High School and University CubeSat Collaboration in Idaho

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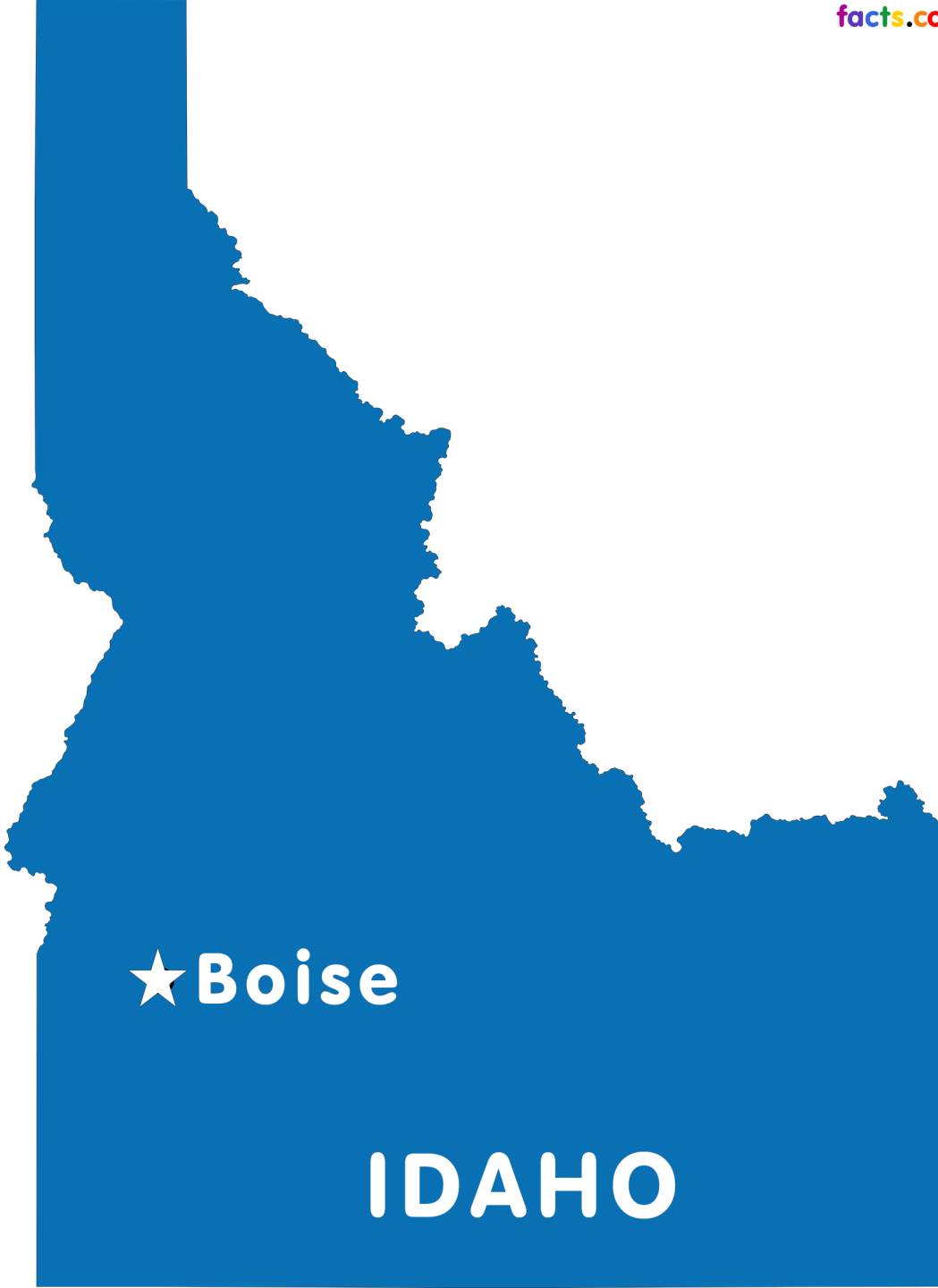
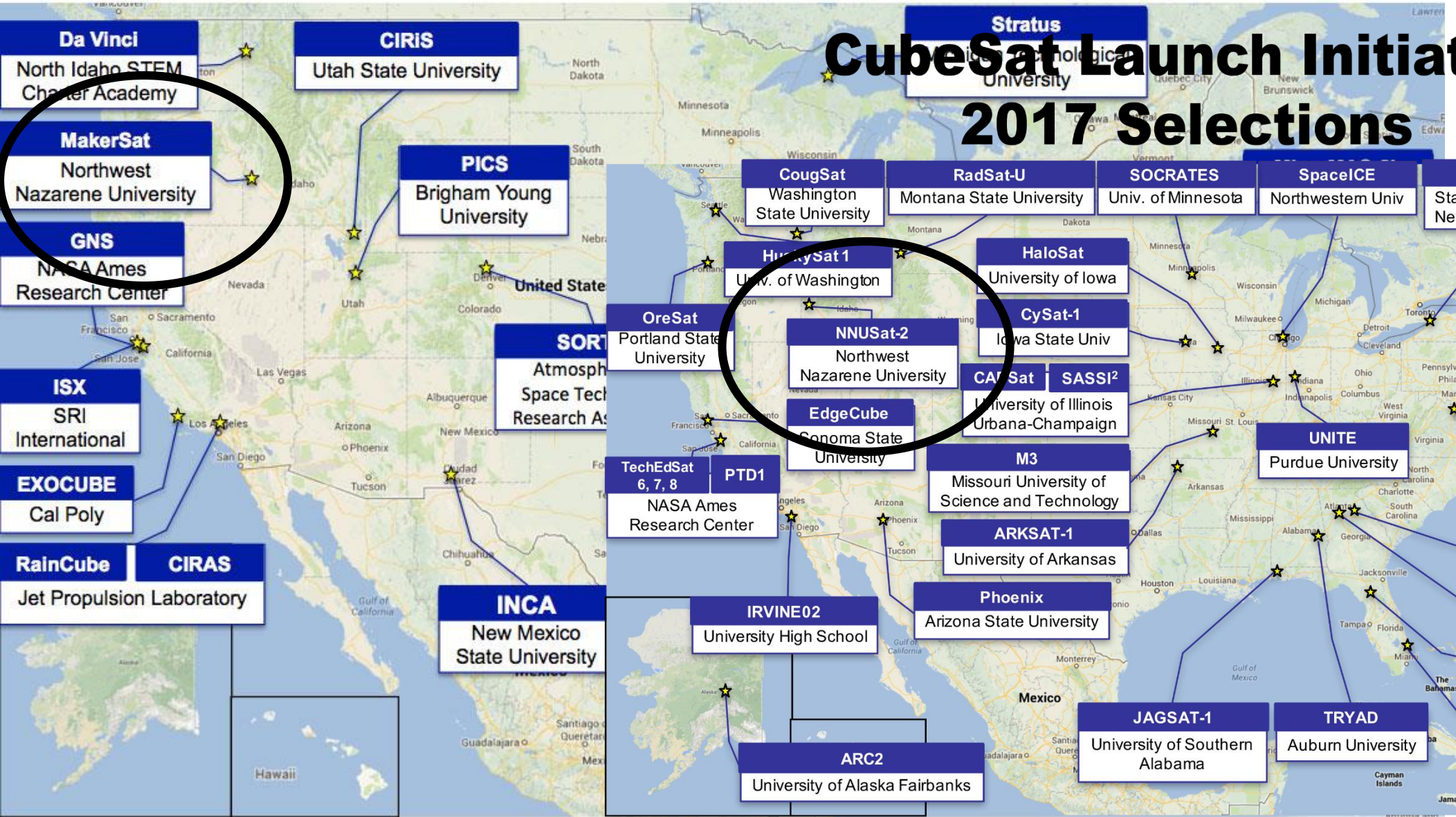
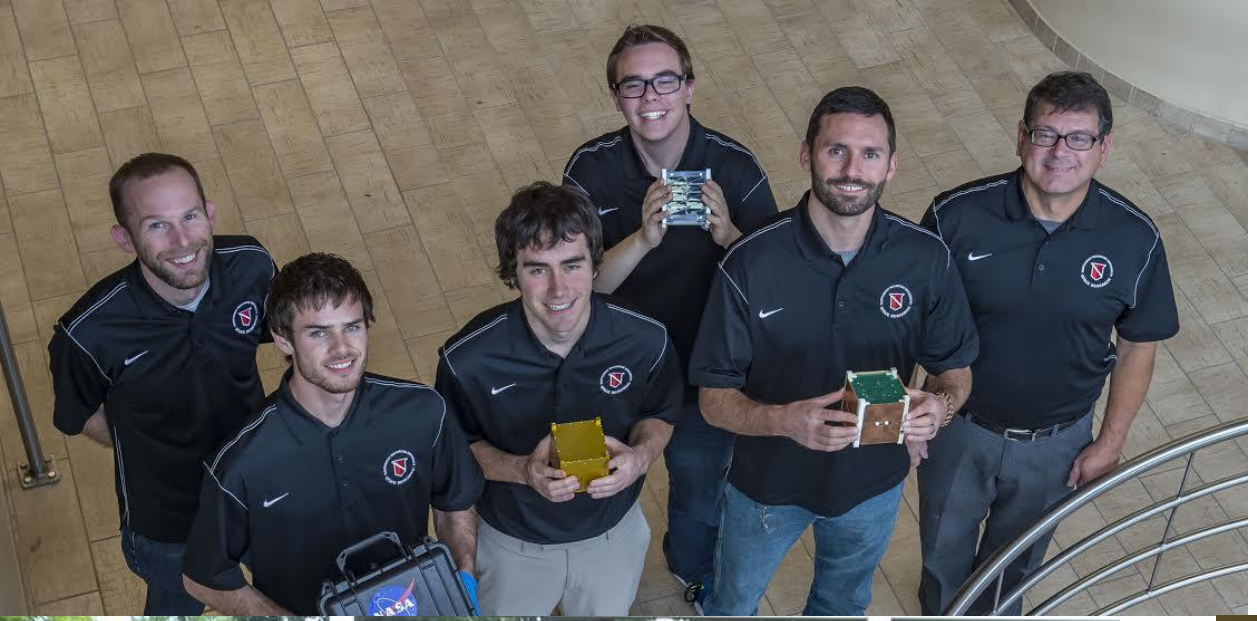


