High Altitude Launch Services for Demonstration Nano-Satellites

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10th ANNUAL CUBESAT DEVELOPERS' WORKSHOP
April 24-26, 2013

Cal Poly College of Engineering
San Luis Obispo, CA

25 April 2012

HALS Based on P-18 Test Vehicle

- Originally developed and flown under IRAD funding
- Re-Configured to Provide High Altitude Launch Services for NASA Launch Services Program for CubeSat payloads

05 Mar 2011

16 Apr 2011

20 Aug 2011

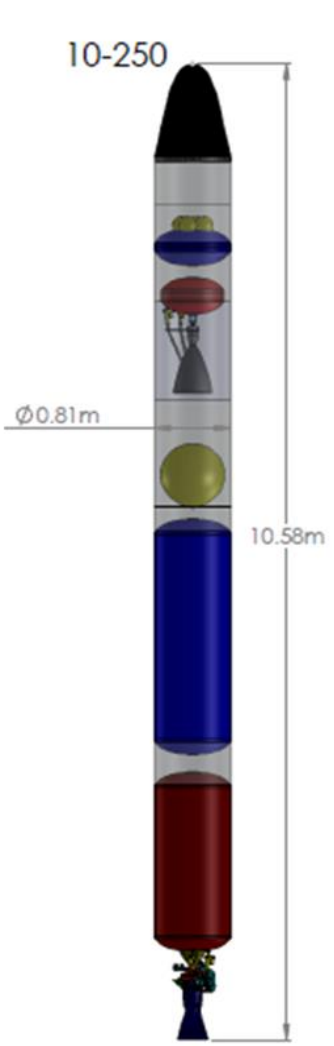
08 Dec 2012

Nanosat Launch Vehicle Development Plan

