Portland State Aerospace Society

Introduction for Dean Corsi

Agenda

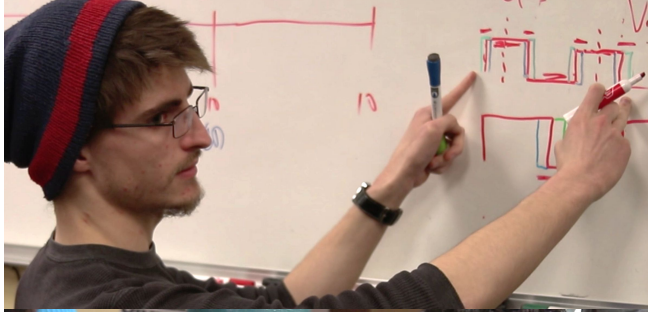
- ➔ Introduction to PSAS
- ➔ OreSat
- ➔ Launch Vehicle 3.1
- ➔ Liquid Fuel Engines
- ➔ BASE11 Challenge
- ➔ MCECS & PSAS

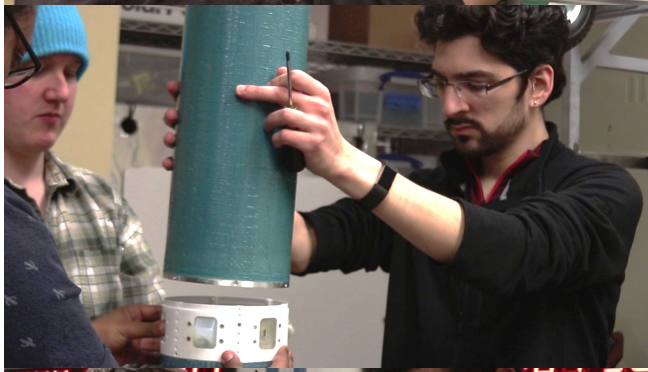
Introduction to PSAS

Portland State Aerospace Society

Rocket Science for Everyone

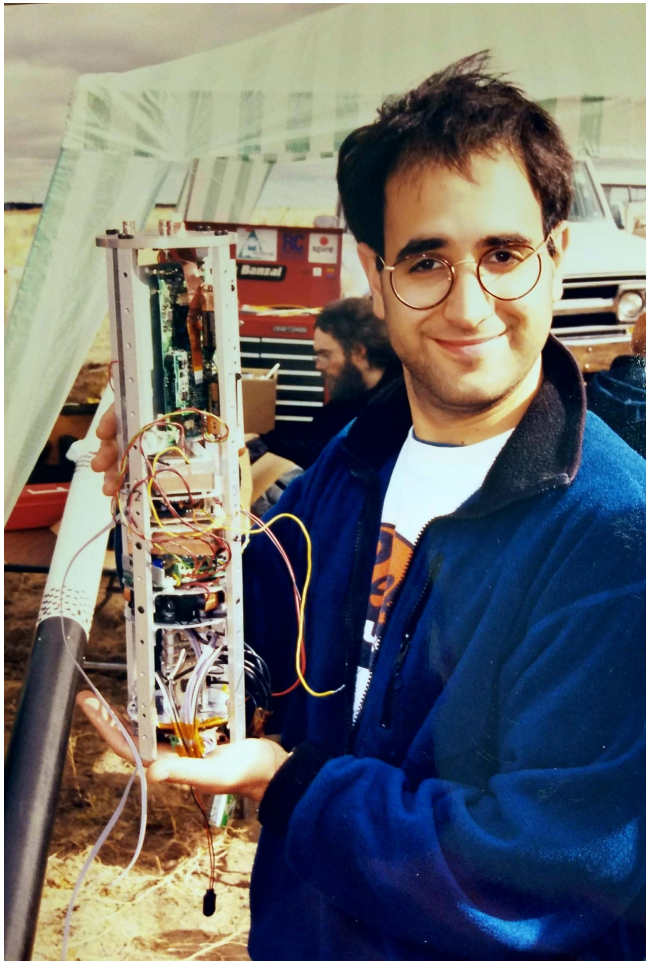
- *Interdisciplinary* extracurricular space program
  - Engineering, business, health, physics, film, education
- Undergraduates, Graduates and *Industry Advisors*
- Crowdfunded, and completely *Open Source*
  - GPL V2 or CERN Open Hardware



