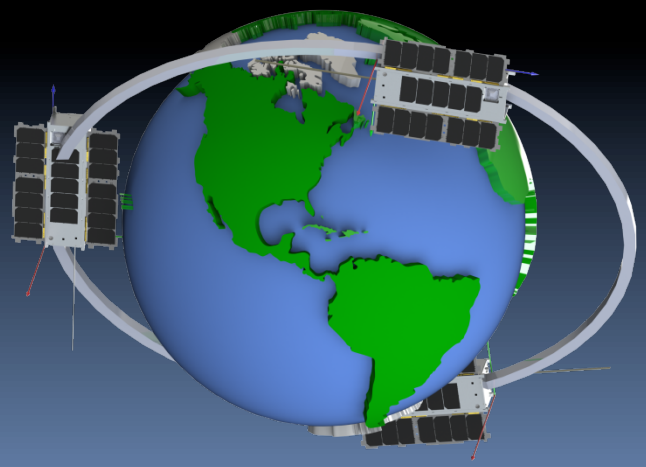


MinXSS CubeSat



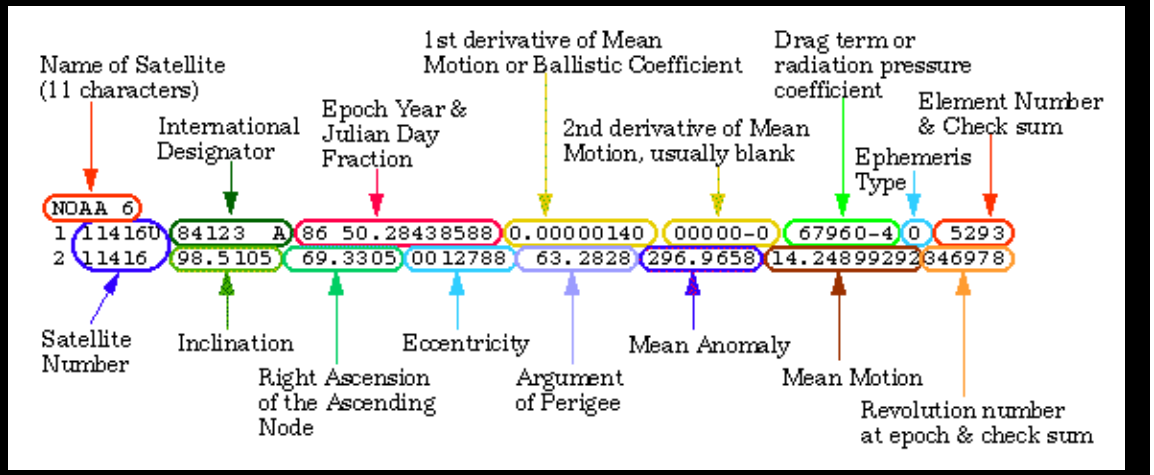
Data Vis & Orbital Software

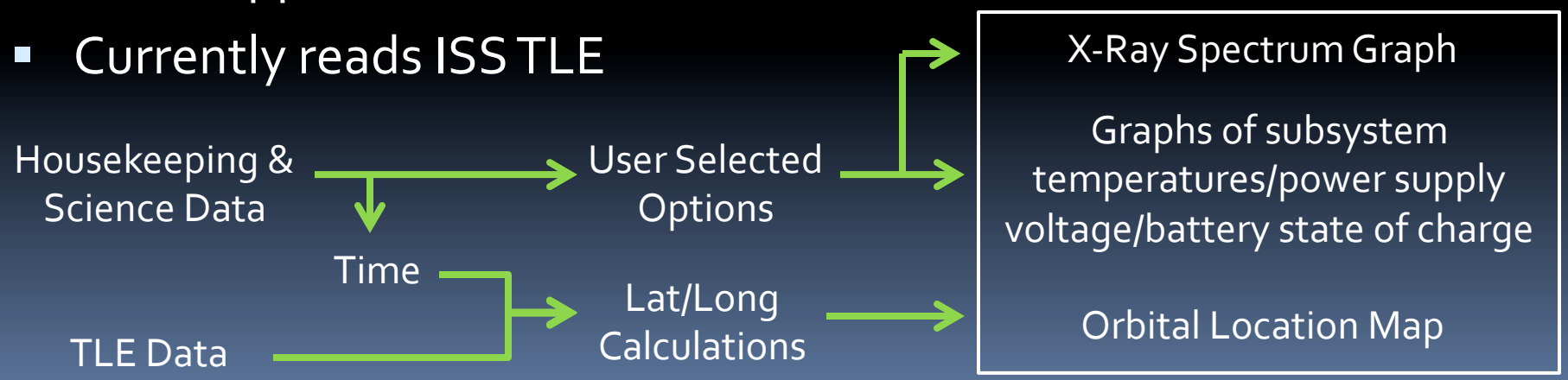
- Purpose of software:
  - create ground software for visualizing & comparing the CubeSat's state of health with it's orbital location
- Housekeeping Data - such as temp of instruments & power levels
- Made with IDL user-interactive widget
- Why does it help us?
  - Monitoring HK data is key part of satellite operations during flight & also during pre-flight tests
  - To fully understand the changes in housekeeping data



