National Aeronautics and Space Administration

Road to NASA

NASA Ames

June 2nd, 2018

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NASA Employee
Aerospace and System Engineer
TechEdSat Series
ISS SPHERES Lab
Small Spacecraft Payloads & Technologies
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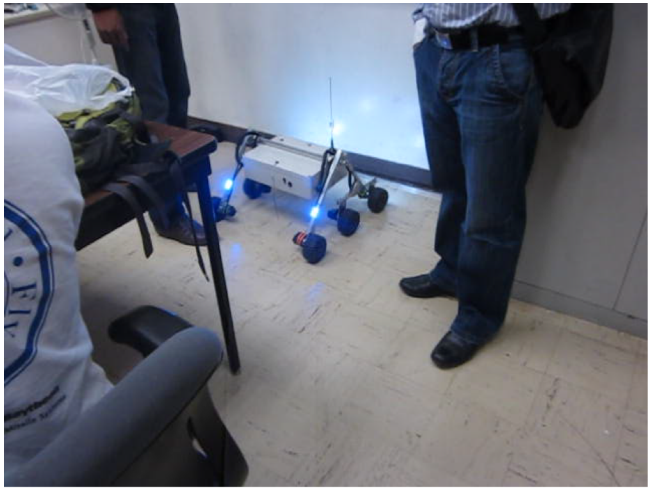
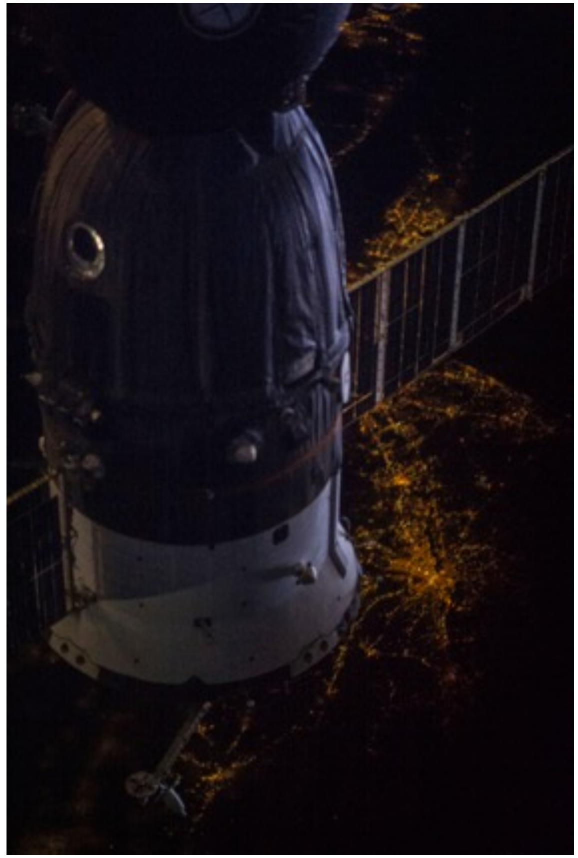
Where I am from and education

the WHEREHOUSE
MUSIC, MOVIES & MORE

An Aerospace Engineer



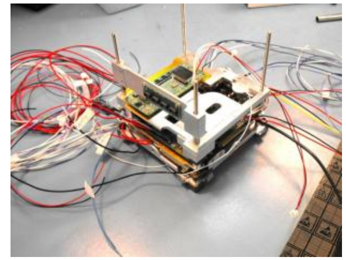
ISS



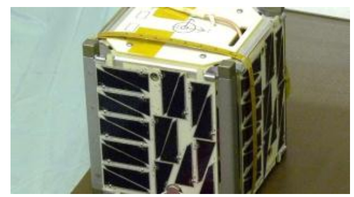
Work at NASA

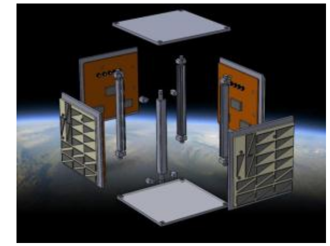
Working in Space

Samantha Cristoforetti

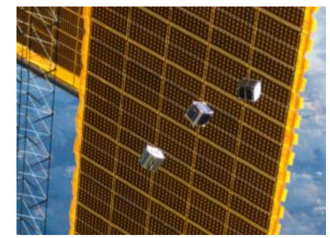


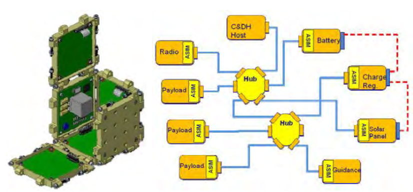
Complex, labor/time intensive





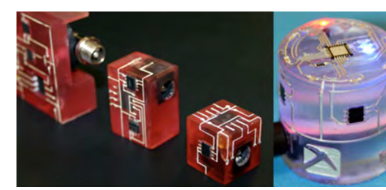
Simple, modular, rapid



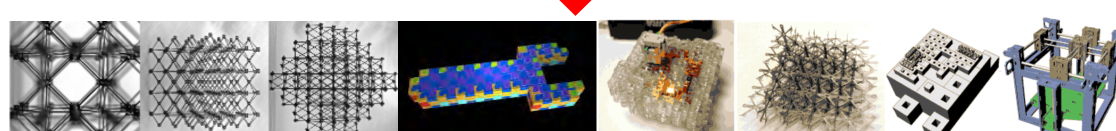


(McNutt ETAL 2009, nano-SPA, AFRL)

(White ETAL 2011, RAMPART)



(Lopes ETAL 2012, COSMIAC, AFRL)

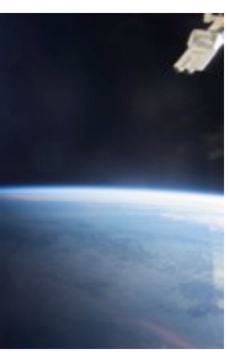


(Cheung ETAL 2013, MIT CBA)

(Ward ETAL 2011, MIT CBA)

Summary

- **Modular "Digital Material" technology for spacecraft subsystems and components to maximize payload volume**
- **Adding assembly capability to the ISS**
- **Numerous Technologies Advanced**
  - Manufacturing
  - Fabrication
  - Assembly
- **Future Work leads to Developing advanced manufacturing technologies that enable the development of more capable and lower-cost space missions and launch vehicles.**



Rodent Research RR

Muscular diseases

Without normal gravity, muscles begin to atrophy with in days after an astronaut reaches orbit.

Osteoporosis

After being in a long stayed at the ISS, astronauts loose bone density.