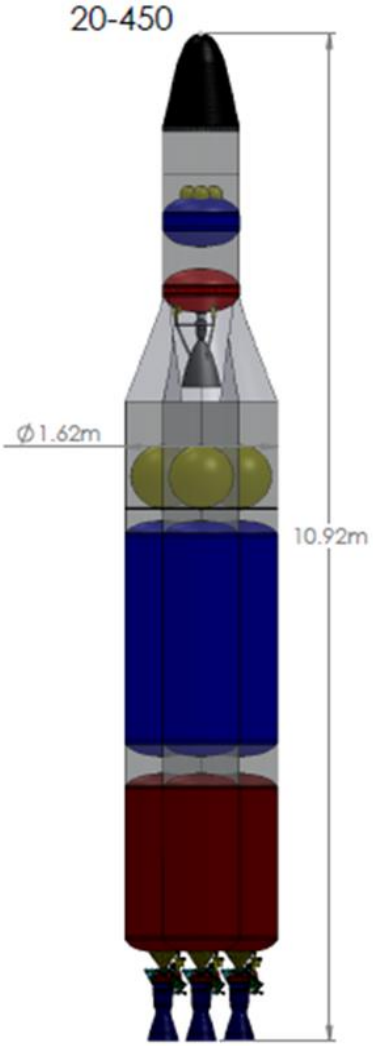
P-9

P-18

P-K/P-19

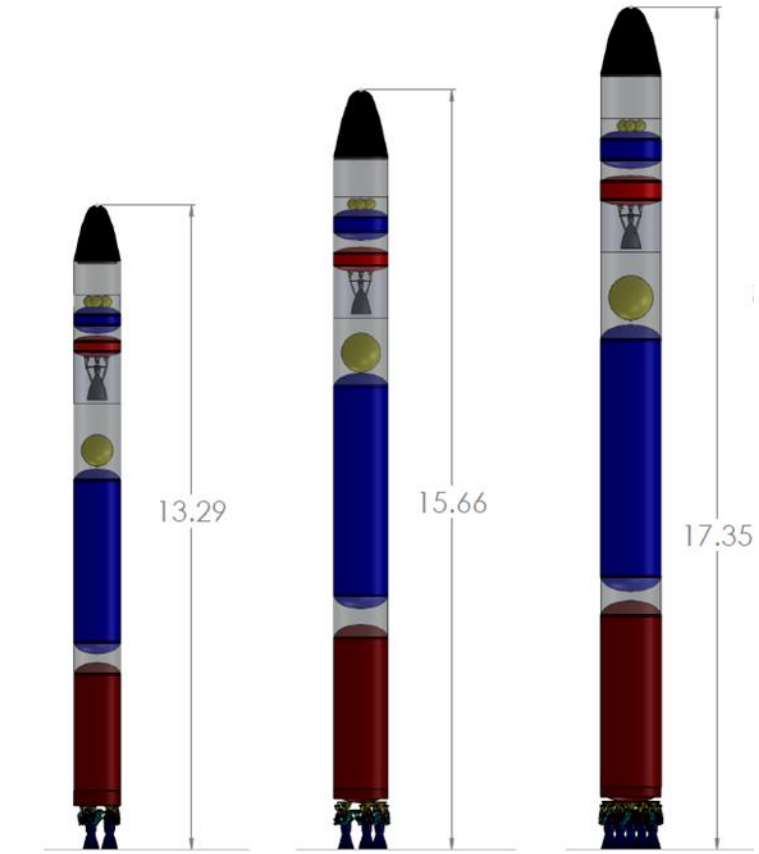


10 kg / 250 km NLV



20 kg / 450 km NLV

Microsat Launch Vehicle Development Plan



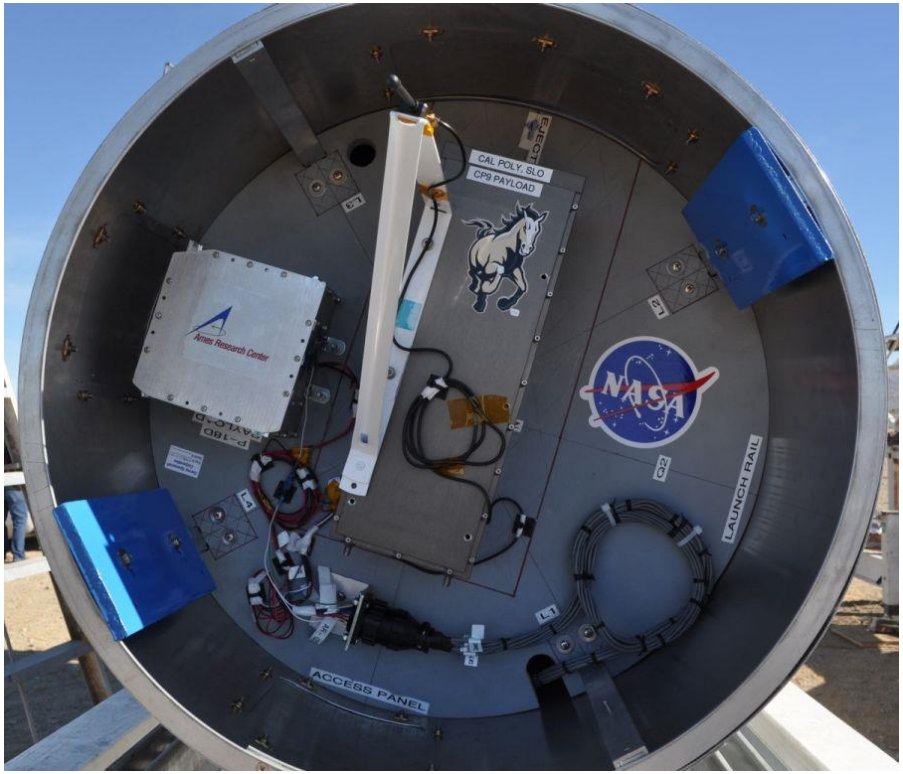
20 kg / 450 km NLV

45 kg / 450 km NLV

60 kg / 450 km NLV

HALS Mission 1 Team

Provide Suborbital Flights for CubeSat Developers



Launch 1 Include Payloads from NASA Ames, Cal Poly SLO, CSULB

Still Refining Parachute Recovery

Question going forward – do we invest in GPS-guided parachute system versus enhanced performance?