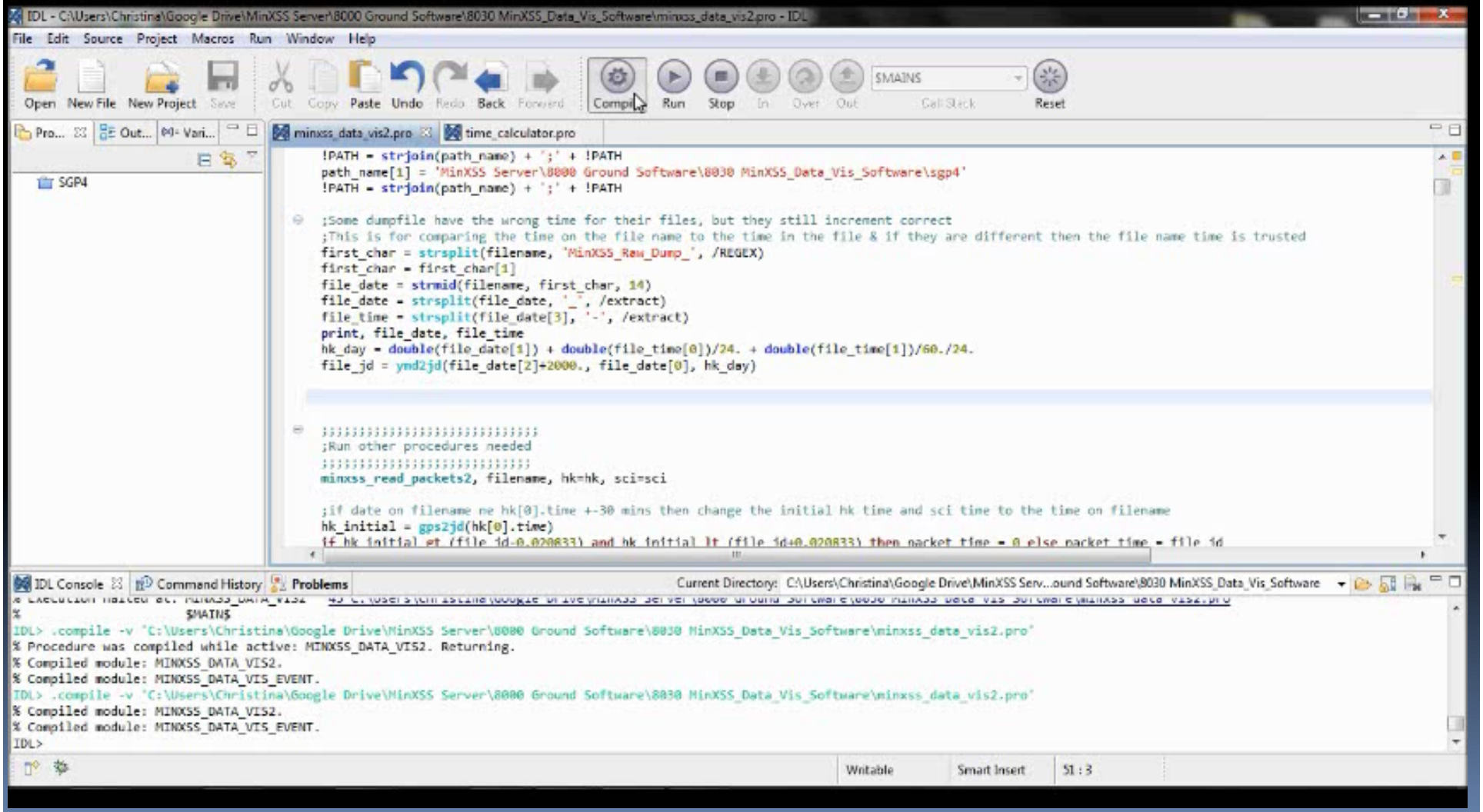
How the Software Works

- Convert raw data packets from CubeSat into useful engineering units (C, V, A, etc.)
- TLE to Lat/Long calculation courtesy of Chris Jeppesen
- Currently reads ISS TLE