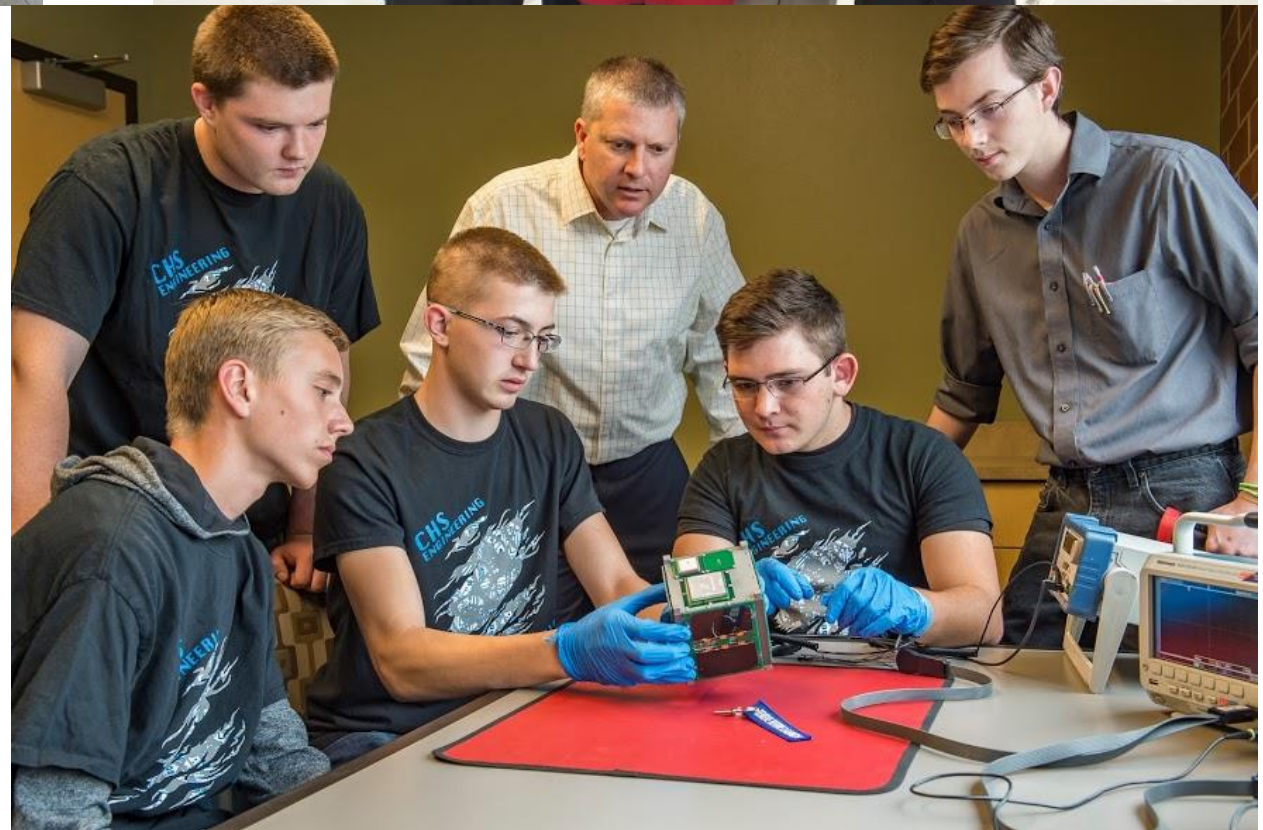
2016 CSLI Selections



CubeSat Launch Initiative 2017 Selections




30th ANNIVERSARY
Small Sat


CHS ENGINEERING

CubeSat Collaboration Background

- Existing relationship & trust between our schools
  - VEX Robotics Collaboration and travel together
  - Dual Credit Program together
- Initial plan was for 2016-17 school year relaxed schedule for a 2018 ELaNa20 flight
- But…in August 2016, SmallSat created opportunity for jumping onboard ELaNa14 with a very tight timeline