Each astronaut has to excises 2 hrs and eat food that has calcium and vitamin D

The exercise prevent lost of muscle and bone density

http://www.nasa.gov/sites/default/files/atoms/files/np-2015-03-016-jsc_rodent-iss-mini-book-508.pdf

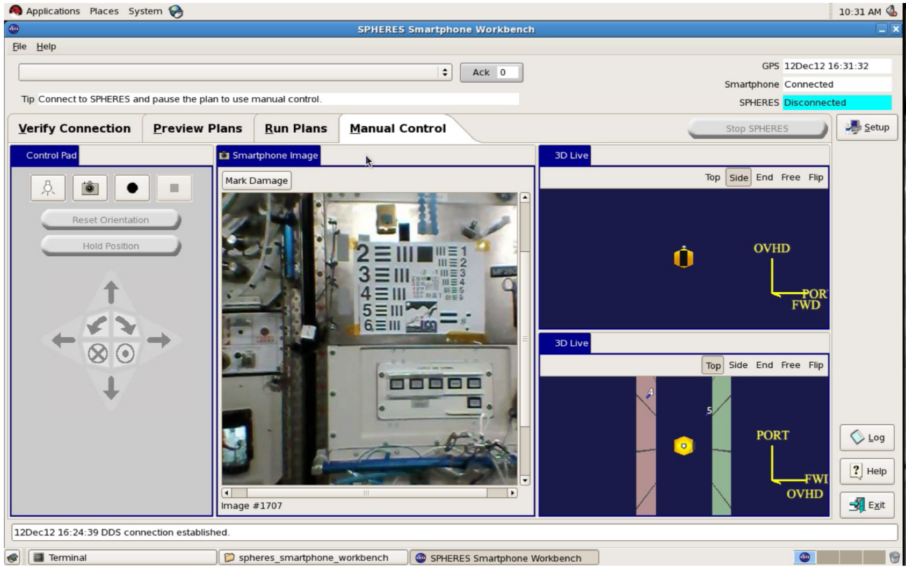
Water re-cycle System

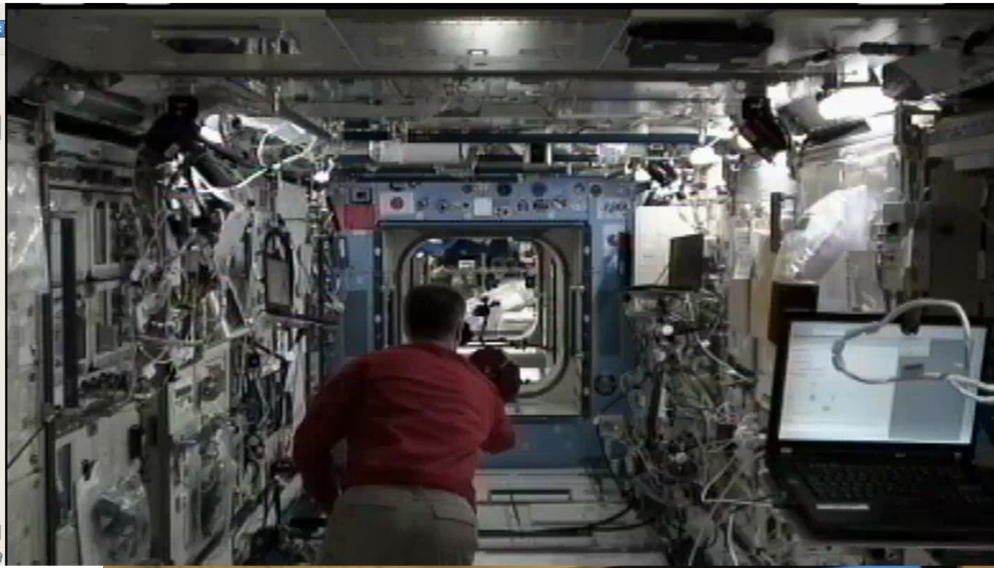
http://www.nasa.gov/mission_pages/station/research/benefits/water_purification.html

http://www.nasa.gov/mission_pages/station/research/benefits/water_filtration

Campañia Concern for Kids (CFK)

SPERES and Robotics



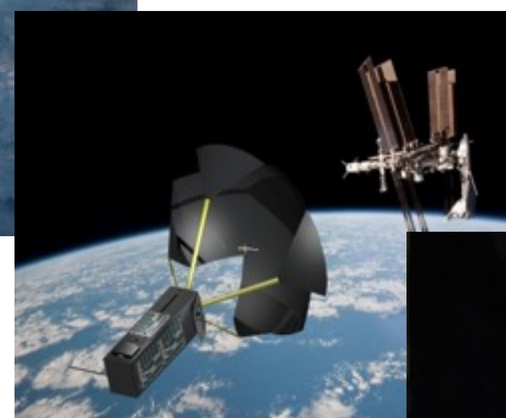


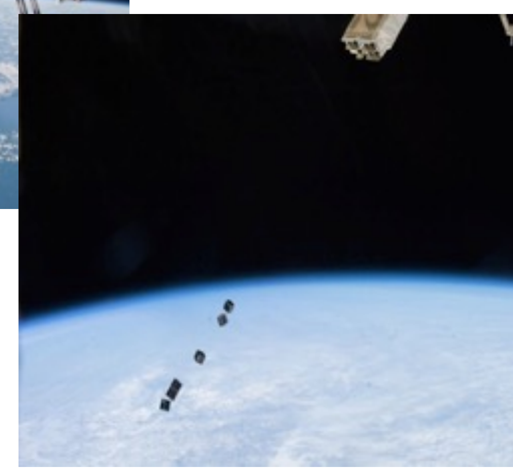
Luke and SPHERES SPHERES at ISS

TechEdSat-N

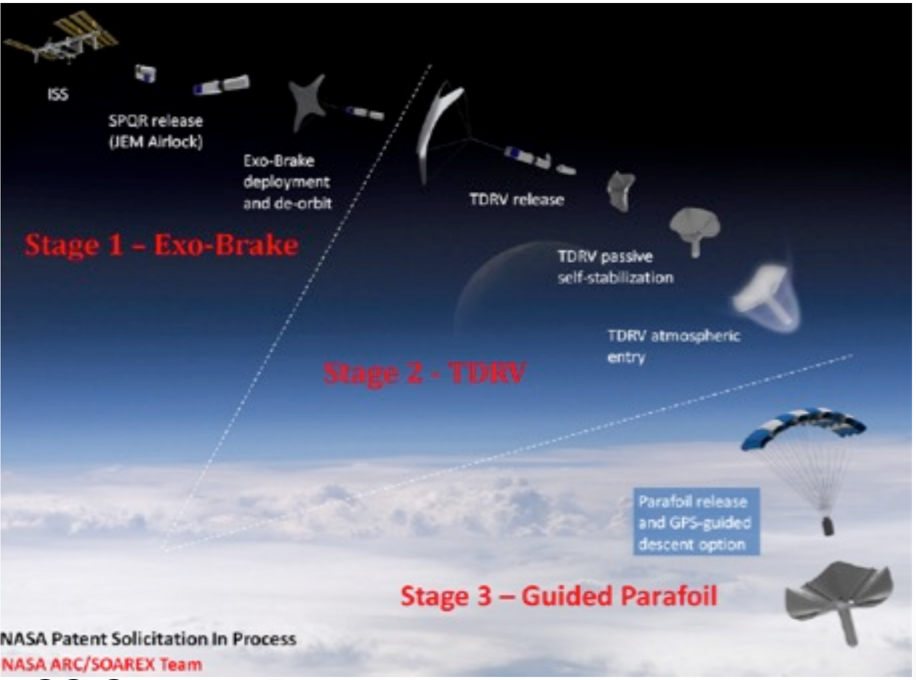
Pioneering the Use of the International Space Station as a Nanosatellite Deployment Platform







Next-Up!