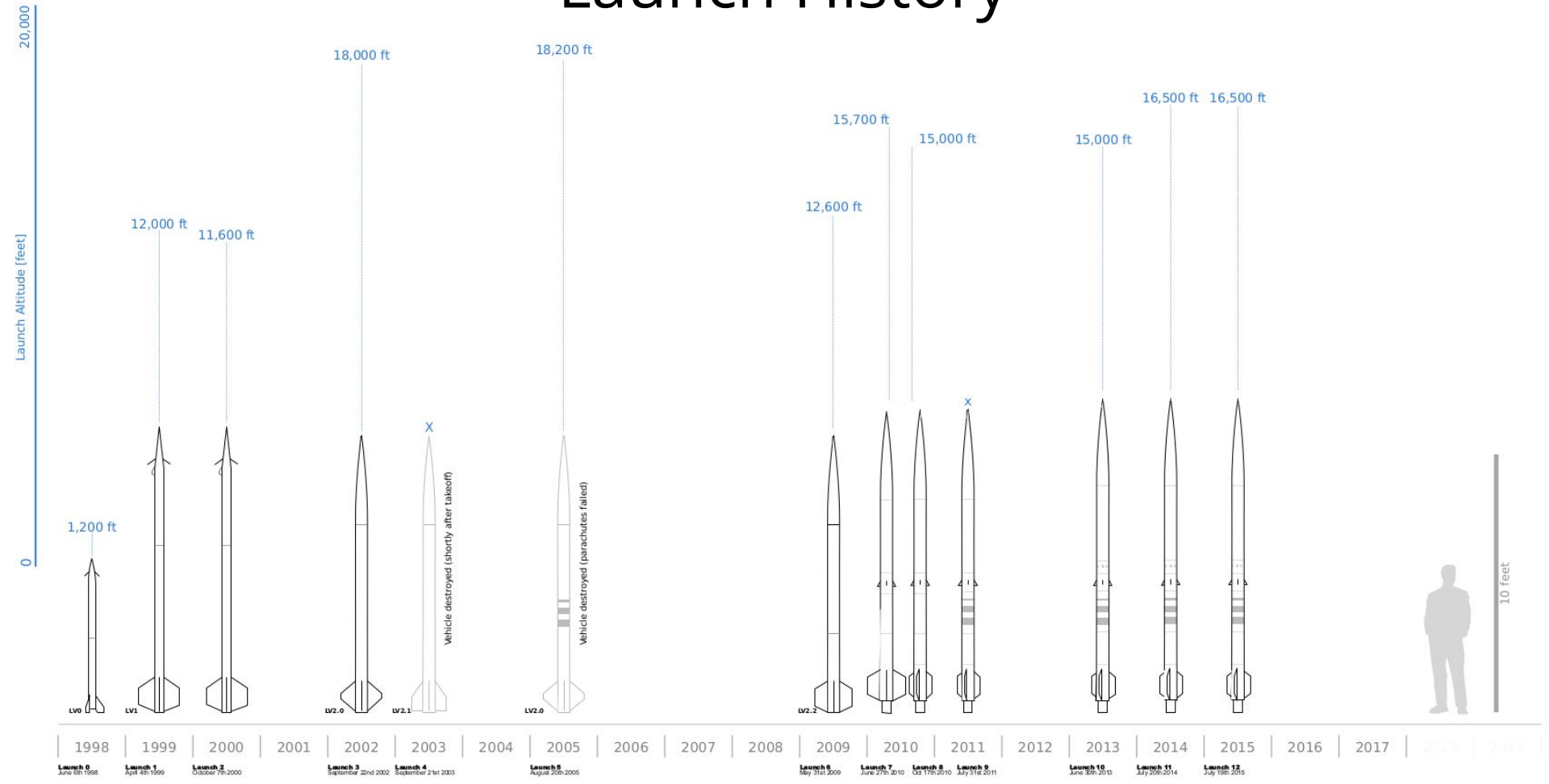


A 20 Year Legacy of Innovation

- ➔ Flew solid state IMUs (2001)
- ➔ First to fly Linux on a rocket (2005)
- ➔ First to push WiFi past Mach 1 (2005)
- ➔ First 3 axis cold gas Reaction Control System (prototype 2015)
- ➔ First electric feed system for liquid fuel motor (prototype 2017)



Launch History

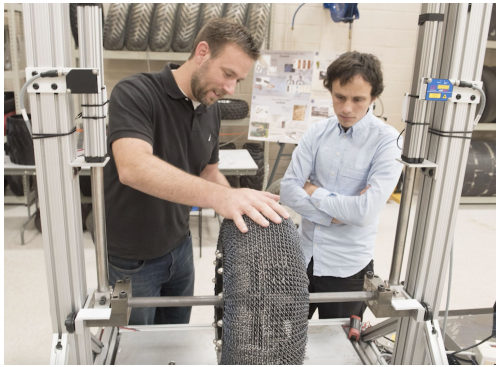


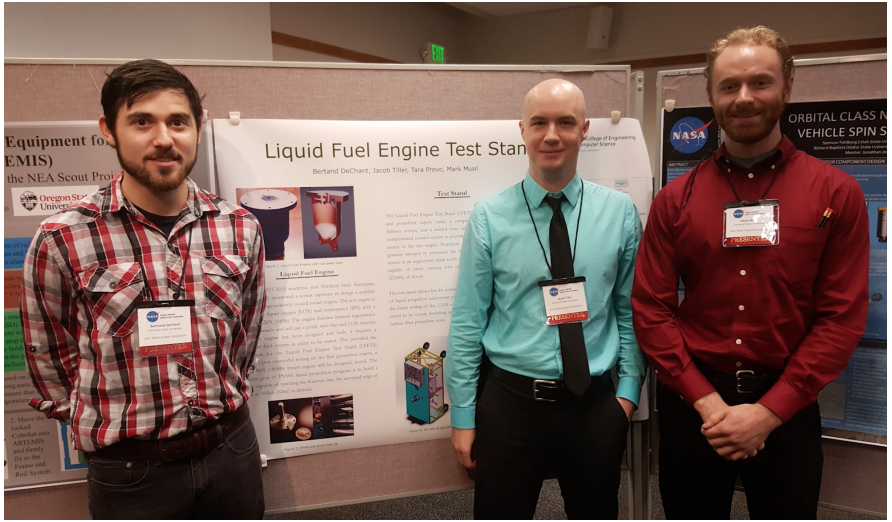
Some numbers

- ➔ > 10 industry advisors
- ➔ > 30 extremely active student members
- ➔ > 50 regularly active student members
- ➔ > 100s of students involved
- ➔ > 1,000s of peeps following
- ➔ EE, ME, CS, Physics, Math, Business, Public Health, Graphics Design, Film

2017-2018 Student Placements

- ➔ PSAS builds rockets, satellites, and better engineering students!
- ➔ 1 internship with CERN
- ➔ 3 internships with NASA
- ➔ An increasing number of our alums are landing careers within the growing aerospace industry





PSAS Strategic Projects: OreSat

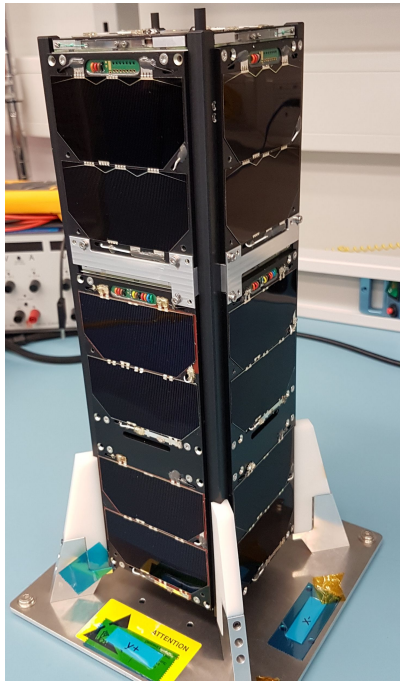
Rocket Avionics

- ➔ Linux-based flight computer
- ➔ Custom inertial measurement unit
- ➔ SDR GPS receiver
- ➔ "DxWiFi" Amateur radio-based telemetry on WiFi
- ➔ 360 degree "VR" video
- ➔ DIY cylindrical microwave patch antennas