CP SLO Payload Team

Before and After

Leveraged Operations Associated with Continued Flight Test Support to ORBITEC for their Vortex Engine

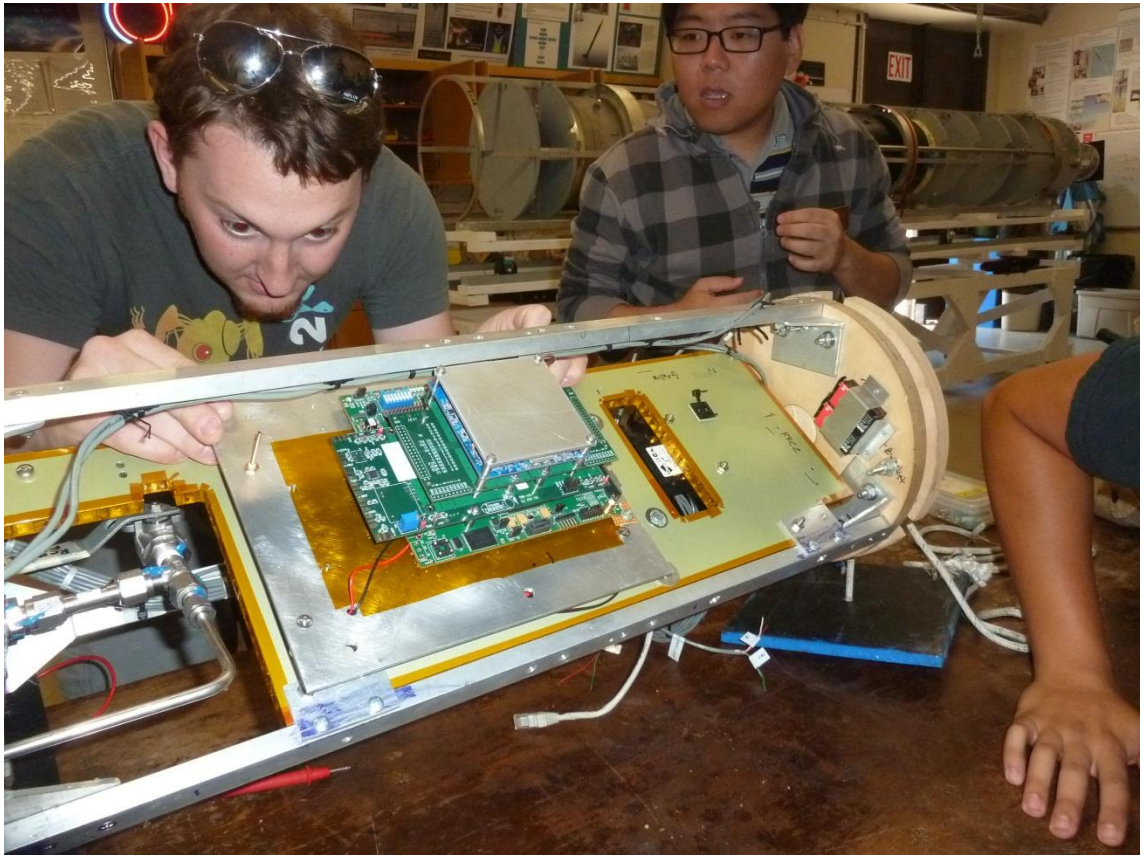
24 Sep 2011

20 Oct 2012

NLV Second Stage
- Pursue TVC -

- teamed with Millennium Space Systems to upgrade existing test vehicle, Prospector 3

Integrated S-Band Transceiver Payload from TUI in Less than Three Weeks After Initial Telecon