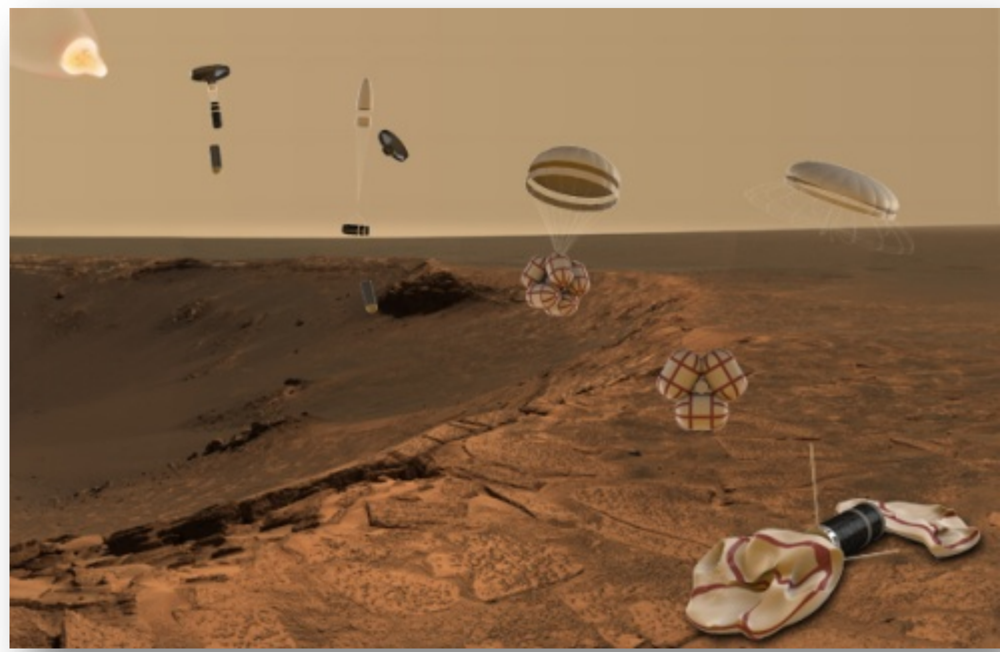
ISS Sample Return

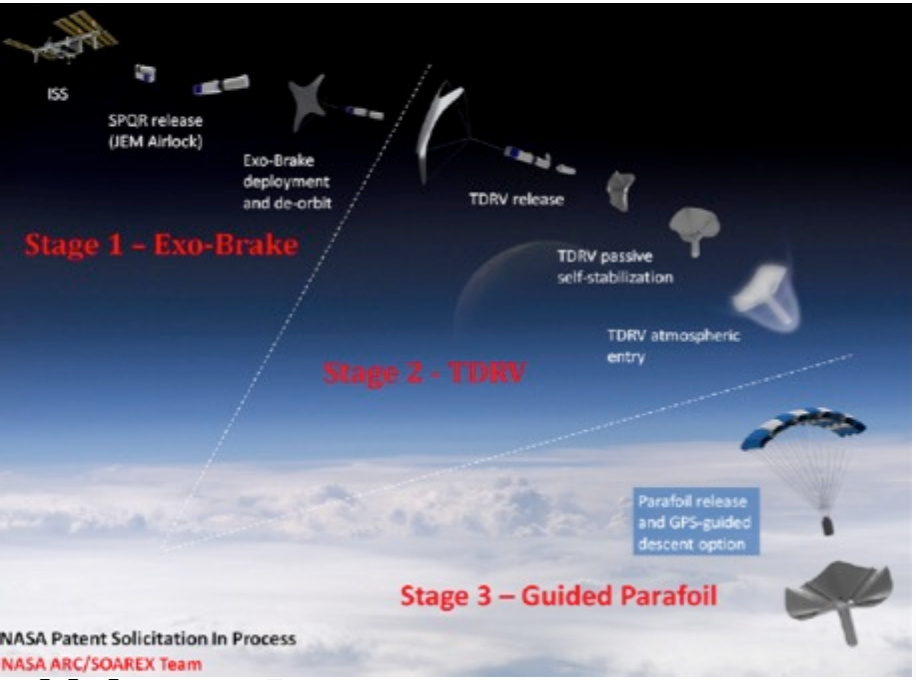
SPQR-Small Payload Quick Return

- **3 stage concept**
- **On-demand sample return**

Atromos: Cubesat Mission to the Surface of Mars

- **Mission Attributes**
- **Self-stabilizing re-entry probe (TDRV-Tube Deployed Re-Entry Vehicle)**
- **EDL Technique for small probes**
- **Nuclear option for mission longevity**





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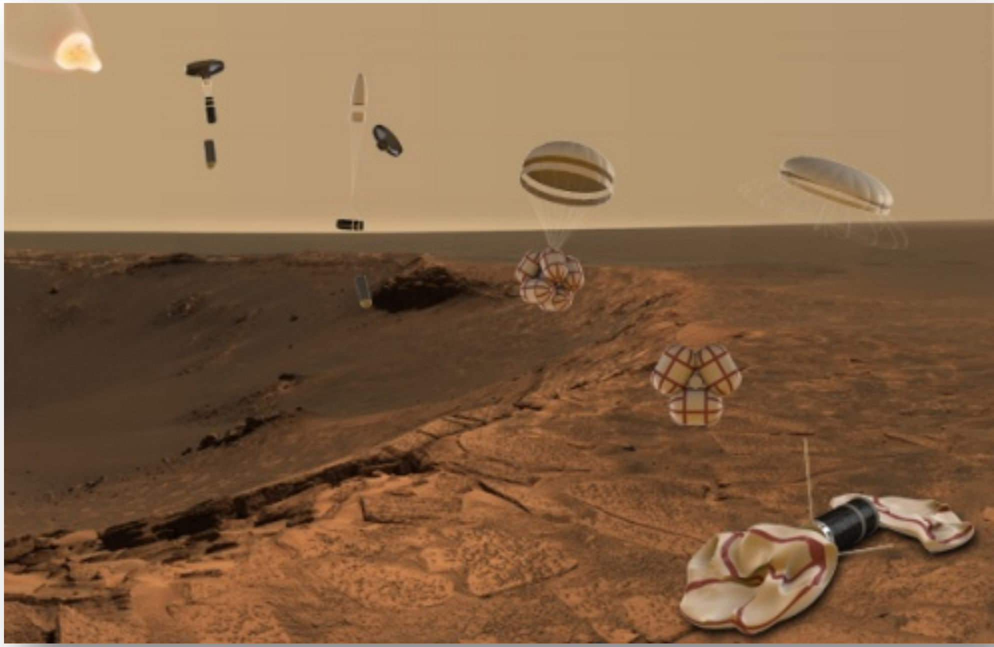
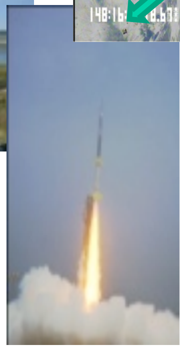
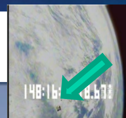