Rocket Avionics → Nanosatellite

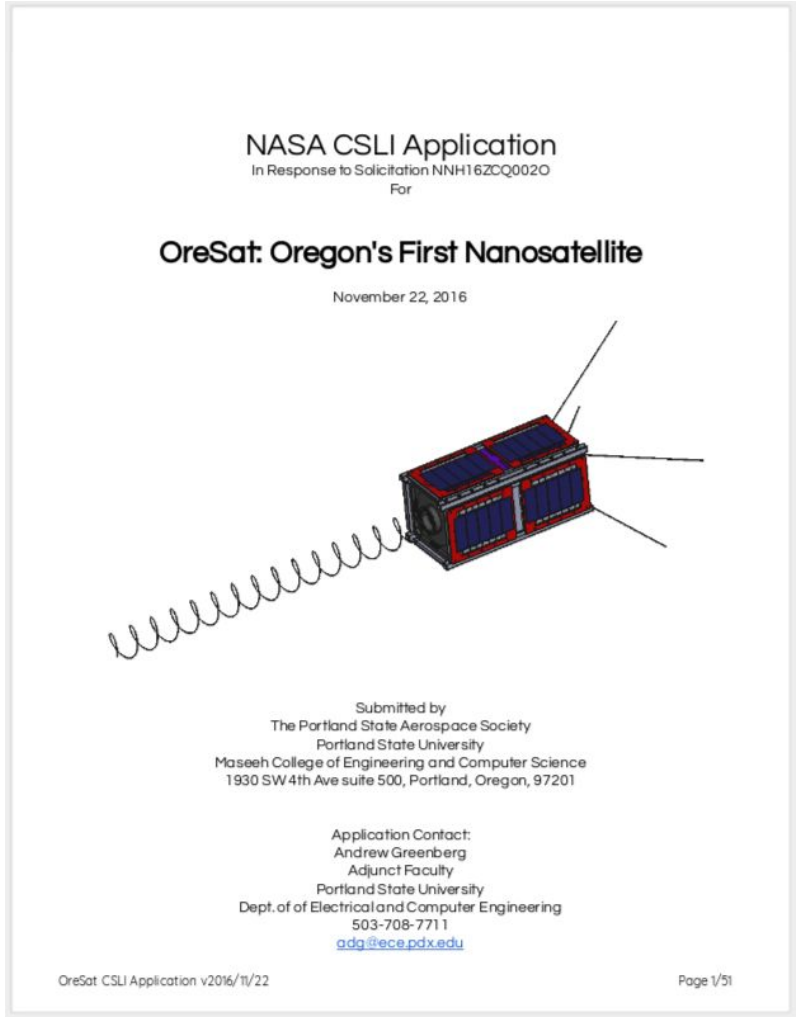
➔ Oh! Hey!

=



OreSat!

- NASA CubeSat Launch Initiative
- Free ride to space
- ".. an artisanally handcrafted satellite from the State of Oregon.."
- Good training for future projects



NASA CSLI Application

In Response to Solicitation NNH16ZCQ002O

For

OreSat: Oregon's First Nanosatellite

November 22, 2016

Submitted by
The Portland State Aerospace Society
Portland State University
Maseeh College of Engineering and Computer Science
1930 SW 4th Ave suite 500, Portland, Oregon, 97201

Application Contact:
Andrew Greenberg
Adjunct Faculty
Portland State University
Dept. of of Electrical and Computer Engineering
503-708-7711
adg@ece.pdx.edu