Caldwell High School Science

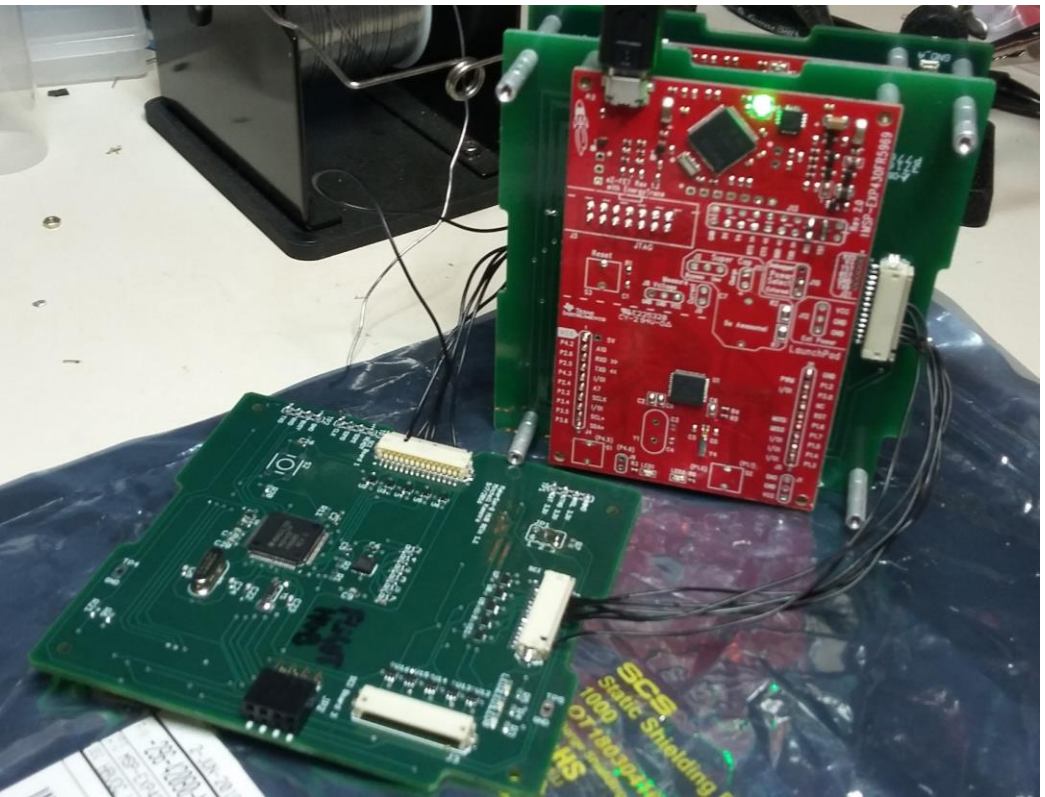
- Initial Science Ideas
  - VHF/UHF radio
  - Visible light beacon
  - CCD imaging camera
  - Total ionizing dose radiation (RadFET for TID)
  - √ Ionizing radiation particle counter “Space Weather” experiment
- Harsh Realities
  - Only two months to flight qualified hardware
  - Financial limitations, parts procurement time
  - No previous satellite experience

CubeSat 101: Drinking from a firehose

- 8/6/16 Decision to join ELaNa14 mission
- How to rapidly build & integrate?
- 9/6 ENGR boards 1st pass build
- 9/13 ENGR boards 1st pass tested
- 9/14 ENGR boards 2nd pass build
- 9/20 ENGR boards 2nd pass tested
- 9/25 FLIGHT boards build @ Plexus
- 10/1 FLIGHT boards tested
- 10/5 NNU&CHS FLIGHT boards integ
- 10/8-16 Integ w/ BUS @ NSL Indiana
- 10/17-23 Environ tests @ SDL Utah
  - Shake and Bake
- 10/31-11/4 Shock test @ Tyvak
- 11/4 All test reports submitted
- This morning…Mission Readiness Review
- September 2017 Launch into Polar, sun-synchronous orbit

TI MSP430 “LaunchPad” microcontroller daughterboard on simple science sensor motherboard: QUICK DEV. STRATEGY

- PIN Diode sensor w/3-wire interface
- TI MSP430 LaunchPad daughterboard (red)
- Simple 2-layer sensor motherboard (green)