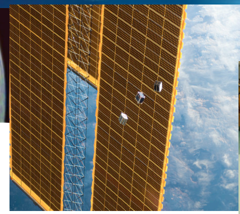
Relevant Flight Experiments TES

SOAREX-6
2008



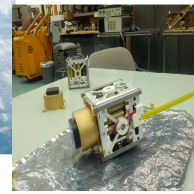
SOAREX-7
2009





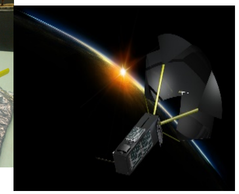
TES-1
Oct 4, 2012

First US Nanosat deployed off ISS
PSRP process mastered
Rad-tolerant processor demo



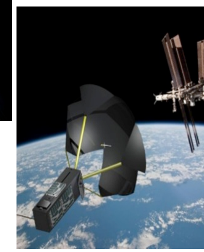
TES-2
Iridium test
Aug 21, 2013

First Iridium in-space COM demonstration



TES-3
Aug 3, 2013
(6 wk deorbit)

Evolution of TES-3
Iridium modem
Uplink/via email demonstrated
Exo-Brake II



TES-4
Mar 3, 2015
(4 wk deorbit)

WSM1, AIM Camera
X-Band, ISM-Band, P5 alpha, ISM-Camera and Full ExoBrake

SOAREX-8 During test (WFF) July 7, 2015

WSM2, AIM Camera
ISM-Band, P5 alpha, ISM-Camera

SOAREX -9 (WFF) March 3, 2016

First US 3U Nanosat deployed off ISS First Exo-Brake test

Modulated Exo-Brake
Improved positional/ target accuracy
Improved Targeting, WSM2, ISM Band

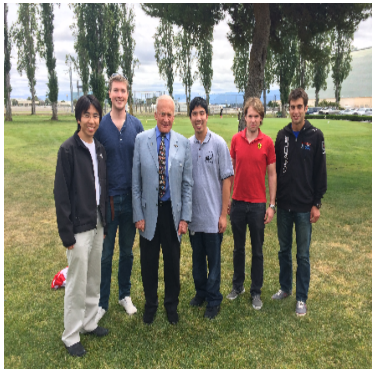
TechEdSat5/ PhoneSat5 Coming up this year!!

Recent Years of Flight Experiments (2008-2015):
6 Flights +1(SOAREX8) +PhoneSats 1-4

…here before

SOAREX/TechEdSat-N Team

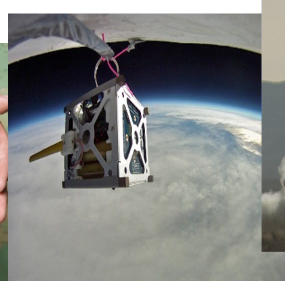
Relevant Flight Experiments PhoneSat



Recent Years of Flight Experiments (2009-2015)

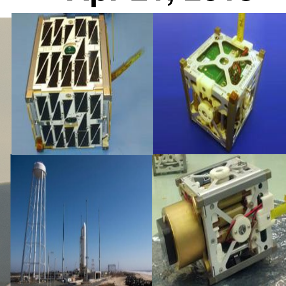
Intimidator-5
July 29, 2010

Balloon
June 9, 2011



SpaceLoft-6
Apr 5, 2012

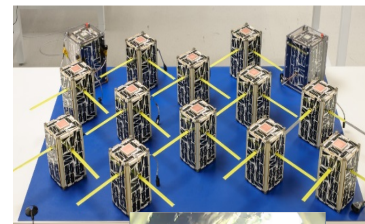
PhoneSat
1a, 1b, 2.0
Antares A-ONE
Apr 21, 2013



PhoneSat 2.4
ORS-3 Minotaur 1
Nov 20, 2013
(still in orbit)

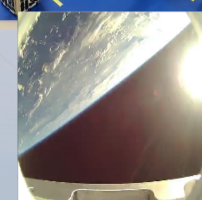
PhoneSat 2.5
CRS-3 Falcon 9
Apr 18, 2014

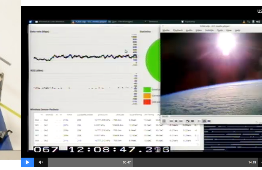
SOAREX-8
Terrier/Black Brant
July 7, 2015