OreSat CSLI Application v2016/11/22

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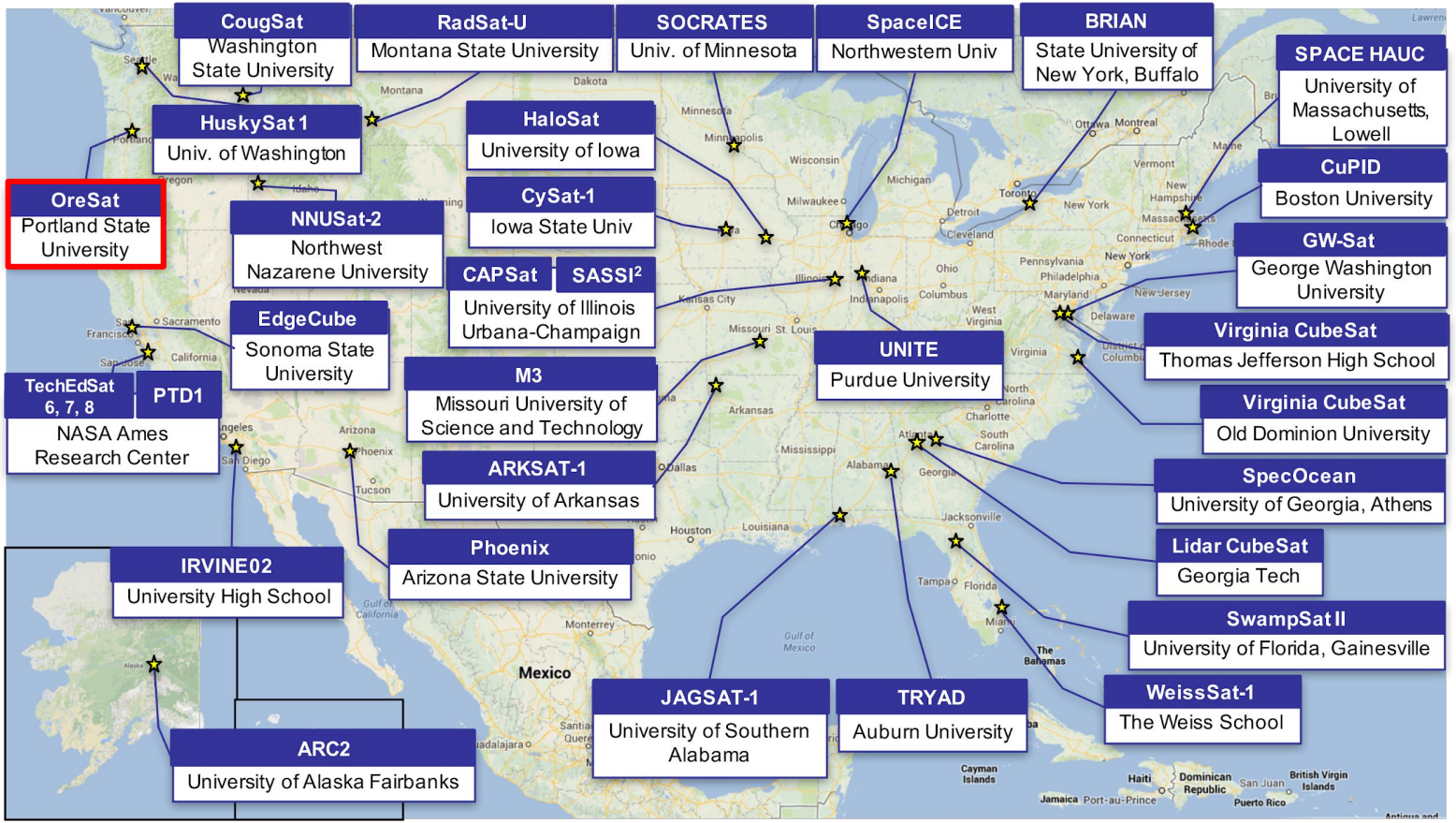
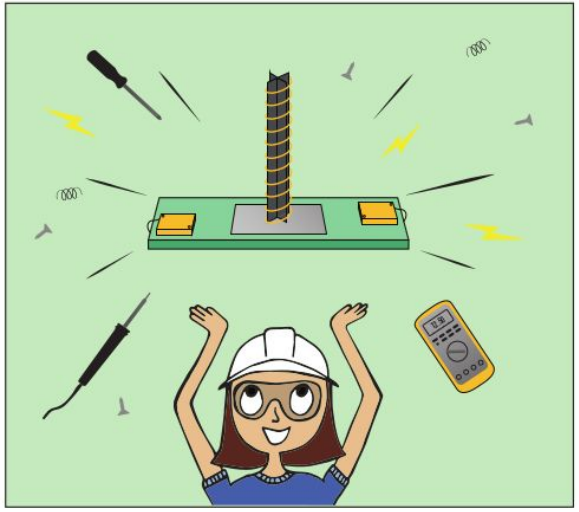
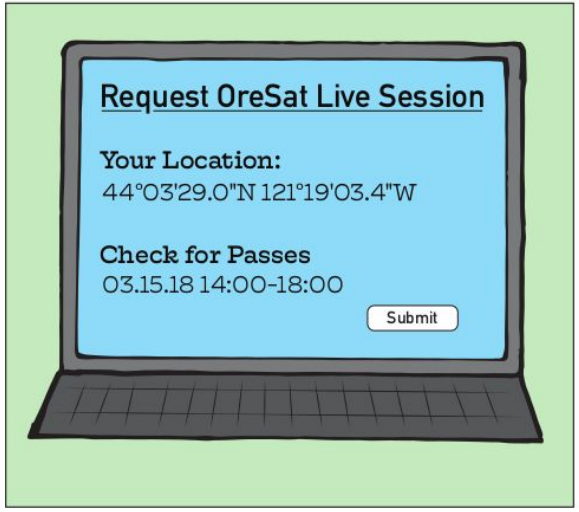
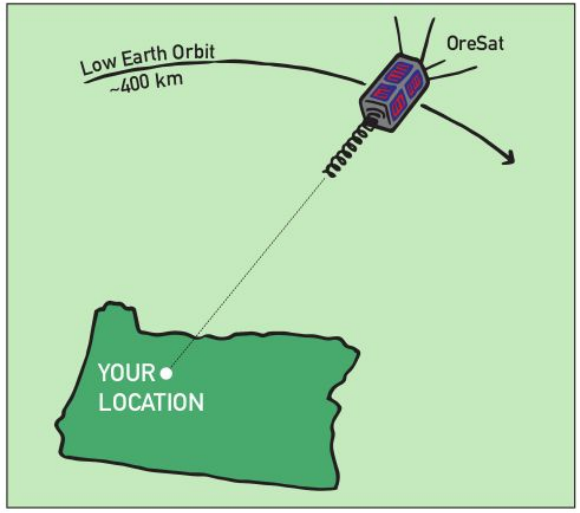
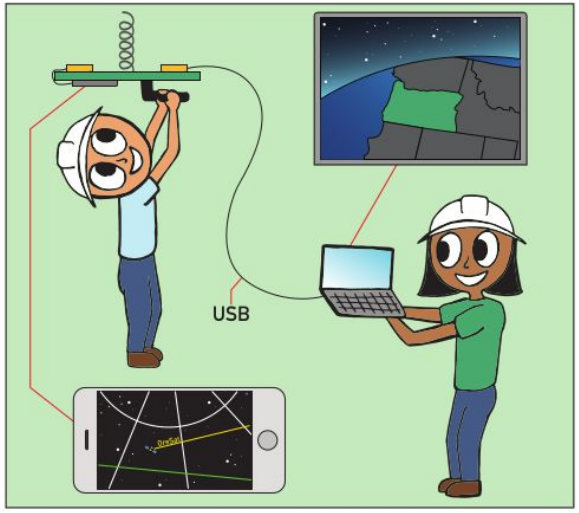
CubeSat Launch Initiative
2017 Selections