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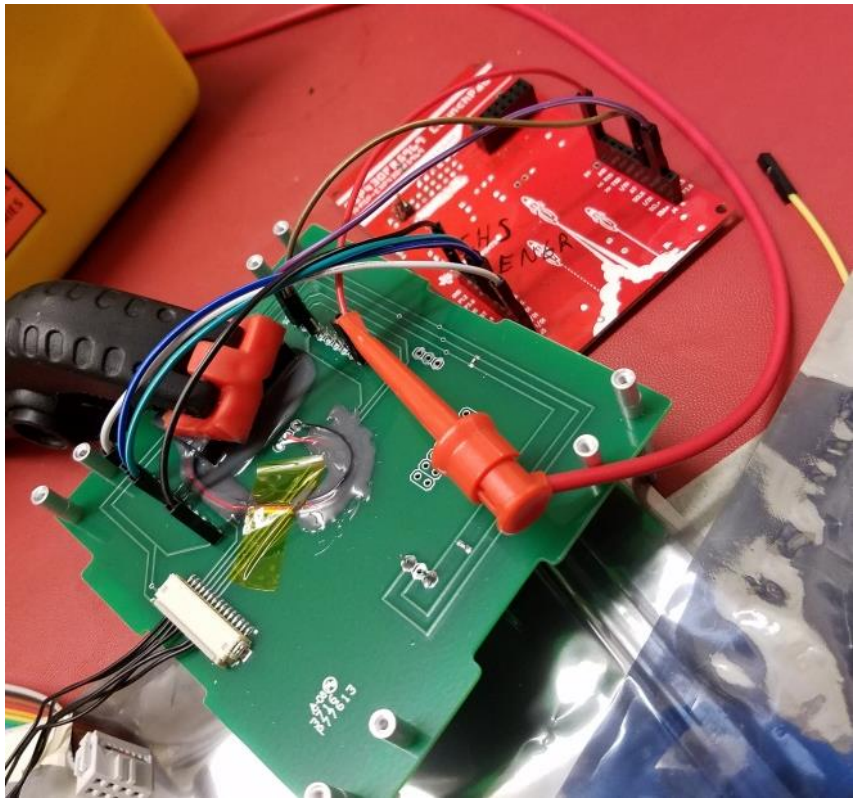
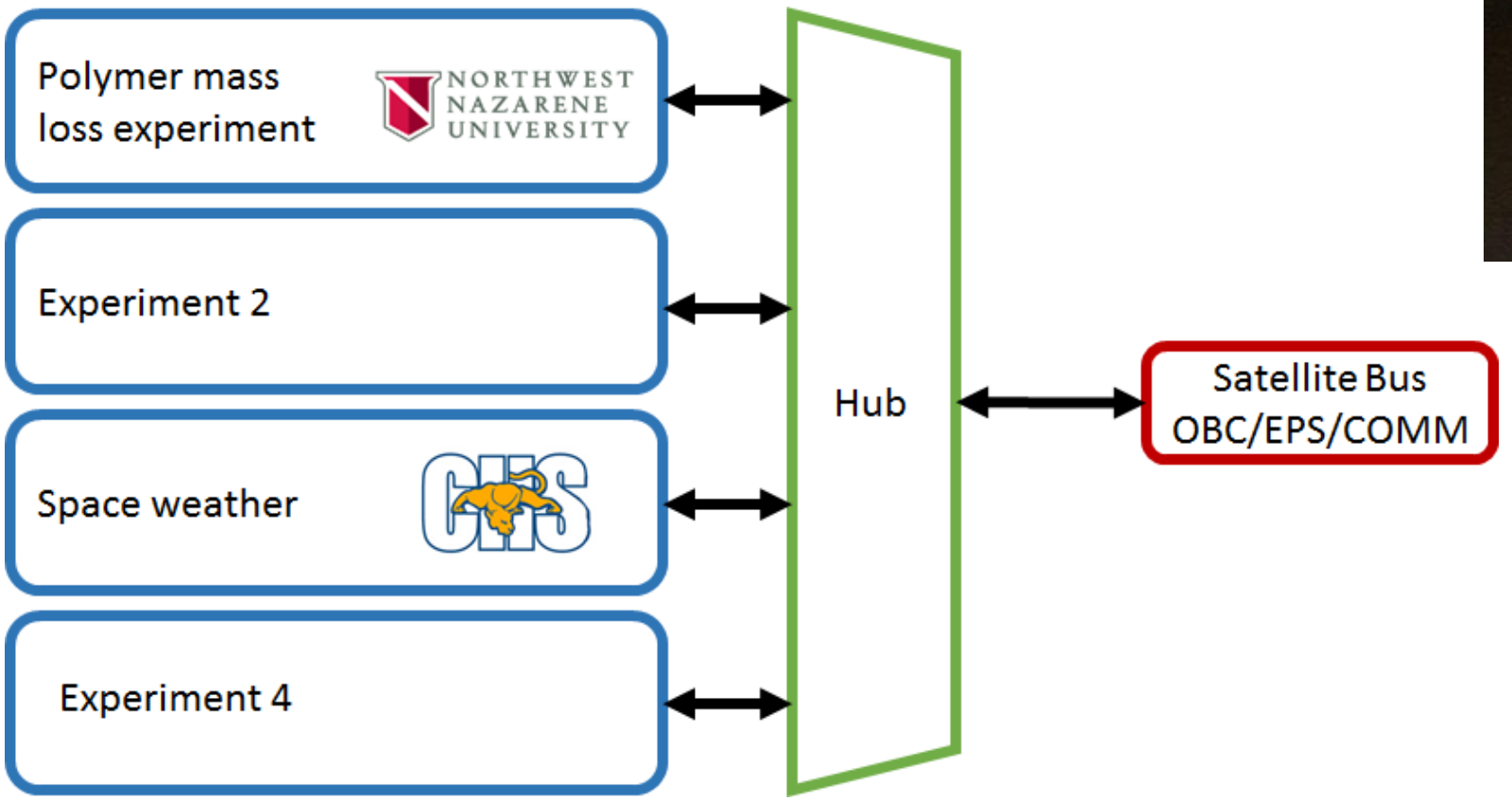
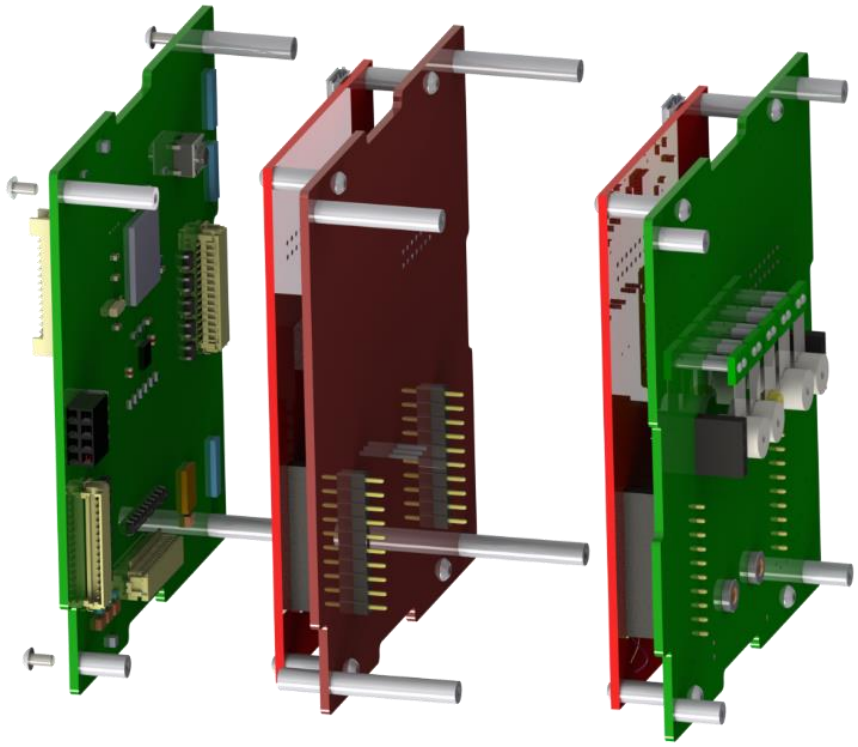


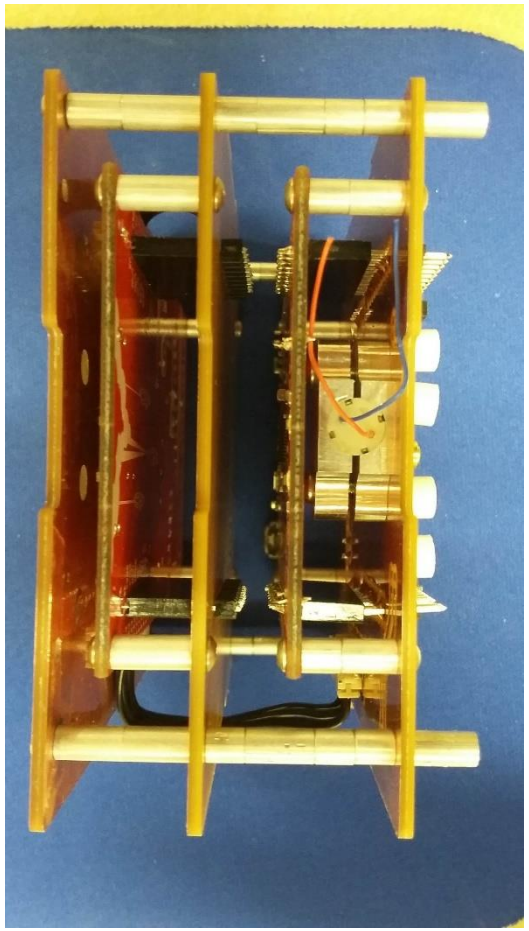
MakerSat Multi-Project Satellite Architecture

Science “HUB” provides round-robin power control, data buffering, and radio communication to 4 science experiments.