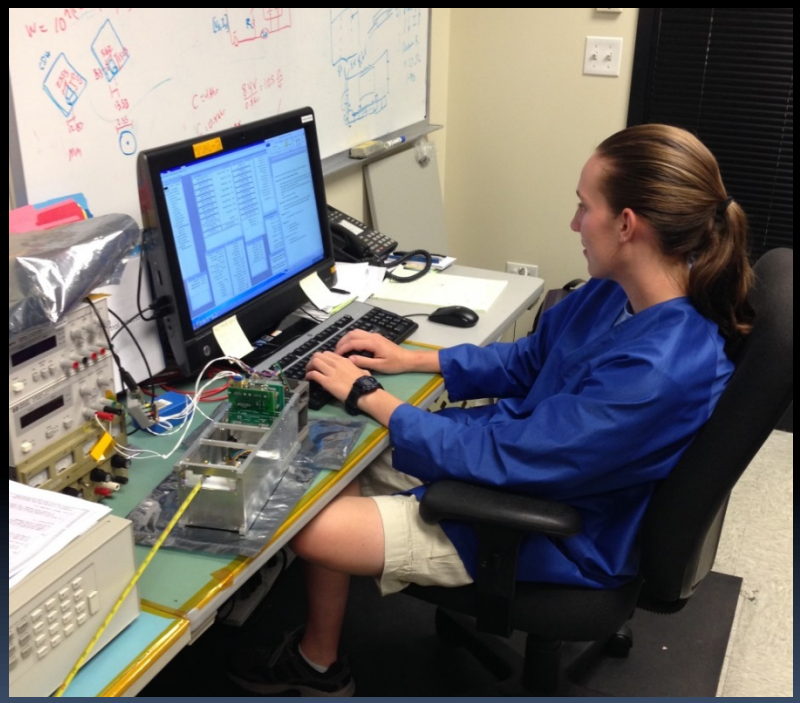




Software Features

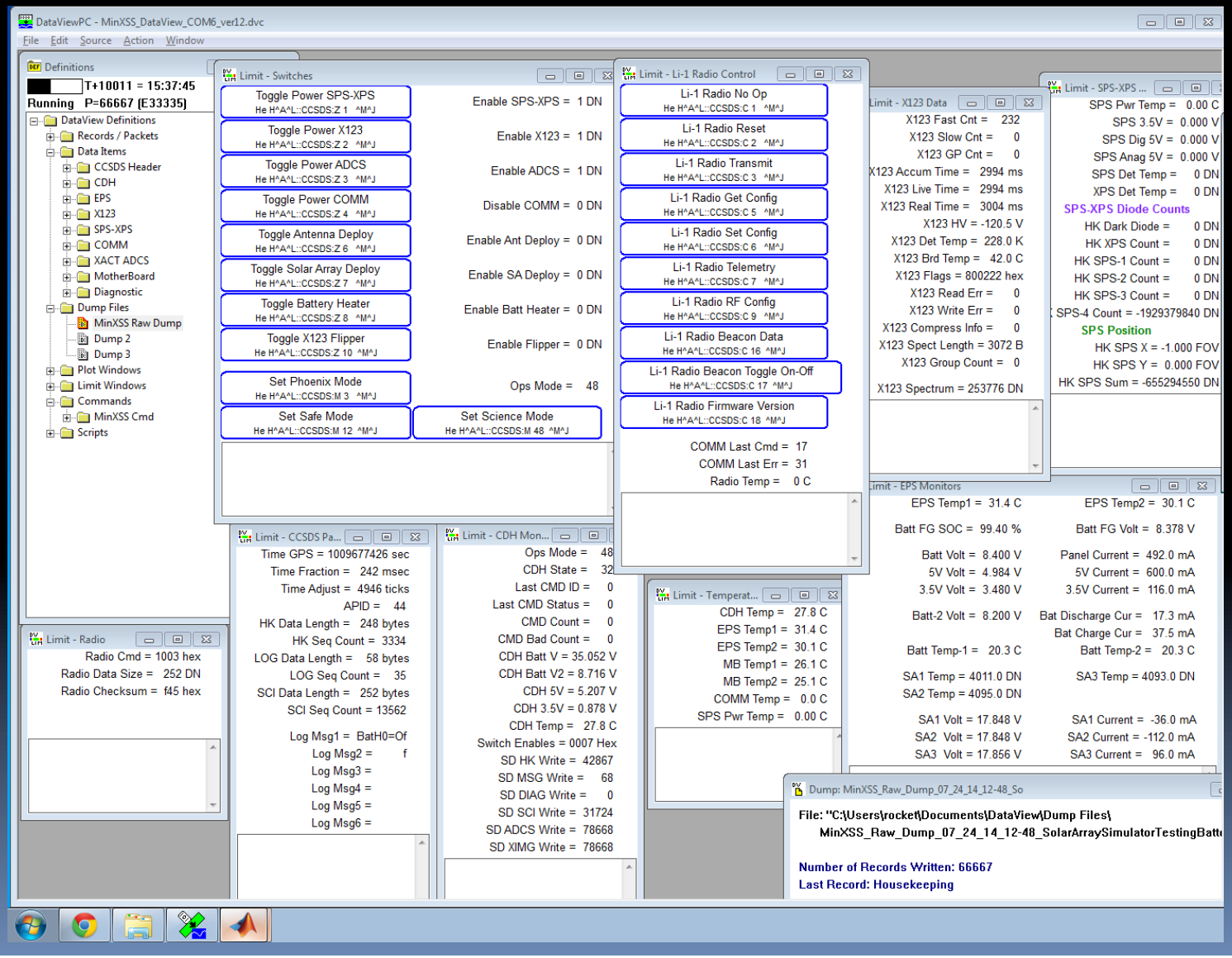


Mission Tests



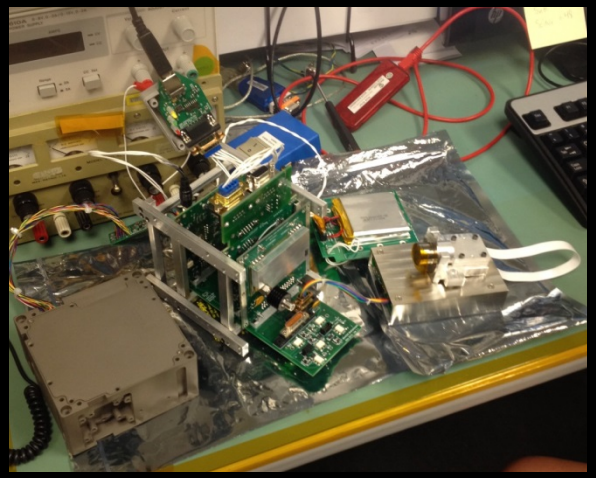
- Purpose:
  - To prove capabilities of Data Vis Software and DataView commands
  - To assemble a functioning integrated prototype
- Mission Early Operations
  - Phoenix Mode
    - Comm powered on
    - Antenna deployed
  - Safe Mode
    - ADCS powered on
    - Command Solar Panels Deployed
  - Science Mode