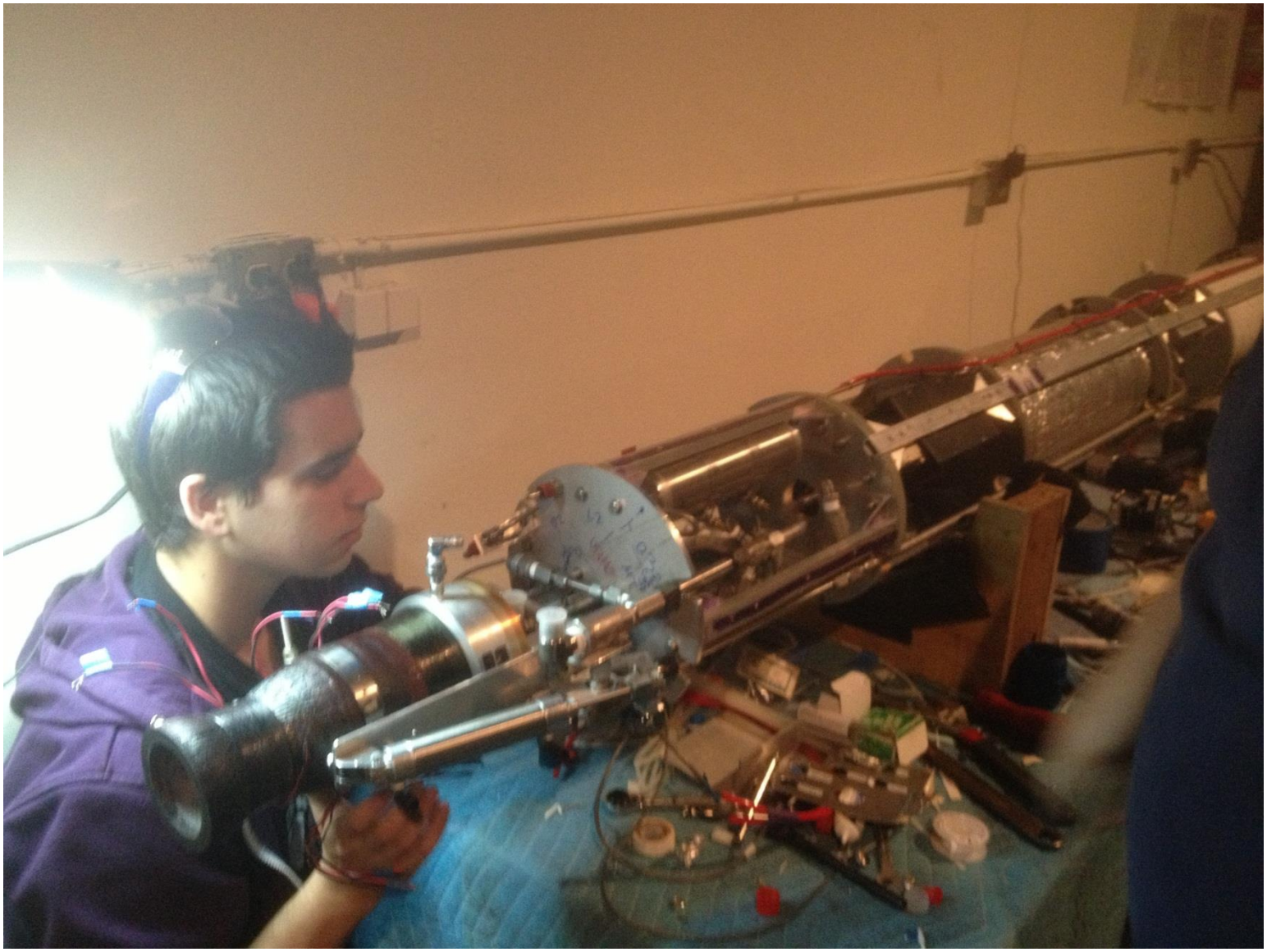


Refurbished Again Into P-3C Configuration Under NASA LSP Project

- LOX/propylene propulsion, with engine featuring HyperTherm's C/SiC-lined ablative chamber
  - to demonstrate TRL=6 for the chamber
  - leveraged original chamber development by HT and CSULB, with GSC test support, under NASA STTR
- also teamed with Long Beach Unified School District (LBUSD) to continue providing STEM opportunities
  - California Academy of Math and Sciences
  - Cabrillo High School