Science Hub+CHS+NNU payload integration stack



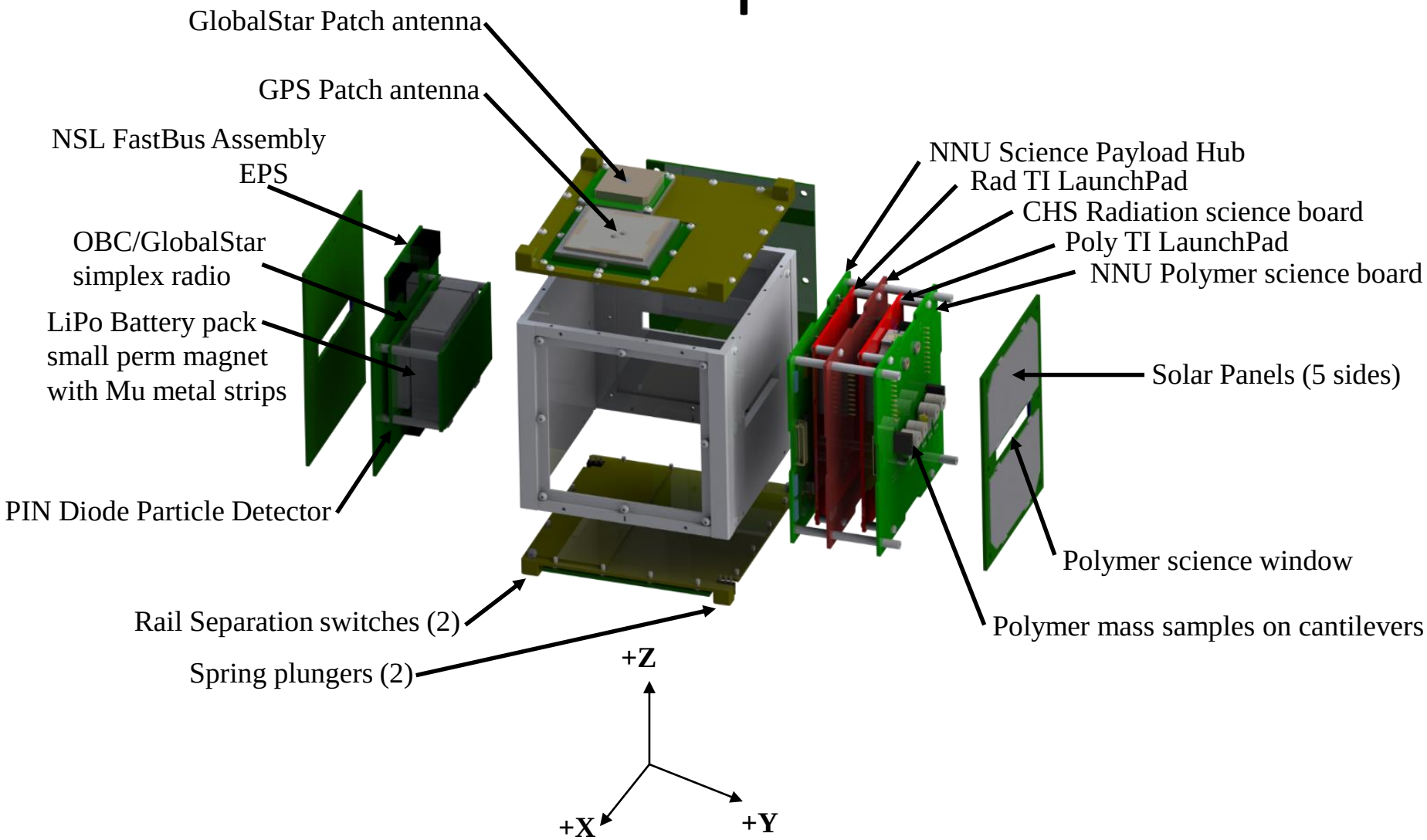


Science Hub

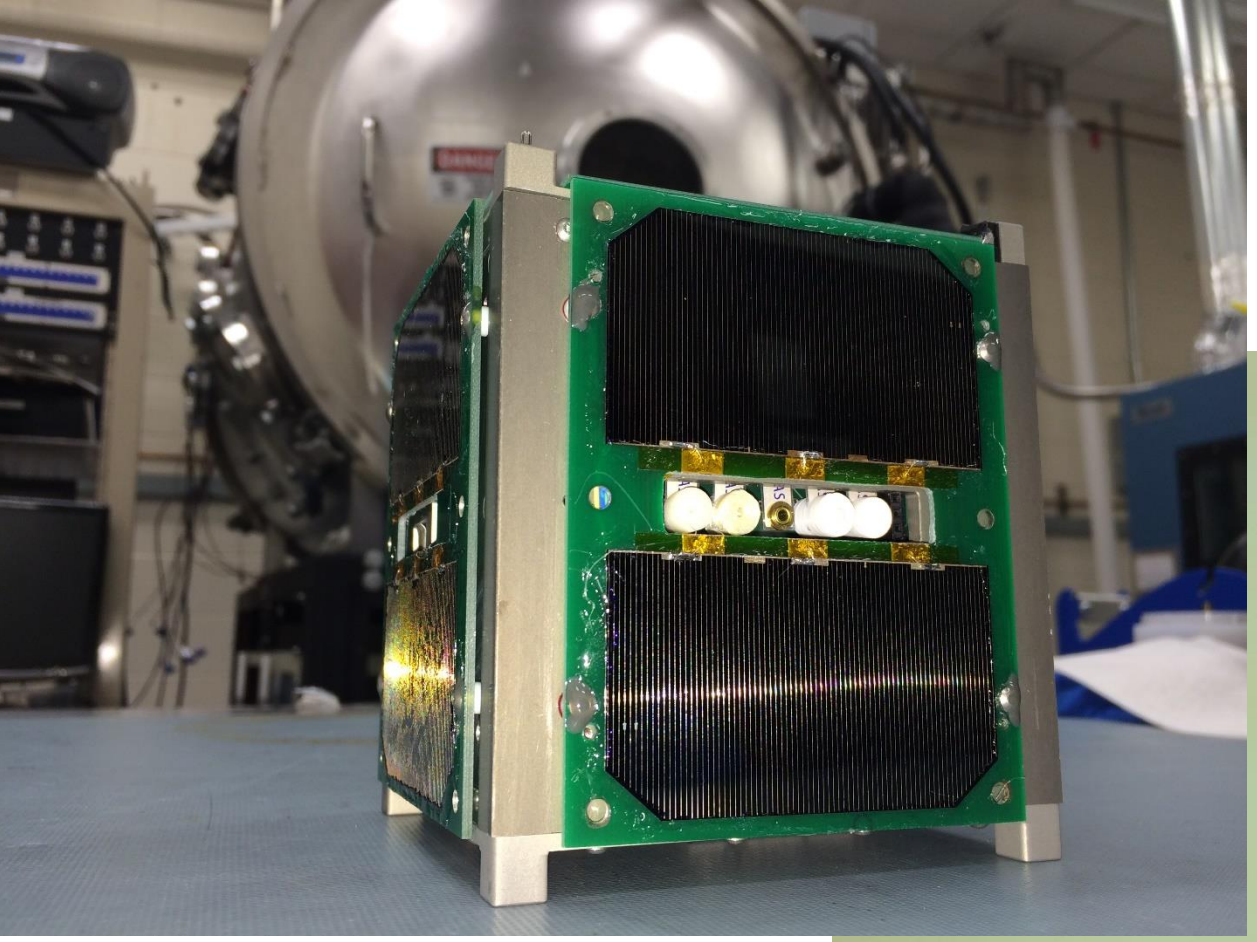
CHS Radiation Counter Experiment

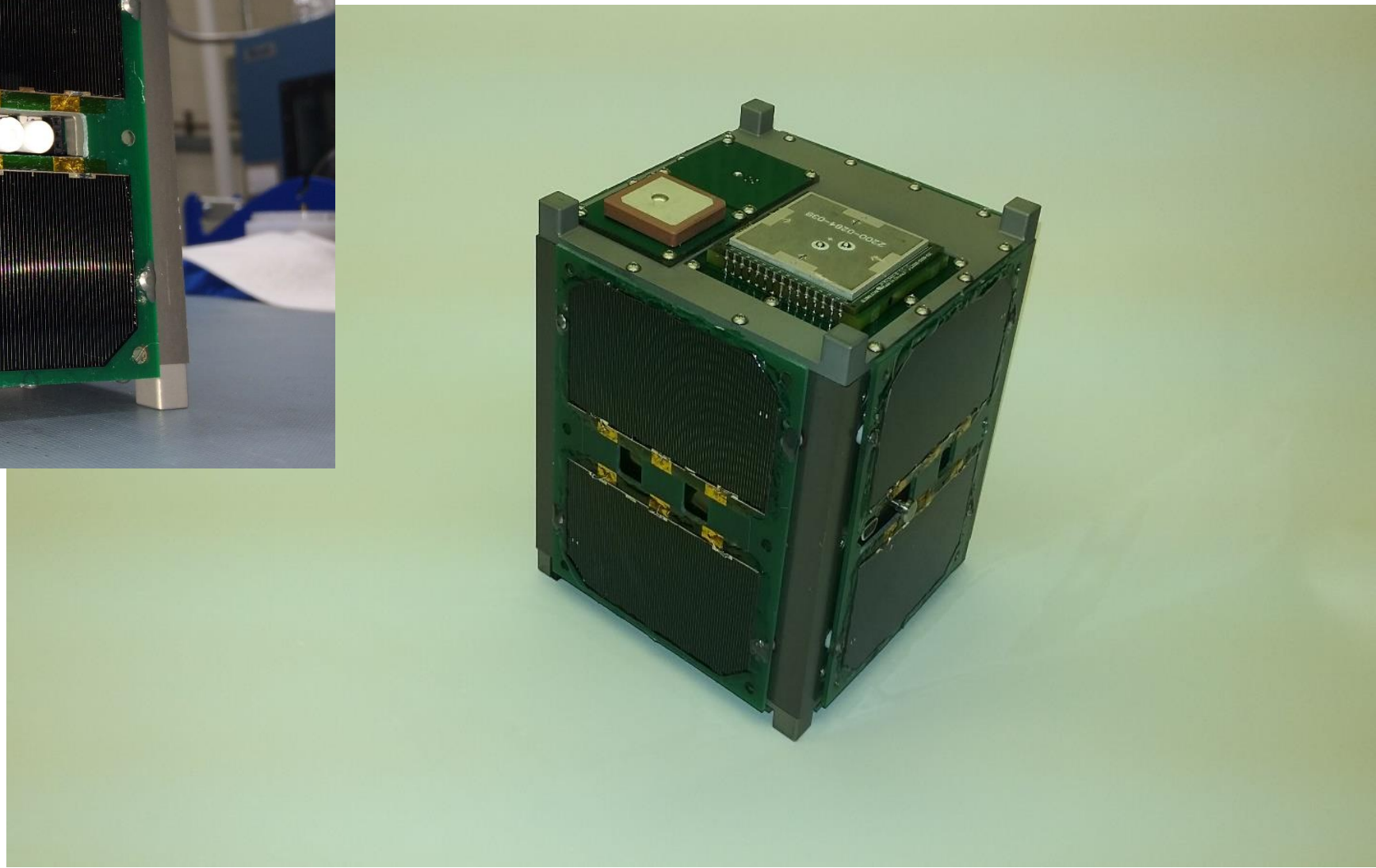
NNU Polymer Mass Loss Experiment

Science Payload integration with 1U FastBus from NearSpaceLaunch

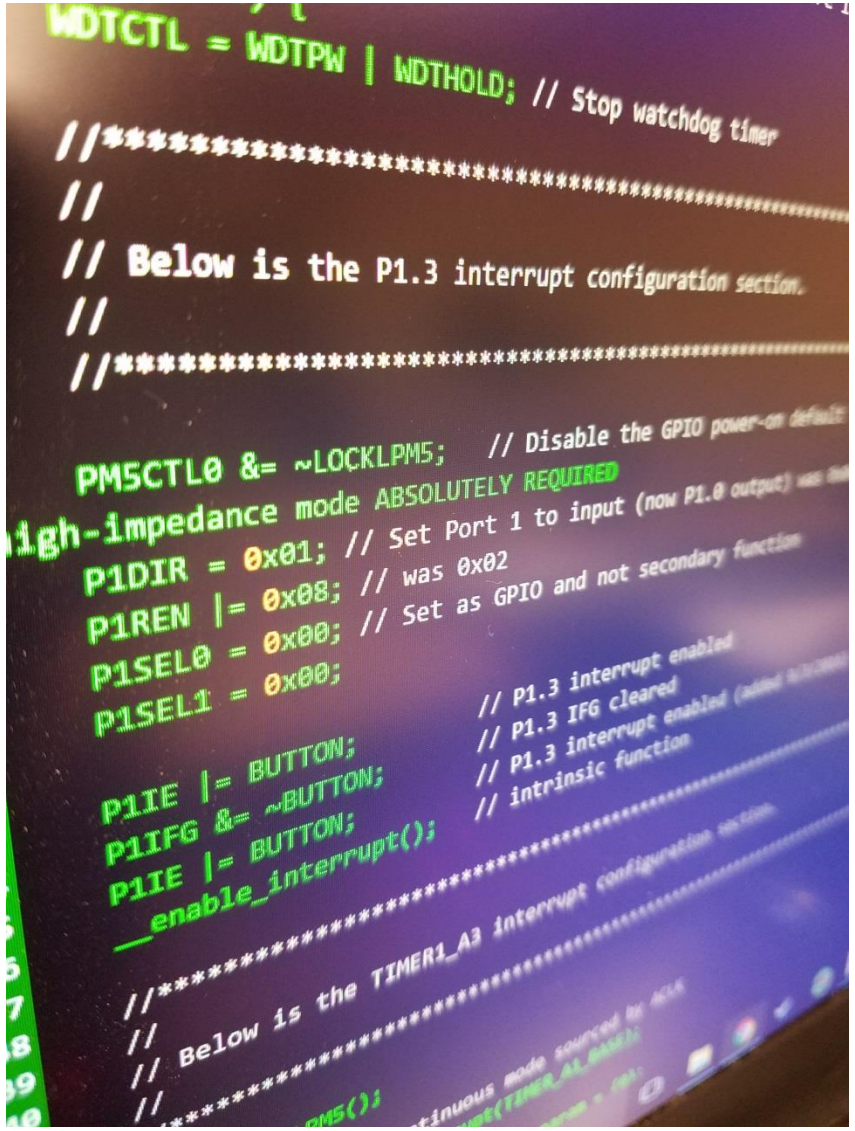


Completed MakerSat-0