    - X123, SPS-XPS power on
  - For ground testing: Power Supply/ Solar Panel Simulator powered on/off

Mission Tests: DataView

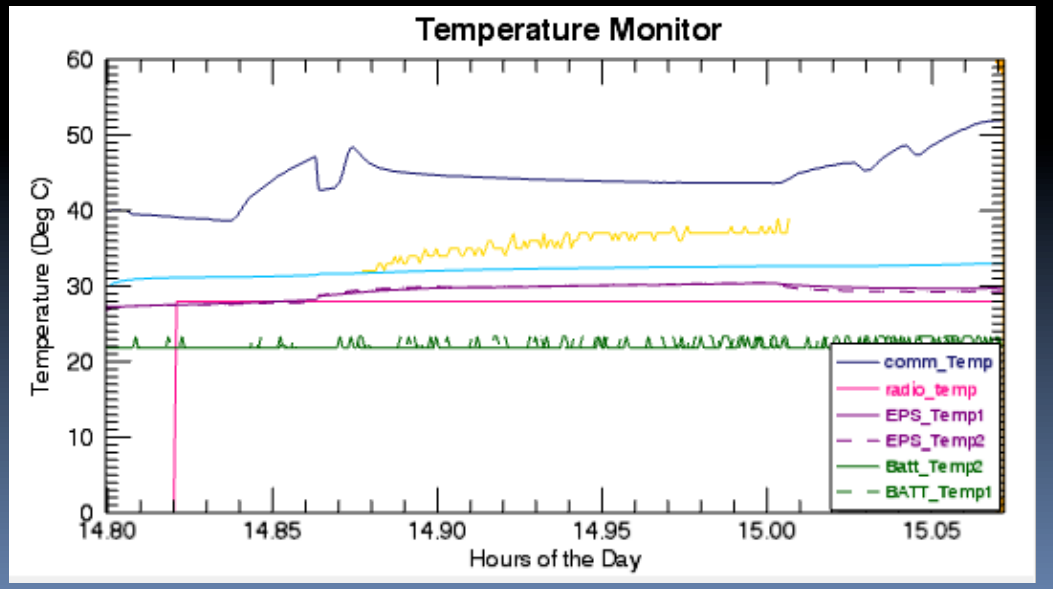


Mission Tests 1-7

- First seven were debugging flight & ground software
- Comm board got too hot in this structure
- Radio command worked sometimes
- Found that DataView has problems receiving mouse actions when processing too much data

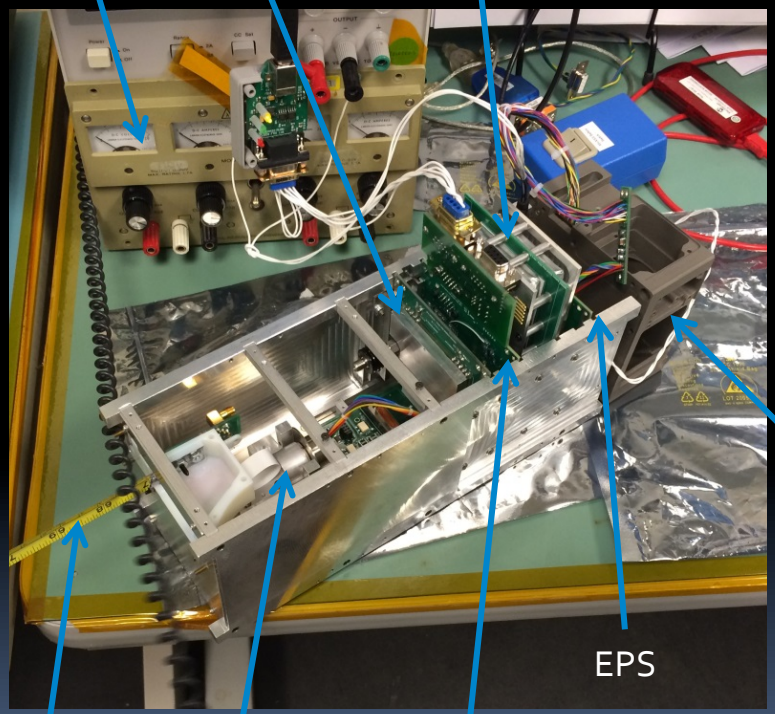


(Assembled on CubeSat Card Cage)