EDSN
Super Strypi
Oct 29, 2015

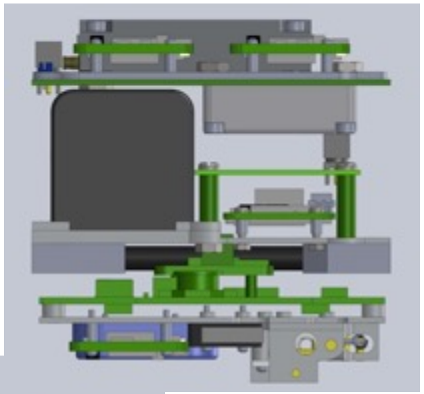
Nodes
Orb-4 Atlas V
Dec 3, 2015

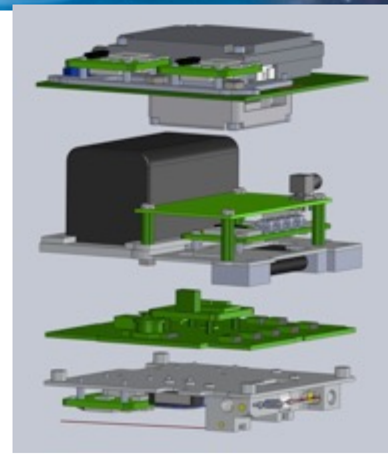


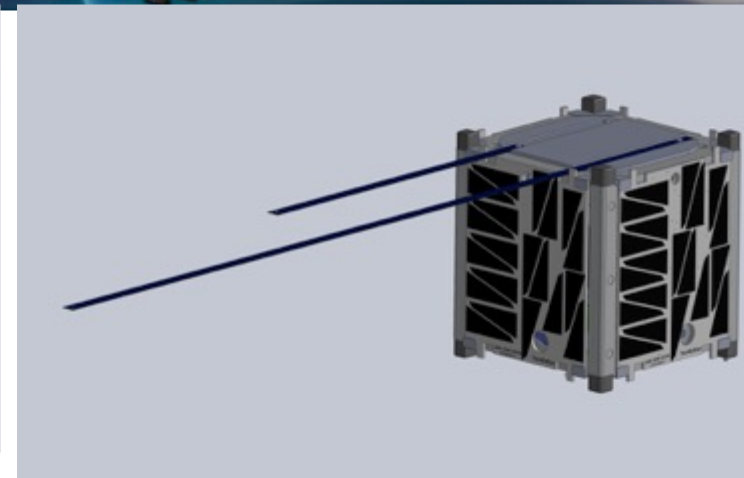


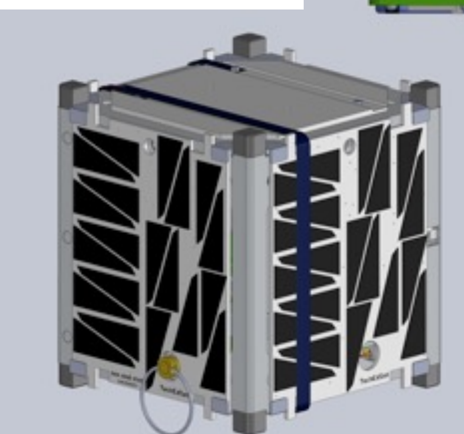
SOAREX-9
(WFF)
March 3, 2016

PhoneSat Team



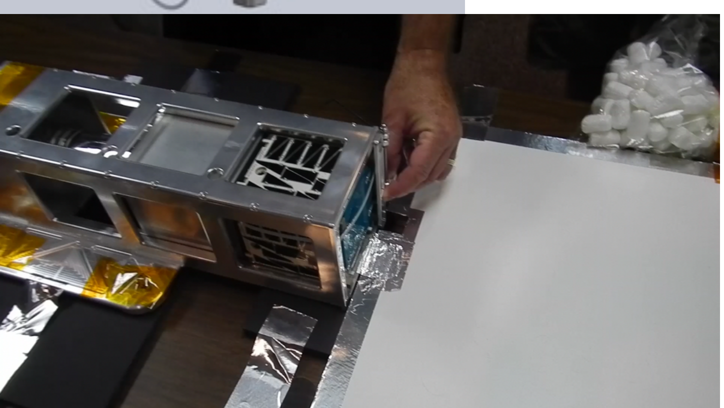


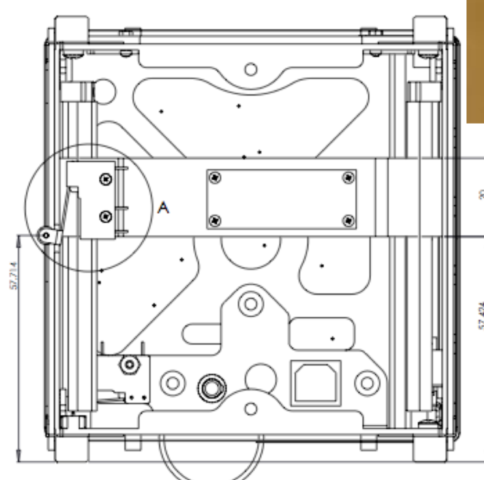




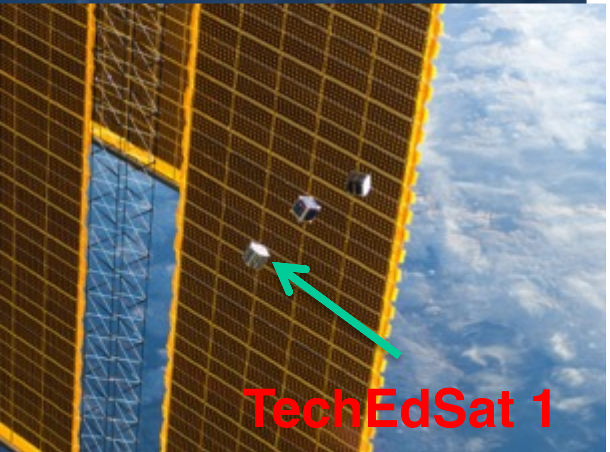
TechEdSat

JSSOD and ISS





Before and after Jettison from ISS

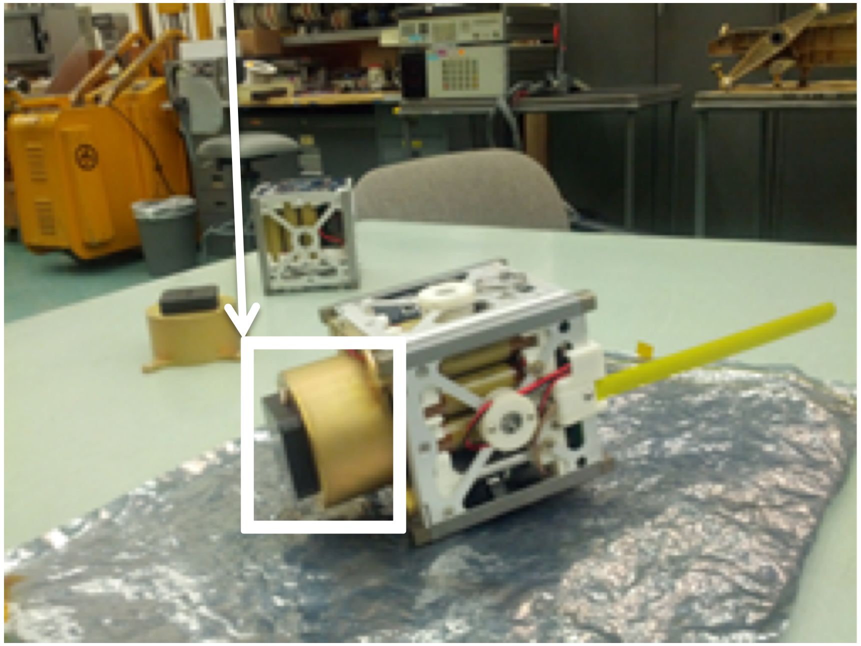


- We were 1st!
- Nominal Success Criteria
- Demonstrated ISS Safety Design for jettison from ISS
- Demonstrated 2-tier RAD-Tolerant Architecture (ÅAC Microtec)
- COM Experiment
  - (UHF, Iridium, OrbComm)
- Launch Date on HTV3 August 14, 2012
- Jettison on October 4, 2012
- ~7 month duration
- Building, tested and certify with in 9 months

Previous Flights: TechEdSat 2

- We were 1st (Antares-1)
- Comprehensive Success Criteria
- Demonstrated COM Experiment
- Launch on April 23, 2013 on Antares-1
- Duration: 24 hrs (by design)
- Attached to the phonesat cubesat