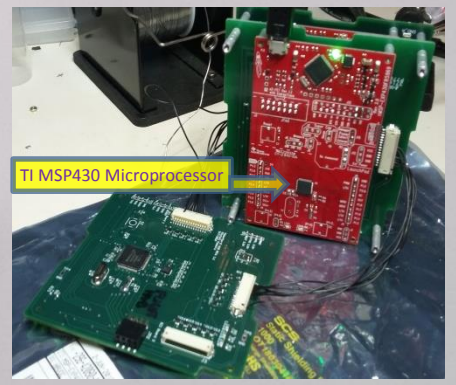


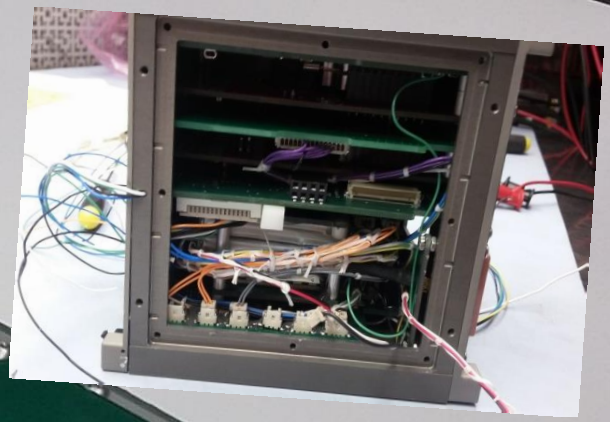
Software & Communications



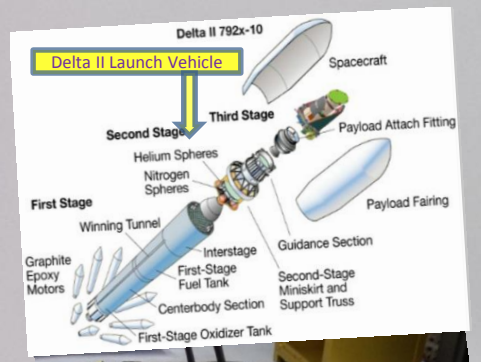
- Interrupt Driven
  - Simple Timer Interrupt
  - External Counter Interrupt
- Data Path
  - Radiation Particle Counter value is measured every 70 mins
  - forwarded through HUB to
  - NSL Eyestar S2 simplex radio to