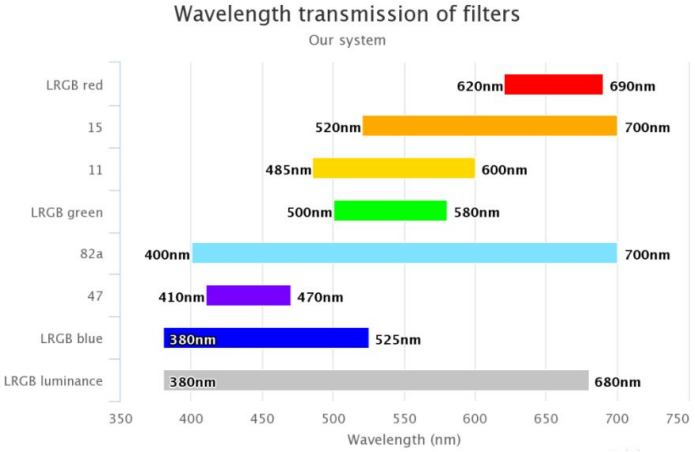


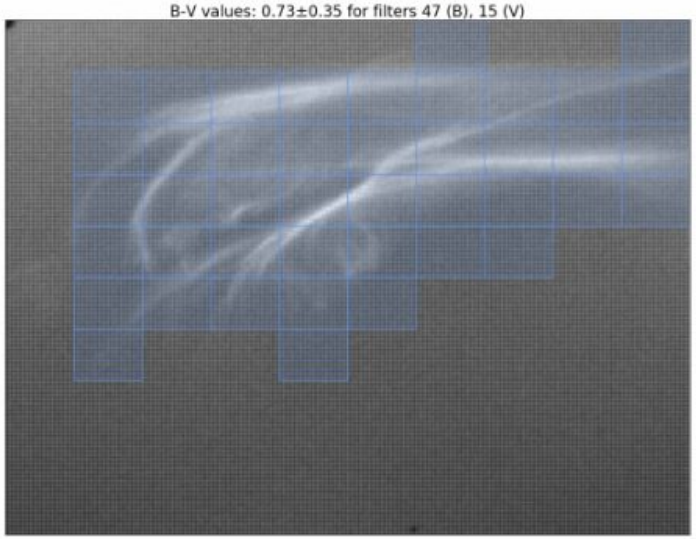

Request OreSat Live Session
Your Location:
44°03'29.0"N 121°19'03.4"W
Check for Passes
03.15.18 14:00-18:00
Submit


Low Earth Orbit
~400 km
OreSat
YOUR
LOCATION


USB

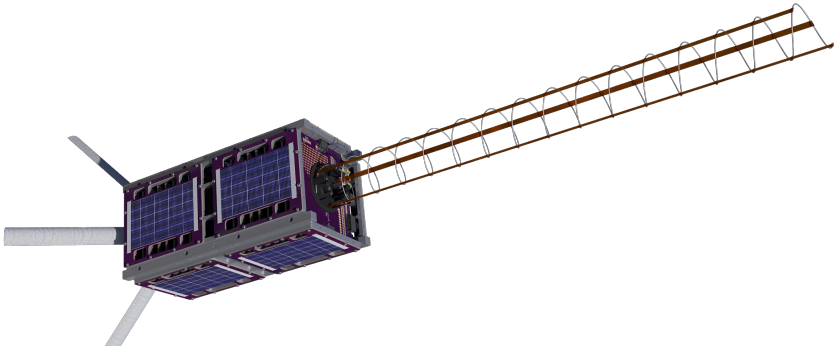
Cirrus Flux Cam Prototype





Things you should know

- STEM outreach to *all the high schools* in Oregon
  - Working with all 11 Oregon STEM Hubs
- Working with other Oregon educational institutions
  - U of O, OSU, community colleges
- In space 2020-2021
- Grand finale: Oregon's first meteor shower!




Handing off to NASA in Summer 2020

PSAS Strategic Projects: Launch Vehicle 3.1

100 km Rocket Technology Development Program

- ➔ Part of a university "Space Race" to 100 km.
- ➔ Active Guidance, Navigation, and Control
- ➔ Composite airframes
- ➔ Liquid fuel engine

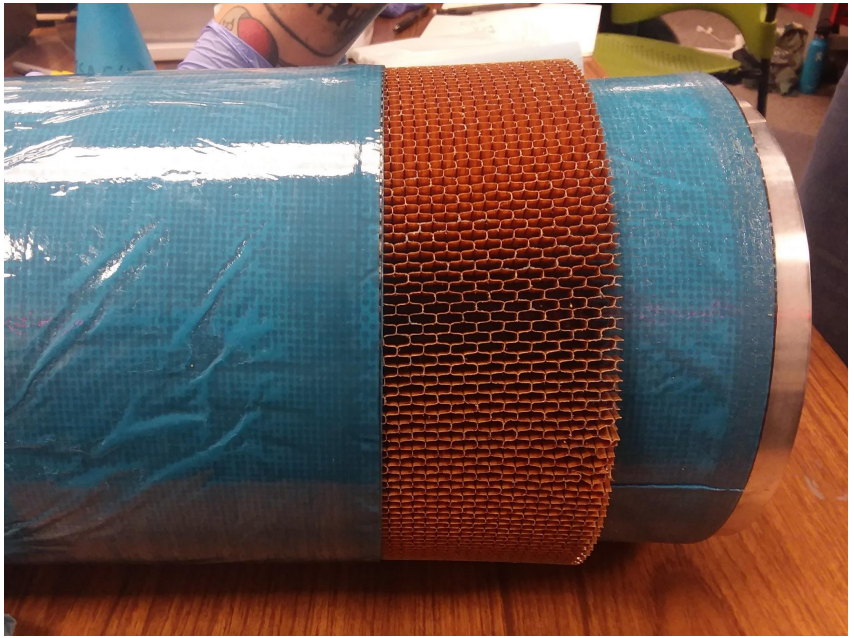
May 2018: Launch 13.1 of LV3.0

- ➔ LV3.0 was a composite airframe demonstrator
- ➔ Flew to ~ 2 km before Rapid Unscheduled Disassembly
- ➔ Formal failure analysis was done; determined failure point was coupling rings, not carbon fiber