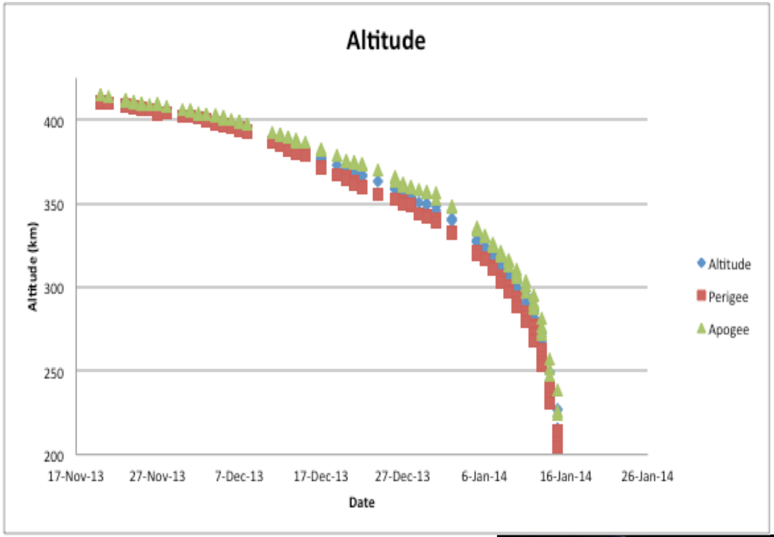
TechEdSat 2

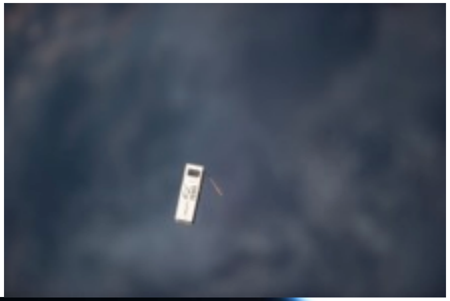


Other Key Contributors: K. Boronowsky, J. Benton, K. Ramus

TechEdSat 3

- We were 1st 3U Jettisoned from ISS
- Nominal Success Criteria
- First Exo-Brake Demonstration
- Advanced Manufacturing
- Comm Experiment II
- Two Tier Architecture
- Launch August 20, 2013 on HTV4
- Jettison on November 23rd, 2014
- Re-entry on January 6, 2014

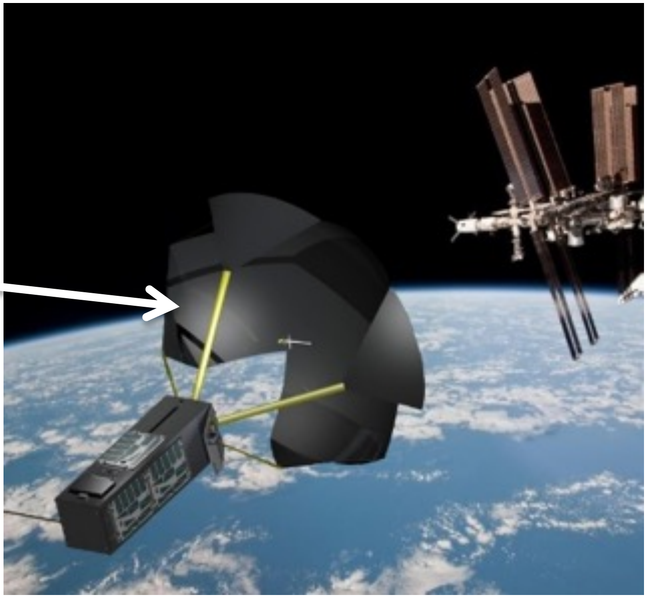


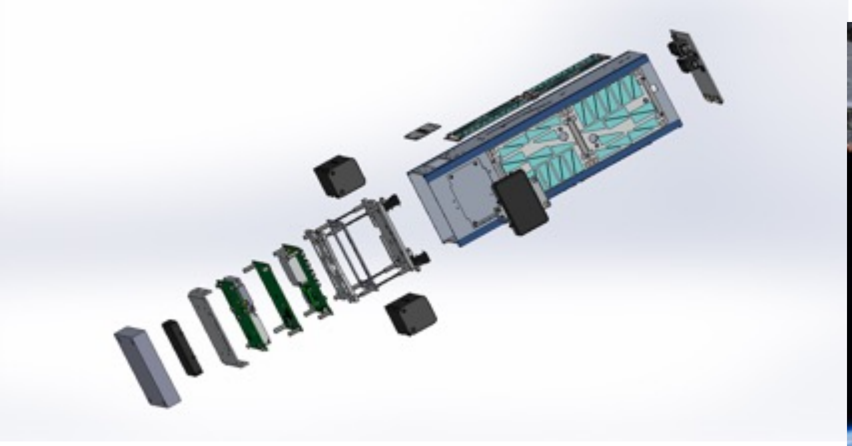


Other Key Contributors: A. Reuter, J. Mojica, M. Scales, J. Benson, J. Seneris.