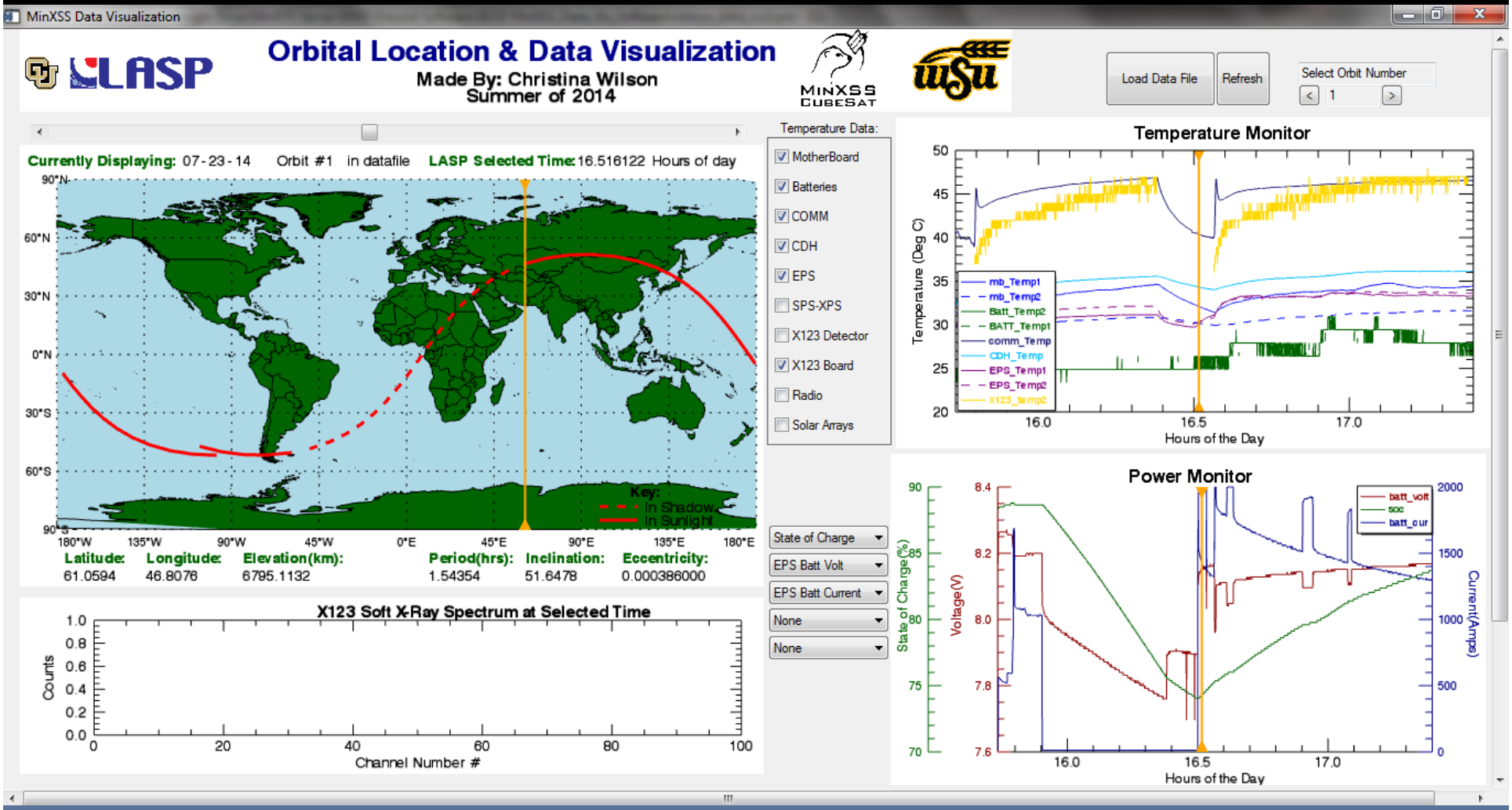
(Mission Test 6 Data)

Mission Test 8



- "Integrated prototype"
- Power Supply used to simulate the sun charging the solar panels
- Ran for little over one complete (ISS) orbit
- Used Heavens Above
- Battery heater toggled on/off to test command
- Radio command returned error