LV 3.1 – Upgraded & Simplified for Reliability

➔ Reducing risks of Rapid Unscheduled Disassembly

Newly designed coupling system

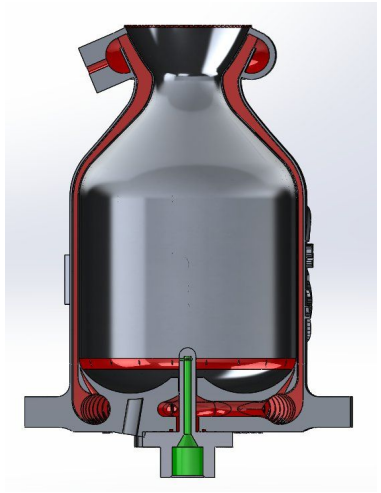


Strengthened module layup process

PSAS Strategic Projects: Liquid Fuel Engine

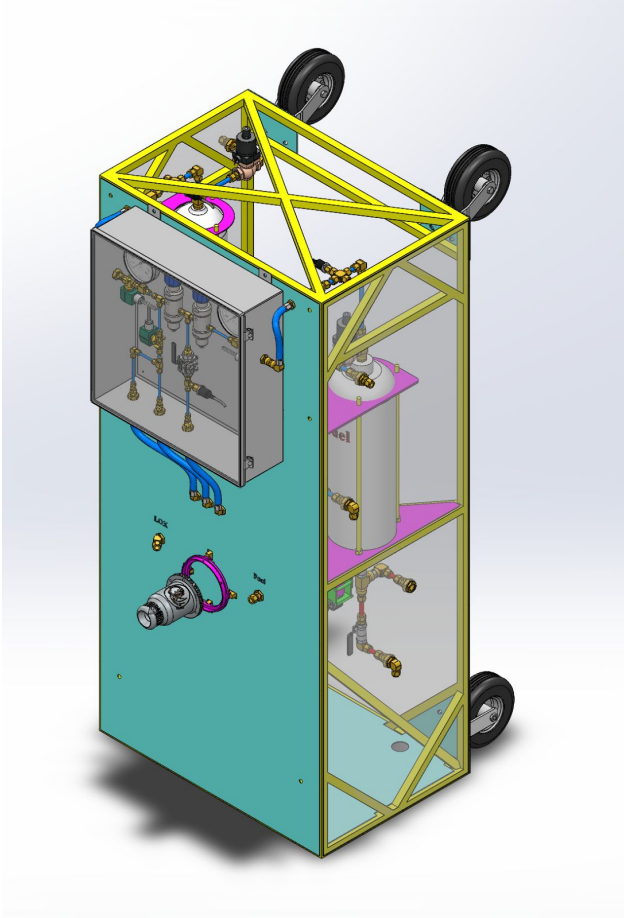
Liquid Fuel Engine

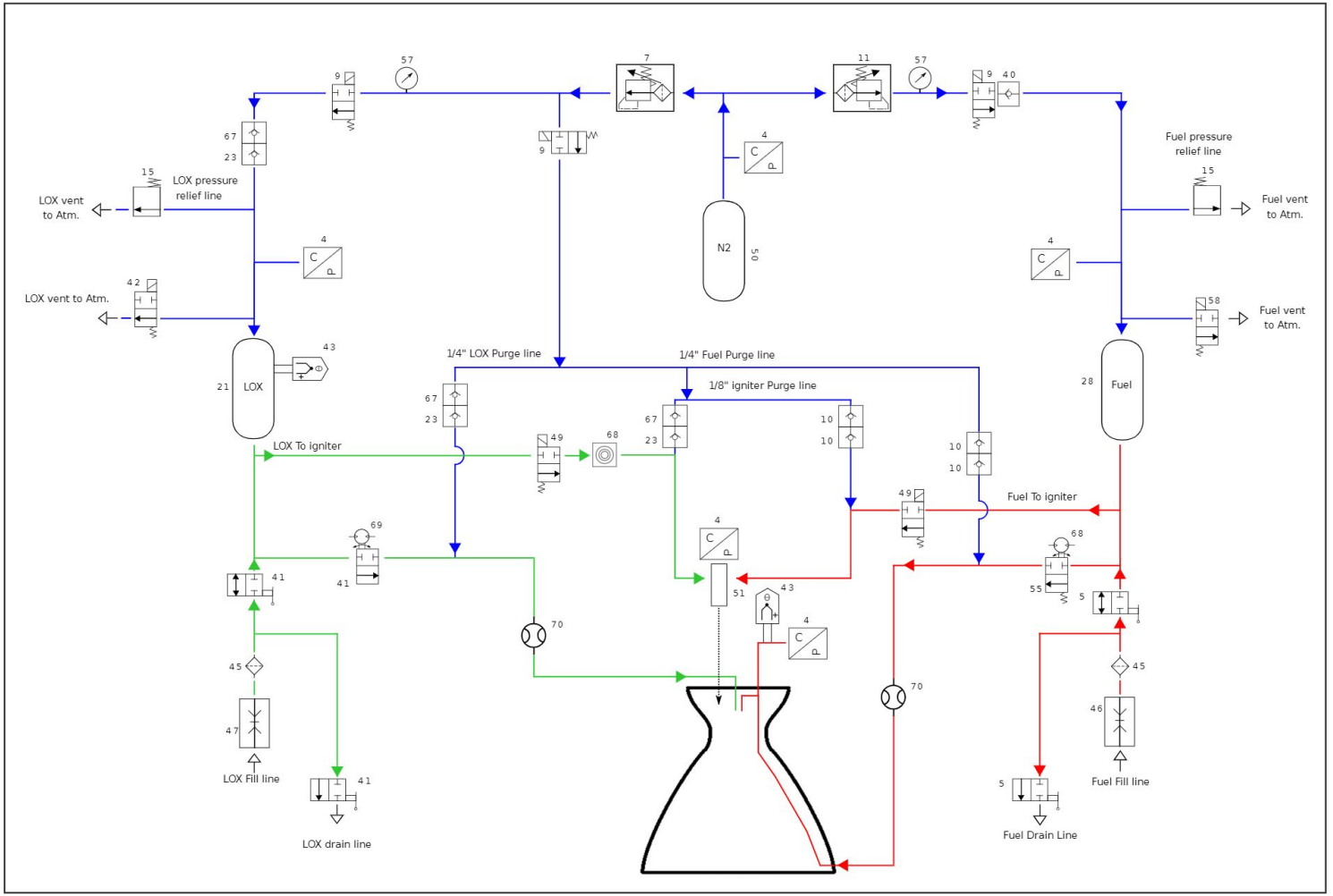
- ➔ Regeneratively cooled prototype engine
- ➔ Procedural Design
- ➔ LOX + Isopropyl alcohol (IPA)
- ➔ DMLS 3D-printed Aluminum