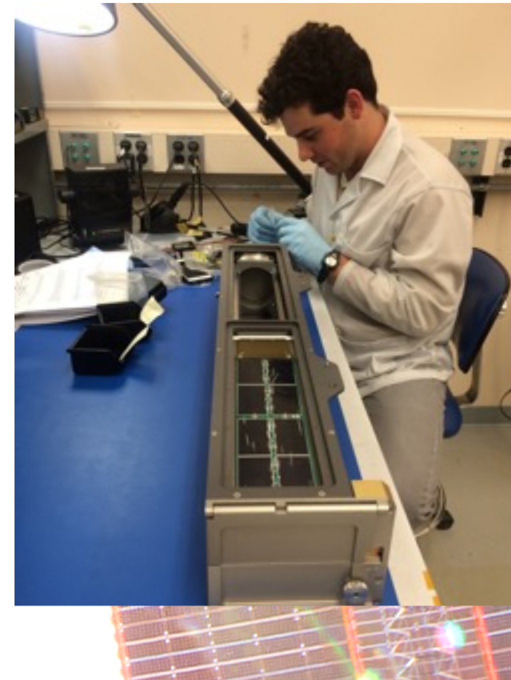
Current Flight: TechEdSat 4

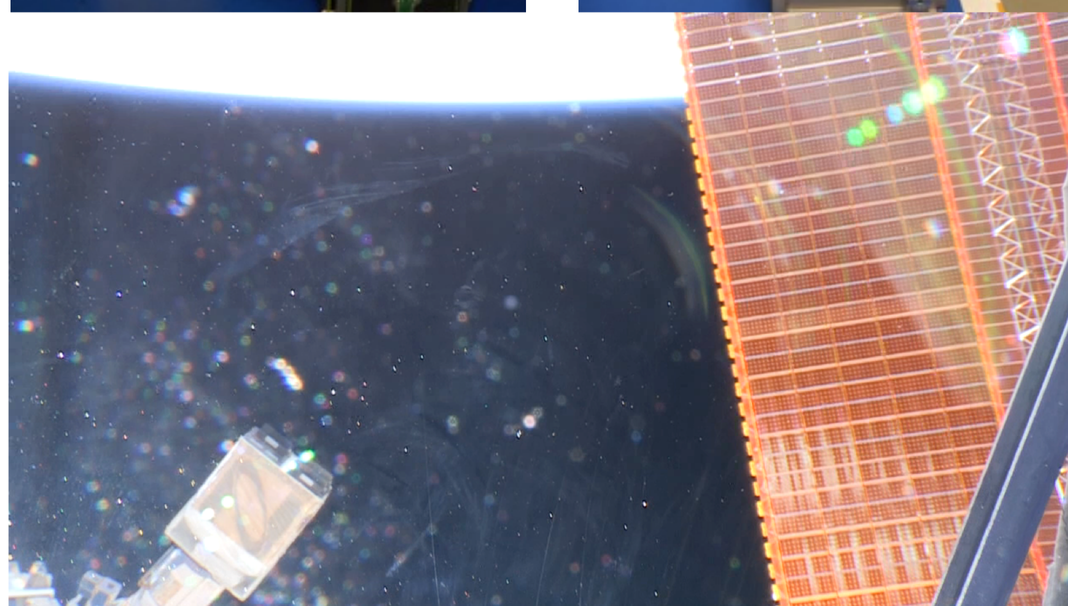
- 1^{st} NASA NanoSatellite 3U Jettisoned from the NRCSD (July 2014)
- Exo-Brake Demonstration
  - β=8kg/m^2
- Advanced Manufacturing
- COM Experiment III + GPS
- Two-tier Architecture
- Build, tested and certify in 6 weeks.