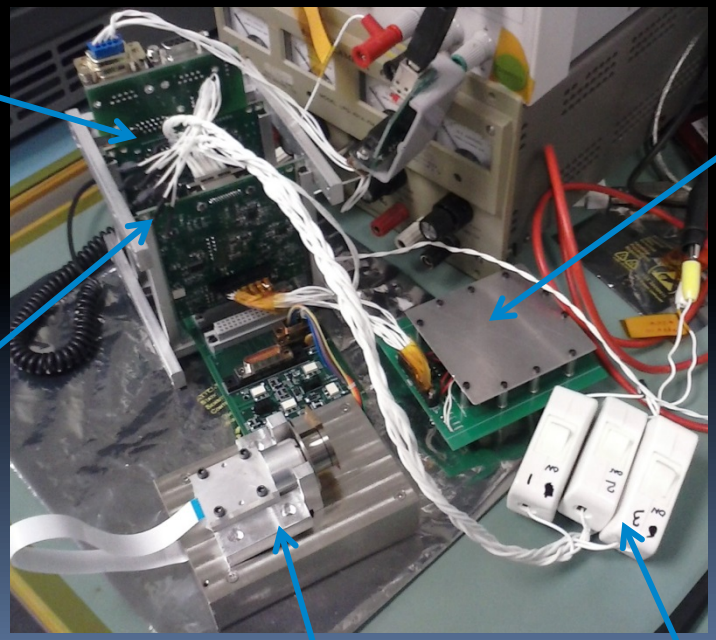
Mission Test 8



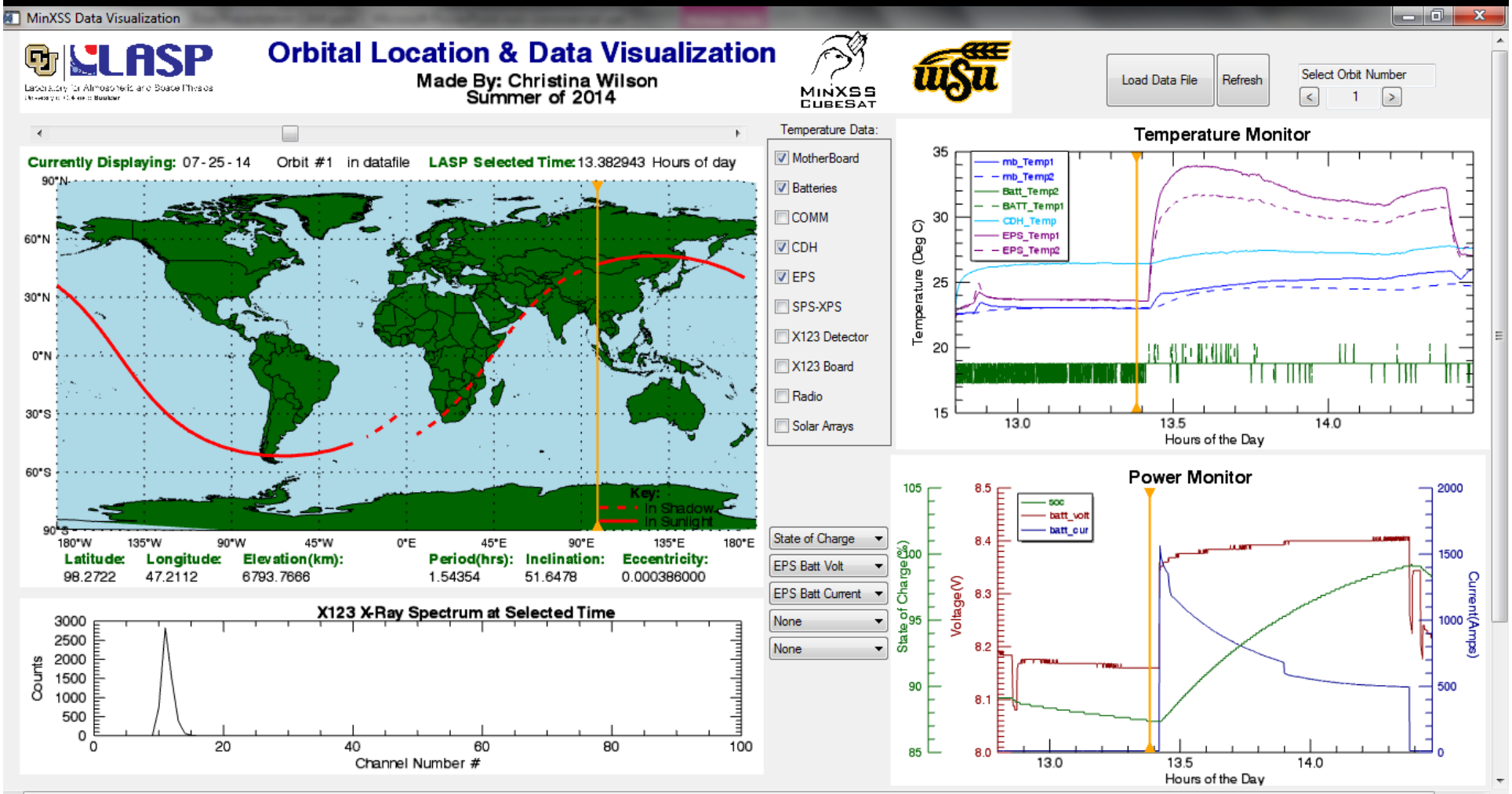
Mission Test 9

- Solar Panel Simulator used to simulate the sun charging the solar panels & batteries
- Pre-entered power on/off time delays
- Ran for multiple (ISS) orbits
- X123 Powered off during eclipse