  - Globalstar satellite constellation to
  - Ground receiving stations to
  - NSL Data Server to
  - CHS & NNU student researchers cellphone or laptop app

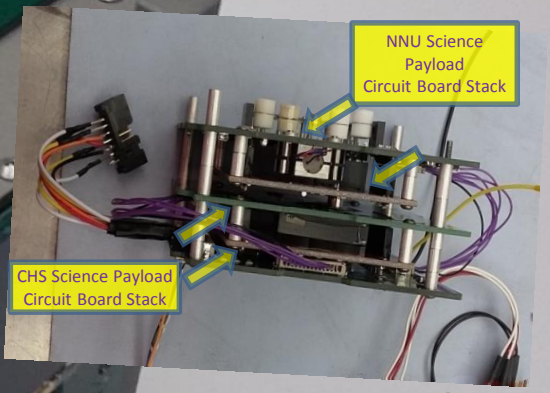
CHS Engineering CubeSat Student Satellite Project

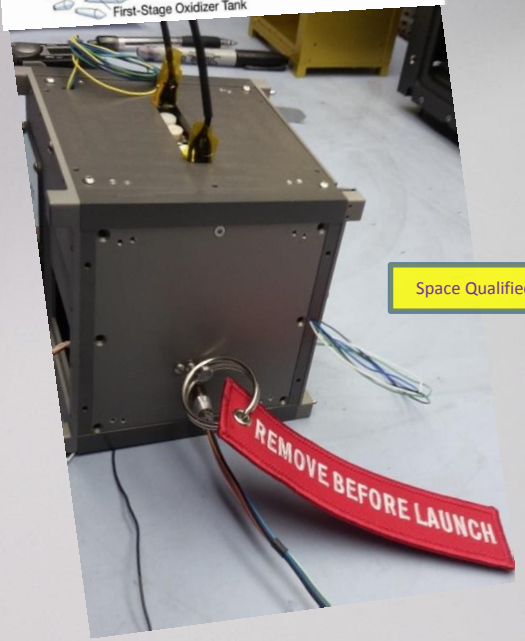




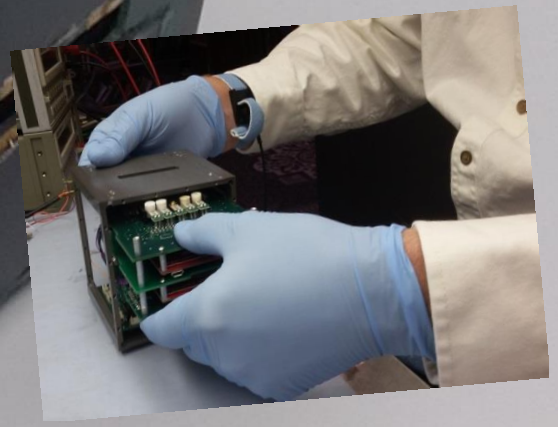
Patch Antenna for Global Star Satellite Phone Data Downlink