Applying STEM processes originally developed working with CSULB

Student Intern Integrating New Gimbal Assembly

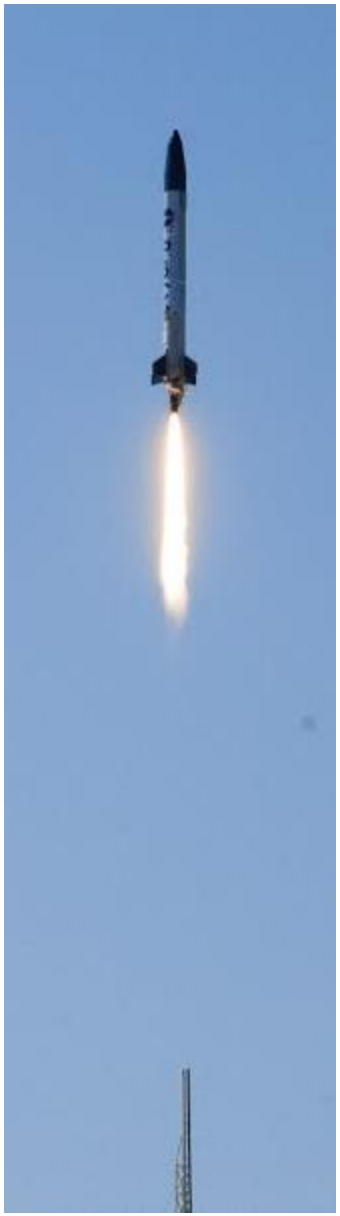


P-3C Lift Off

Saturday, 20 April 2013

FAR Test Site

Successful LOX/Propylene Test



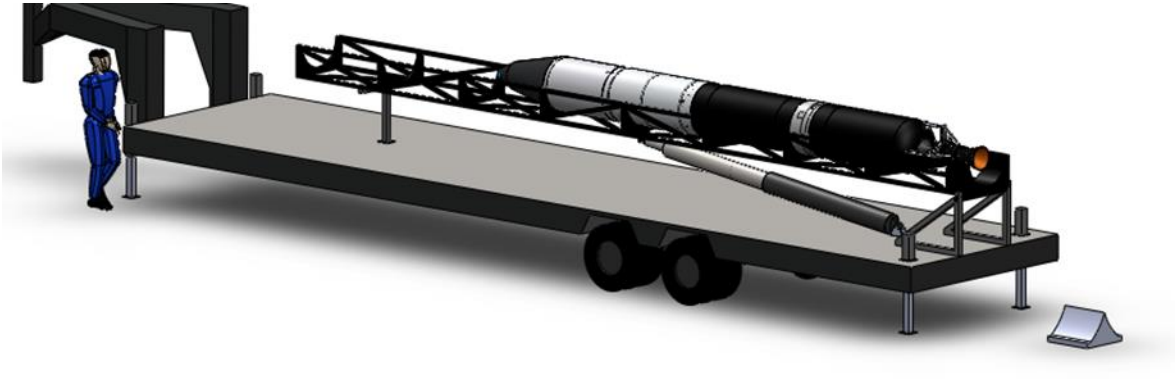
Good Recovery Means More Testing

Student Intern Data Logger Experiment

Next Steps

- Projects
  - P-3C TVC static fire test
  - HALS - P-18D flight 5 / launch 2
  - additional HALS missions (TBD)
  - Gear up for P-19 development under new NASA Phase I SBIR
- Technology Priorities
  - thrust vector control
  - continue transition to LOX/propylene
  - spark igniter ignition
  - pressurization
  - stage separation
  - flight avionics
- Transporter-Erector-Launcher (TEL)
- Launch Sites Ops for High Altitude Flights

Moving Ahead - TEL Development



Summary

- Significant progress in 2012-13
- Major changes in operations, teaming
- New shop facility
- Growing number of opportunities to manifest CubeSat-class payloads