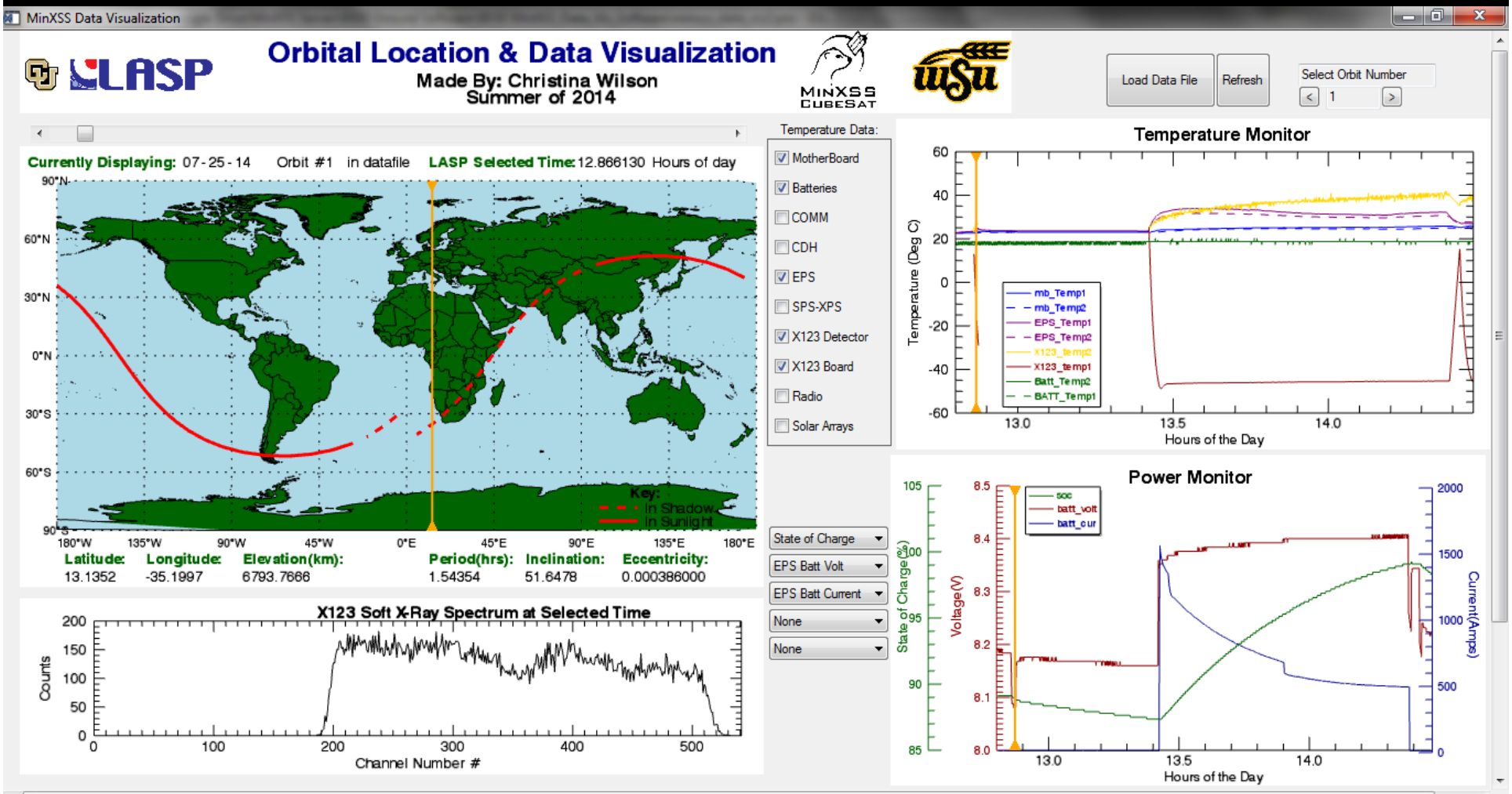
Solar Panel Simulator



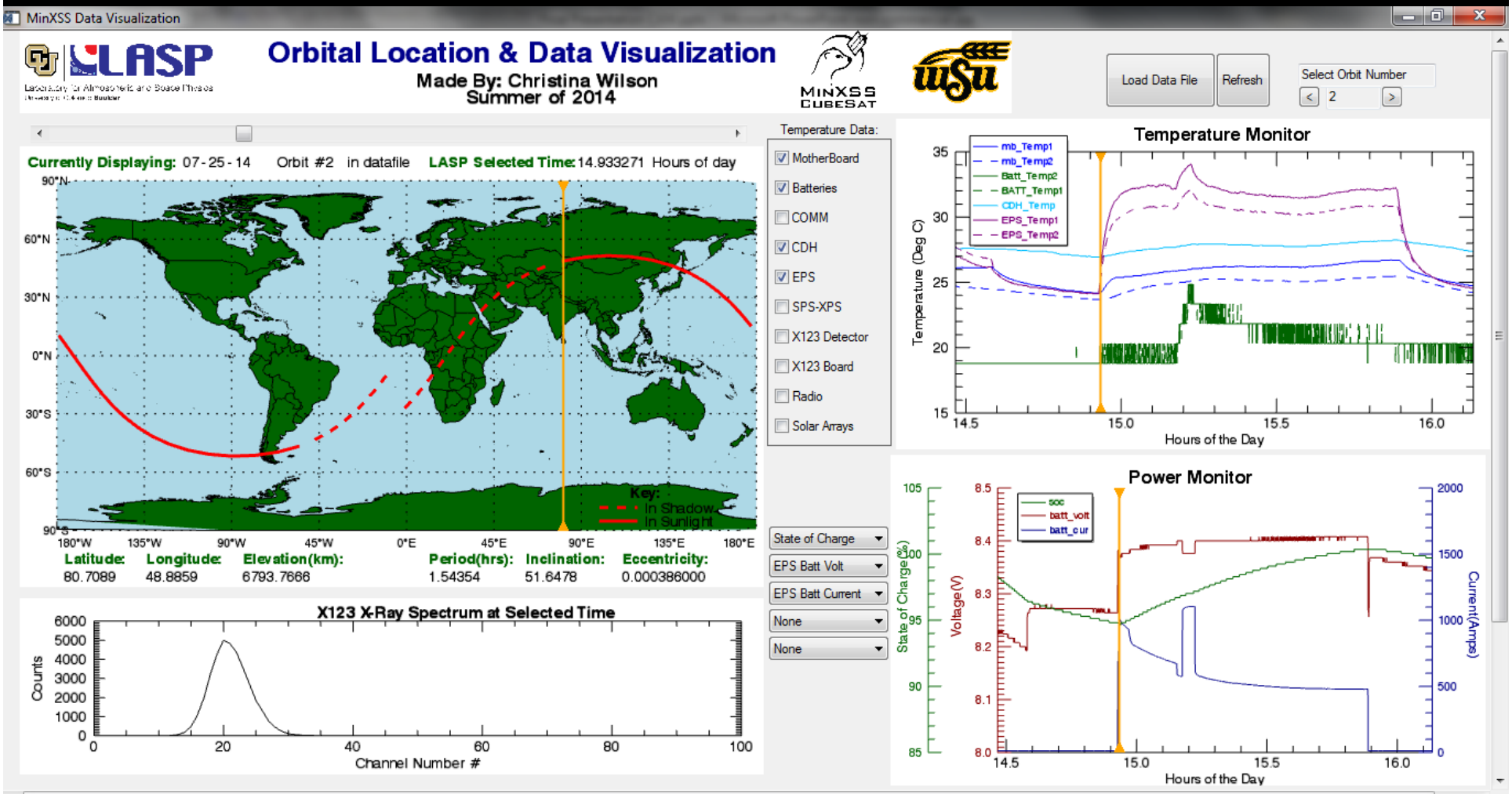
Mission Test 9



Mission Test 9

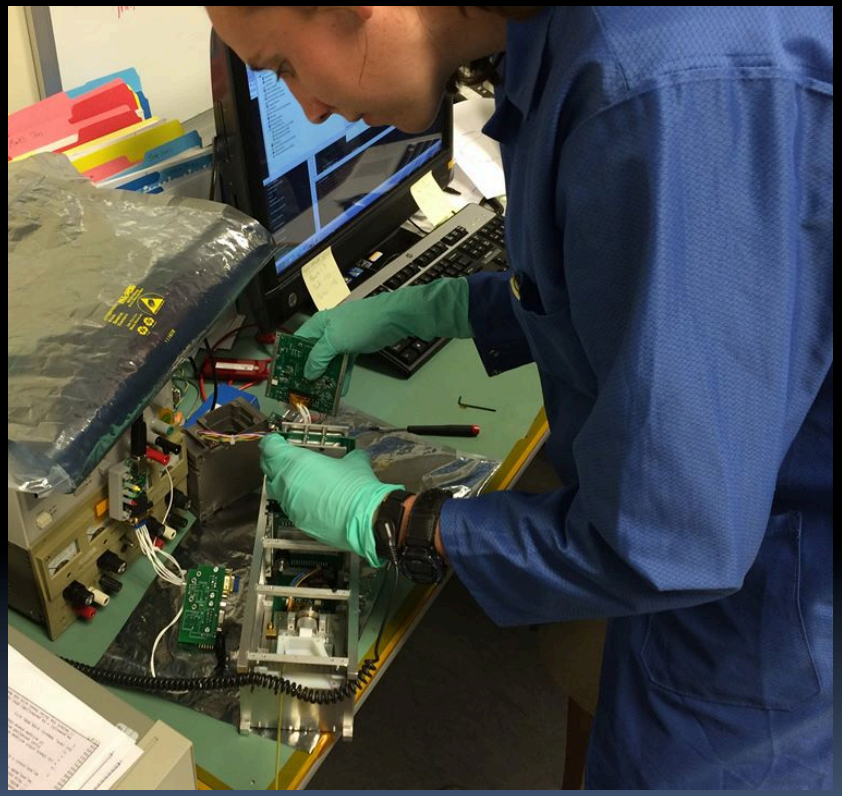


Mission Test 9



Summary of Accomplishments

- Battery testing for NanoRacks
- Created Data Visualization Software
- Performed Mission Tests
  - Validated functionality of MinXSS hardware monitors
  - Helped to improve MinXSS flight software operations modes
  - Proved capabilities of Data Vis Software



Future Work

- Improvements to perform real time analysis and plotting during ground tests
- Data Vis Software will be used to analyze flight data

Questions?