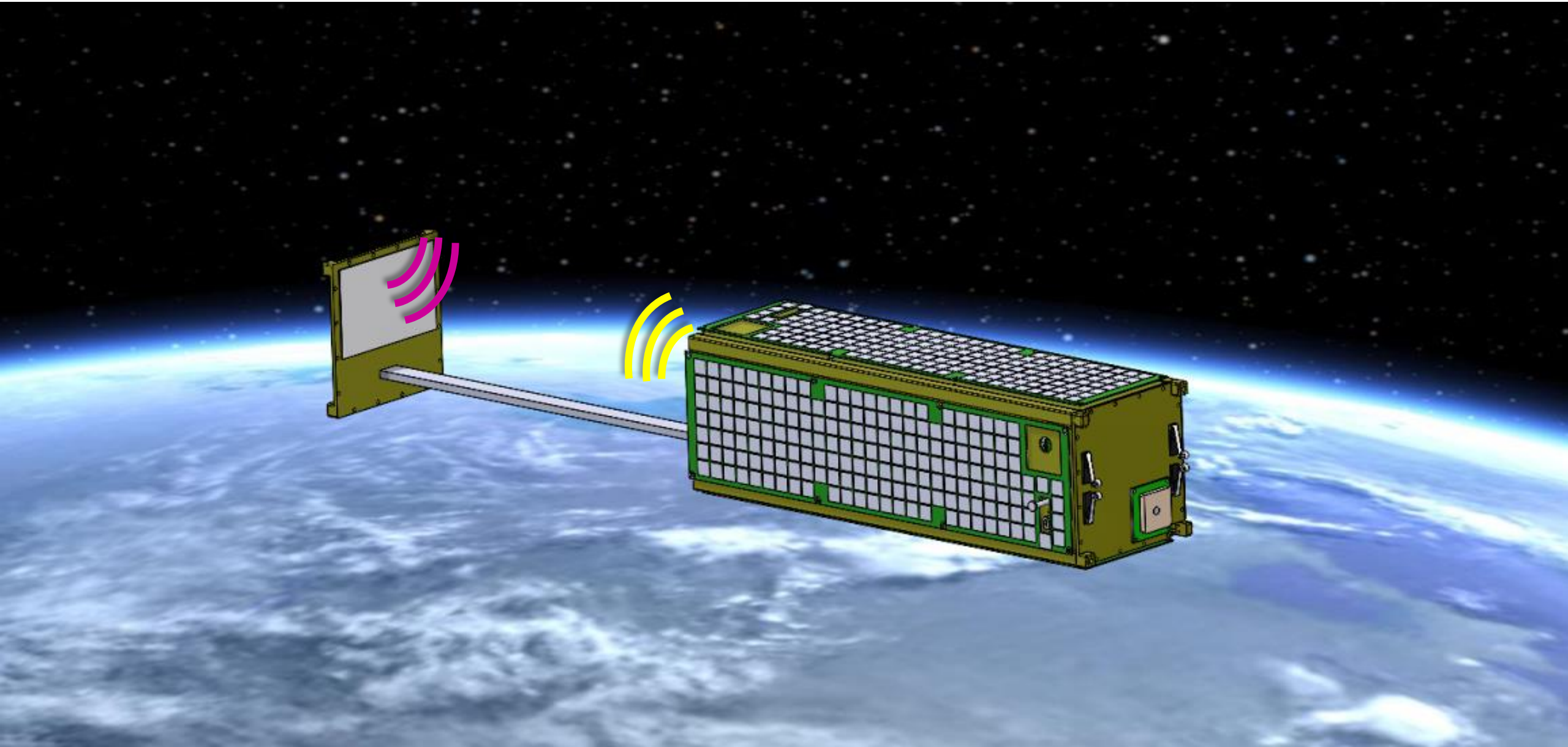


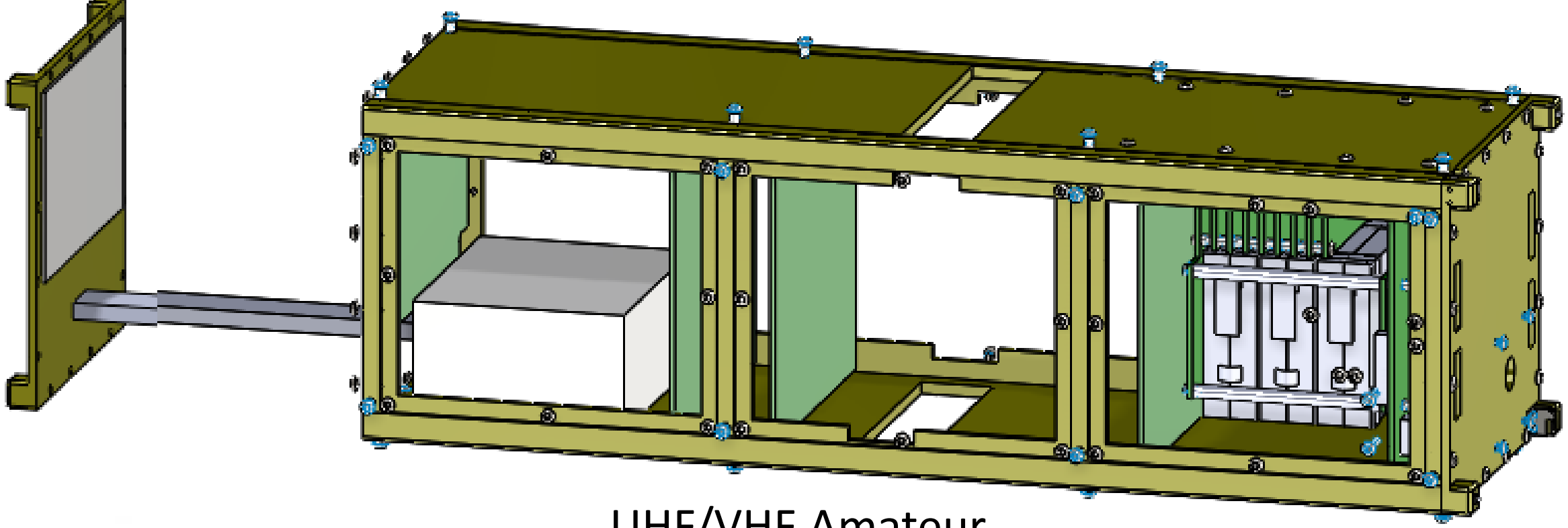


Space Qualified Solar Array

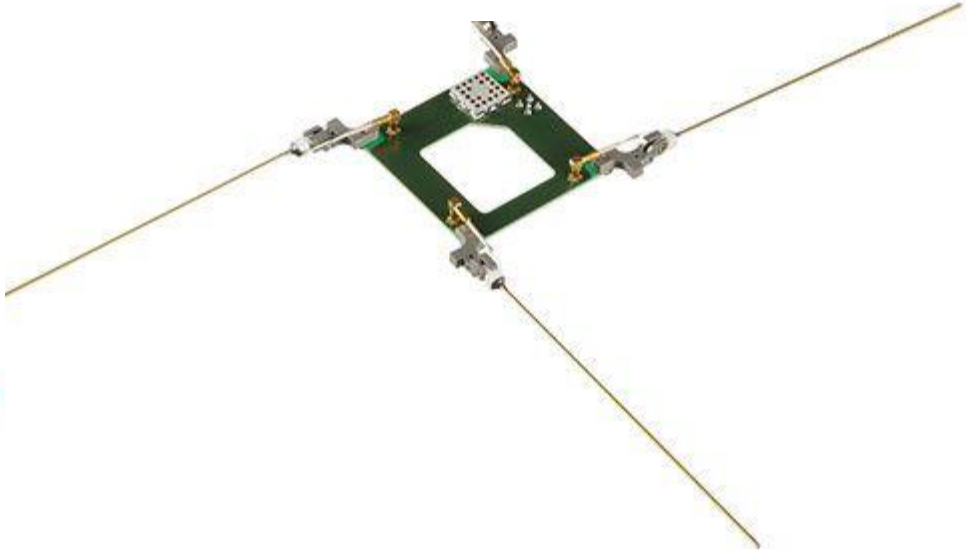


Second Collaborative CubeSat: Radio Frequency Tag (RFTSat) 2017-18



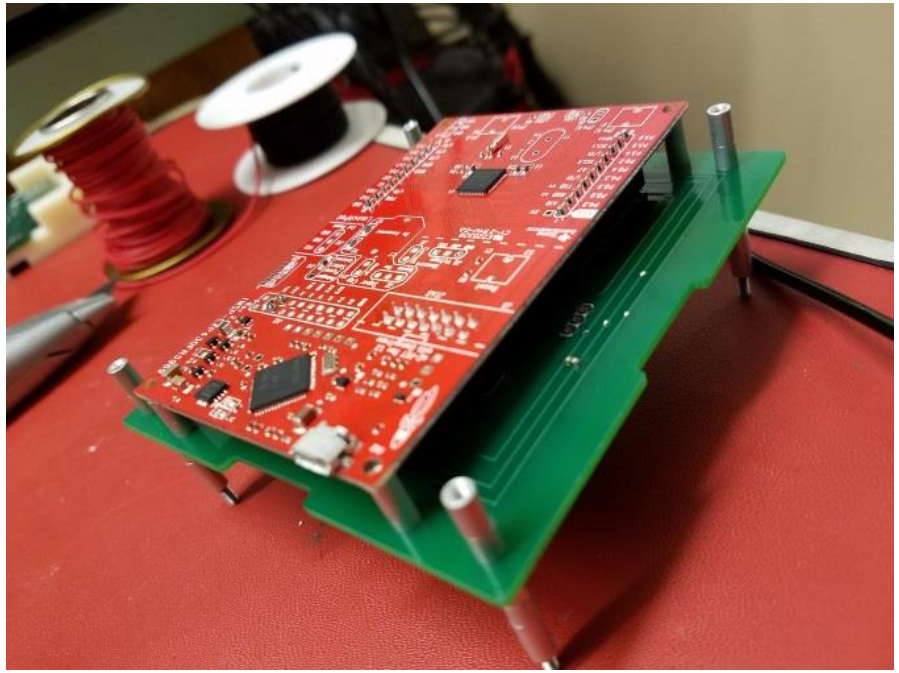


UHF/VHF Amateur
Radio and camera



Challenges

- University vs. high school setting
  - Skill levels, Logistics, Curfew
  - SolidWorks, Eagle CAD, Code Composer, Git Hub
- Qualification Testing



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Tyndall National Institute | Works
Institiúid Náisiúnta

A Recipe for Others to Follow?

- Workable Partnerships / Time to build Relationships
- STEM Education / Its not for show
- Students must be willing to hold themselves accountable
- Time / Logistics
- Cost
- But it is worth it!

Thank you!
Questions?