Liquid Fuel Engine Test Stand

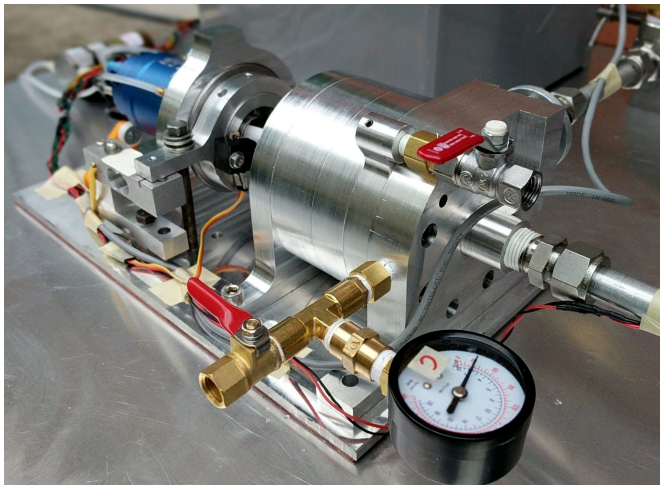
- ➔ Automated testing and demonstration of Hardware including prototype engines and mission critical flight hardware
- ➔ Safety-Centered Power & Control
- ➔ Advanced diagnostic sensing
- ➔ Streamlined remote operation
- ➔ Redundant data collection & transmission

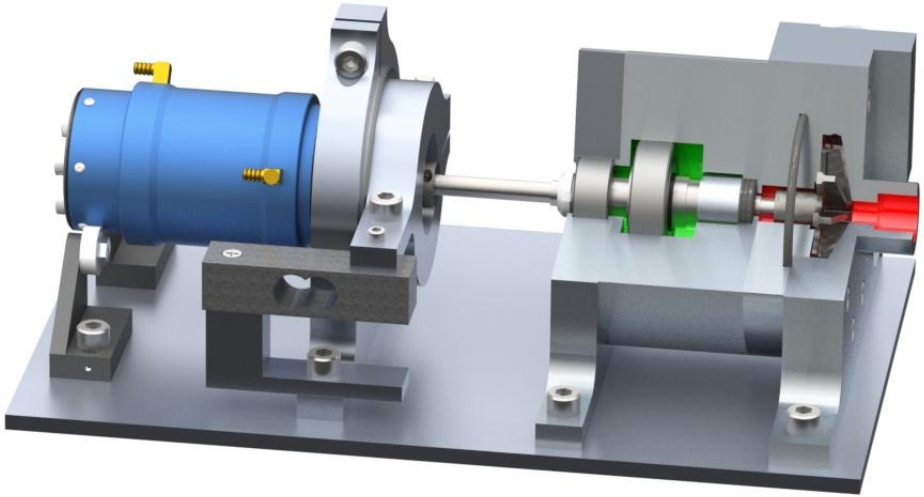



LOX vent to Atm.
LOX pressure relief line
LOX vent to Atm.
LOX
1/4" LOX Purge line
1/4" Fuel Purge line
1/8" igniter Purge line
LOX To igniter
N2
Fuel pressure relief line
Fuel vent to Atm.
Fuel vent to Atm.
Fuel
Fuel To igniter
LOX Fill line
LOX drain line
Fuel Drain Line
Fuel Fill line

Liquid Fuel Engine - Electric Feed System (EFS)

- ➔ Supplies Fuel and Oxidizer using lower head pressures
- ➔ Reduce mass of pressurant containers
- ➔ Have functioning prototype
- ➔ Future LOX capable, twin turbine design for Base 11





Liquid Fuel Engine - Projects

- ➔ Pintle Injector Testing
- ➔ Augmented Spark Torch Igniter
- ➔ Venturi Flowmeter
- ➔ Capacitive Sense Propellant and fuel sensor
- ➔ Pressurant Diffuser
- ➔ Carbon Composite Cryogenic Fuel Tanks
- ➔ LOX-Safe Inductive Rotary Encoder (Valves/actuators/etc..)

Pulling it all together: Base 11 Challenge

University XPRIZE Competition

- ➔ Launch a liquid-bipropellant, single-stage rocket to 100 kilometers within 3 years
- ➔ $1M+ potential prize money
- ➔ Industry-level safety and best practices training

How could we not?

- Basically, the jerks stole our space race
  - *We were doing this before it was cool*
- Possible cash sub-prizes for technical content
- Establish launch vehicle talent pipeline to commercial space companies
  - *Blue Origin, SpaceX, etc.*

MCECS & PSAS!

PSU’s Organic Student Space Program

- ➔ With rocket, space and ground operations, PSAS will be an integrated space program.
- ➔ We are interdisciplinary, but we aren’t fully acknowledged by the departments with students directly benefiting from this program.
- ➔ Can the Dean's office help grease the wheels for us?

What we bring to MCECS

- ➔ Safety critical, real-world interdisciplinary project experience
  - ◆ *Hands-on experience with classroom theory*
  - ◆ *Strongly emphasized in PSAS; multidisciplinary optimization is our middle name*
- ➔ Combining students from other PSU colleges (CLAS, B School)
- ➔ Over 10 industry advisors who share knowledge and skills with students
- ➔ Leg up on: Scholarships, internships, and jobs
- ➔ HUGE PR value and publicity at major STEM events
  - ◆ *1,000s presented to at the OMSI Mini-Maker Faire, Oregon International Air Show*
  - ◆ *Public presentations: OMSI Science Pub, IPA for IPA fundraiser, etc.*

What We Need From MCECS

- ➔ Base 11 sponsorship (support letter) from the Dean's Office
- ➔ Required Insurance: ~ $2000/yr? More? Waiting on PSU Risk Mgmt
- ➔ Engineering student groups are cut-off from PSU SALP funding
  - ◆ *Scholarships?*
  - ◆ *Work study?*
  - ◆ *Operating budget?*
- ➔ Support with fundraising from local industry (we love Kristen!)
- ➔ Support with PR

Questions?

2017-2018 Group Accomplishments

- ➔ Recognized as an official branch of AIAA
- ➔ Tabled at Daimler Days, Techfest NW
- ➔ Participated at Oregon Technology Awards
- ➔ Held successful “IPA for IPA” fundraiser ($1500 raised)

DAIMLER

TECHNOLOGY ASSOCIATION OF OREGON

TECHFESTNW

OreSat

Oregon's First Satellite!

➔ What should we highlight as main OreSat achievements of 2017-18?

AIAA

NATIONAL SPACE GRANT NASA OREGON

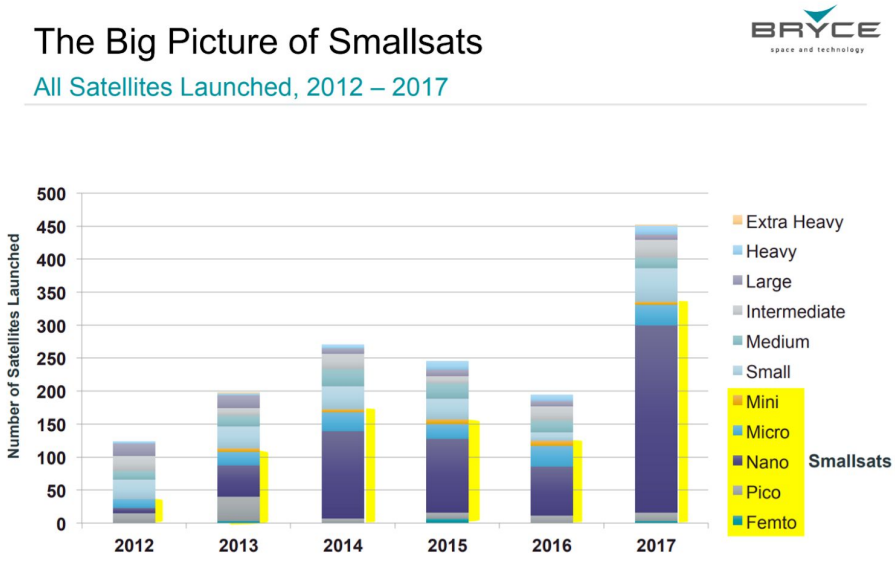
OSH Park
An electric ecosystem

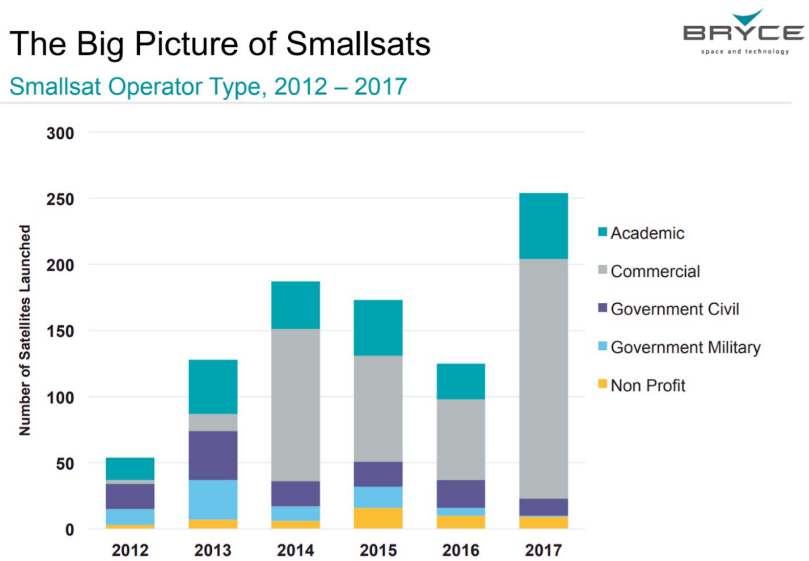
IEEE

ALTA DEVICES
A Hanergy Company

Growth of the Commercial Space Industry

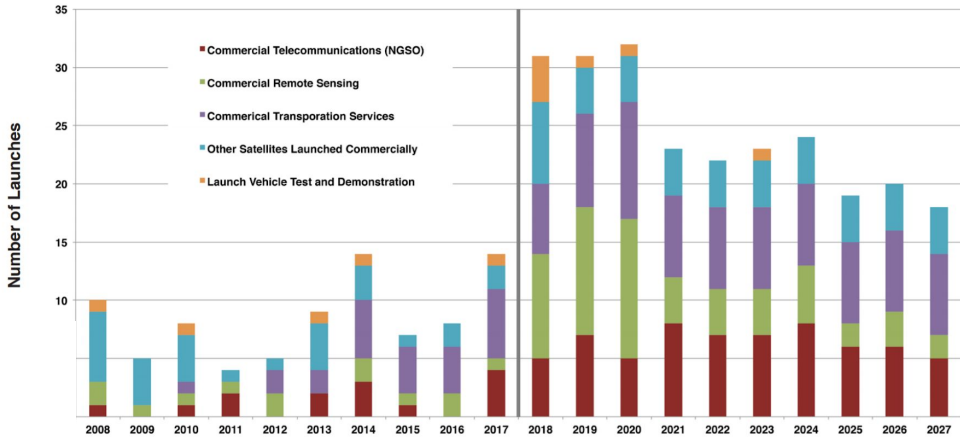
- ➔ 2017 satellite deployments 2X 2016 numbers
- ➔ Share of smallsats in that total: >2x 2016 numbers





Growth of Industry

➔ Satellite deployments have jumped with the increase of launch providers in 2017-18



gure 13. NGSO historical launches and launch forecast.

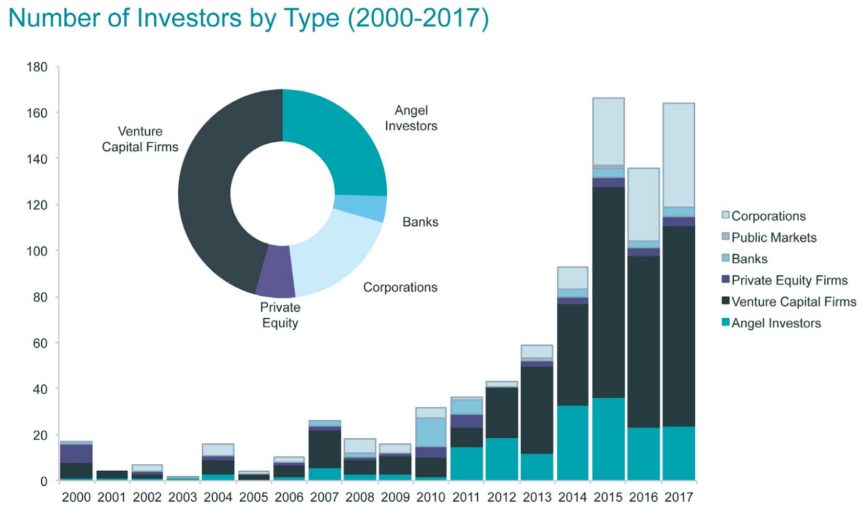


Figure 12. The mix of investors in space companies varies year to year.

➔ Private investment in the commercial space sector has jumped correspondingly