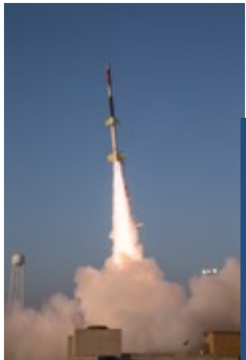


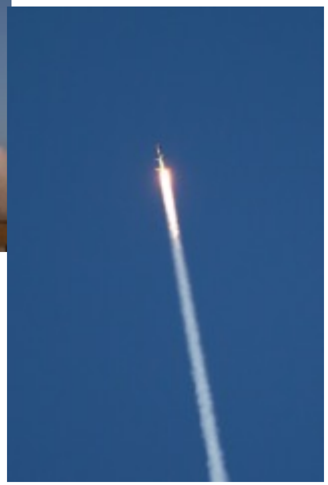


TES X

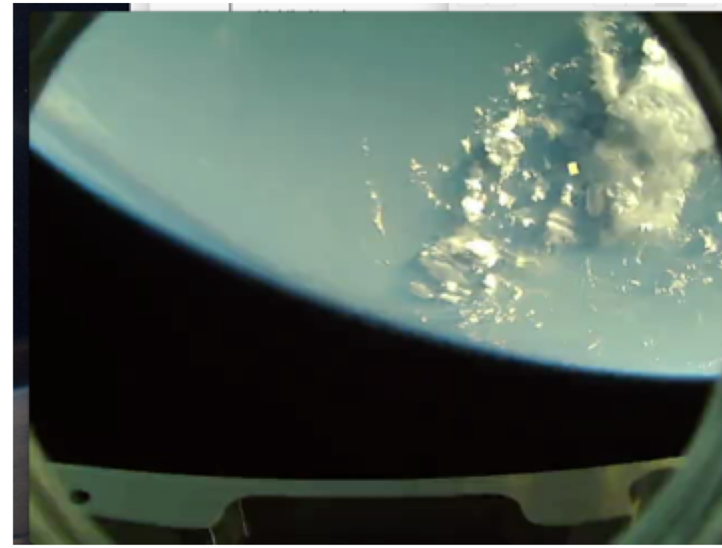




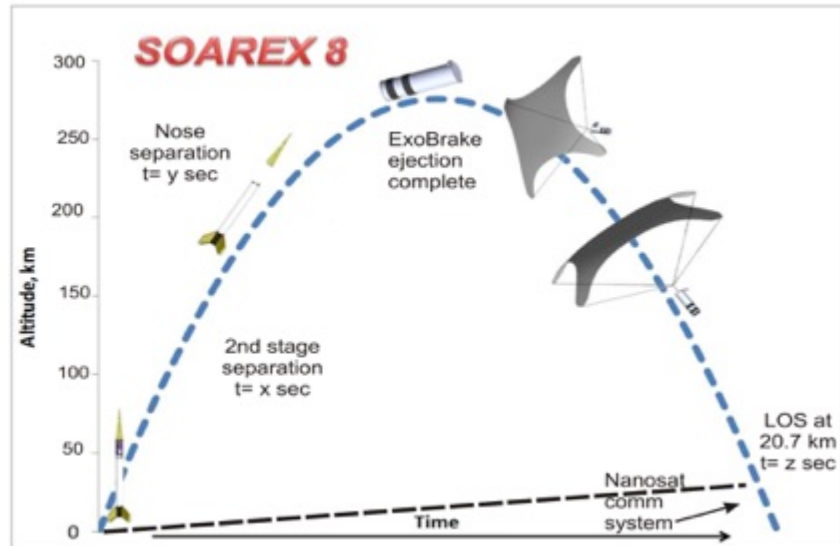


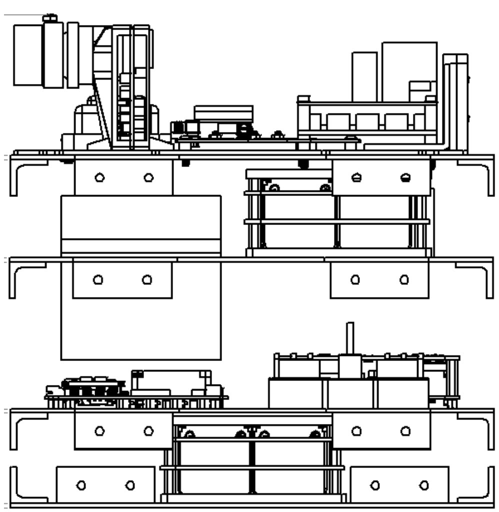


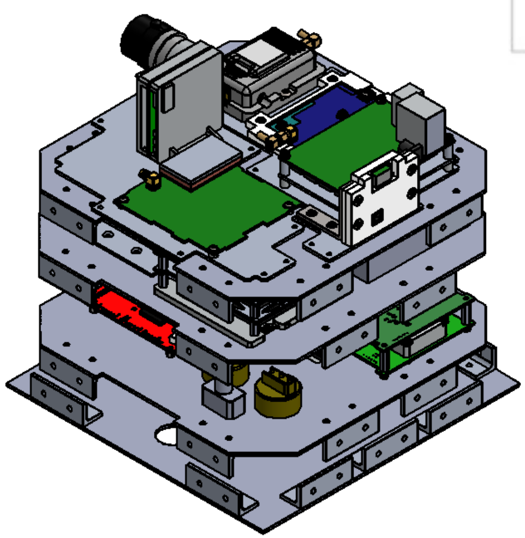
SOAREX-N Sub-Orbital Experiments

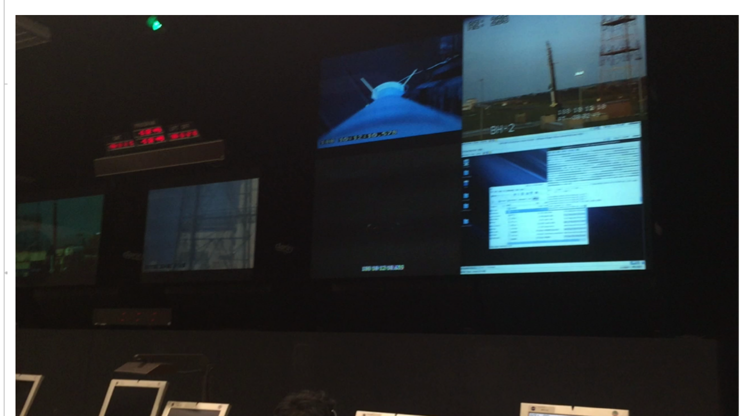


SOAREX 8 Mission



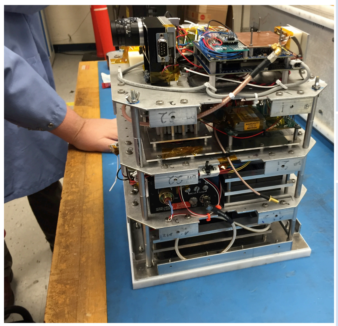


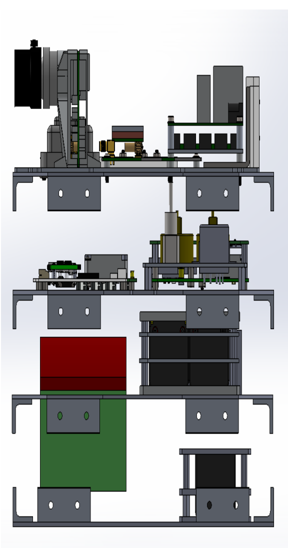




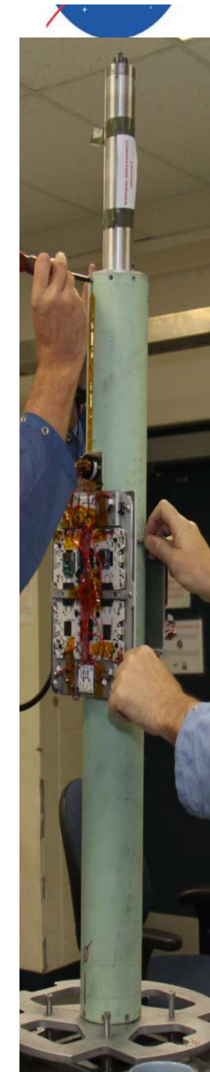
2:42 launch
10:48 EXO-Brake Deployment

SOAREX 8 results of all experiments

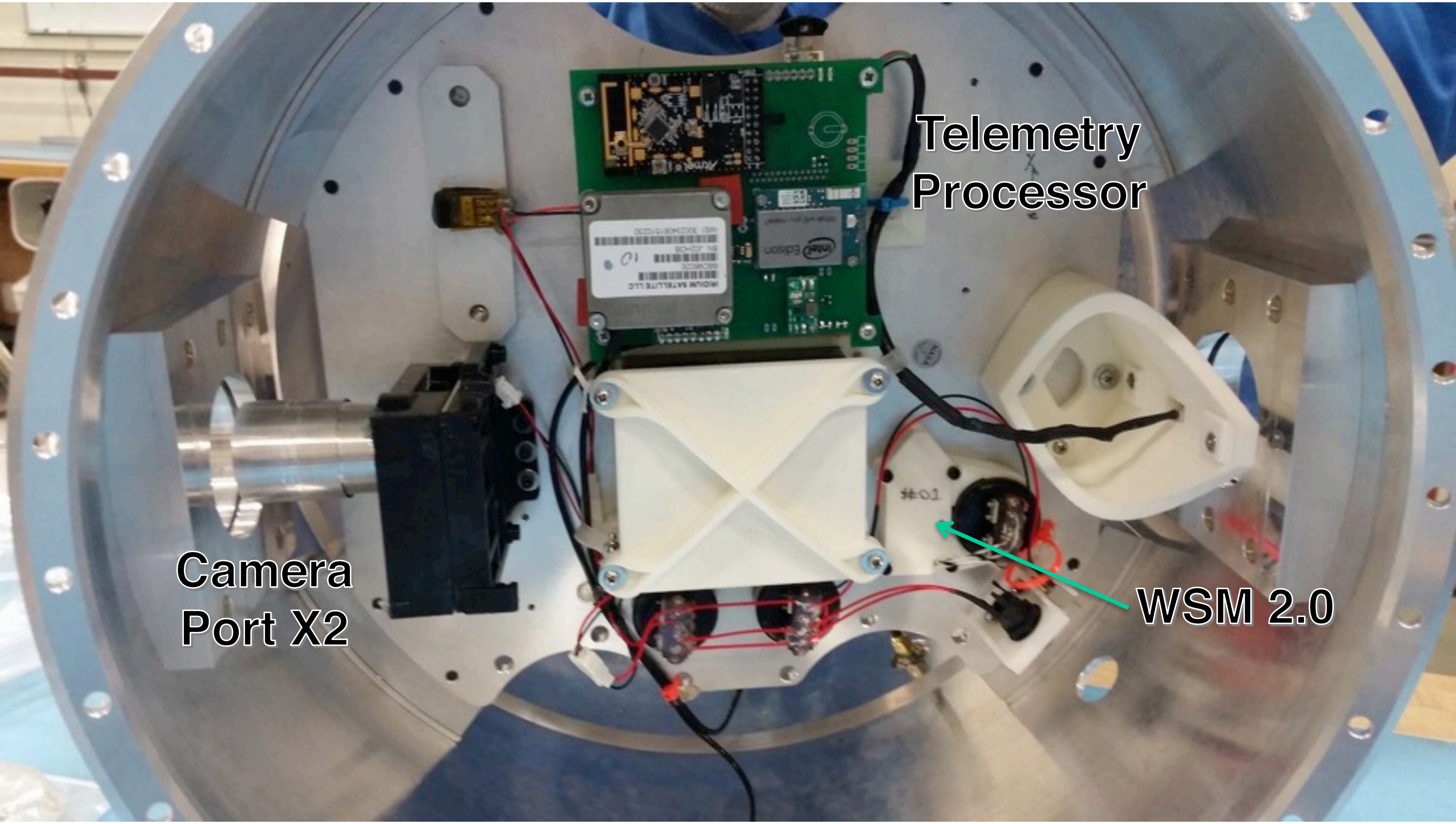




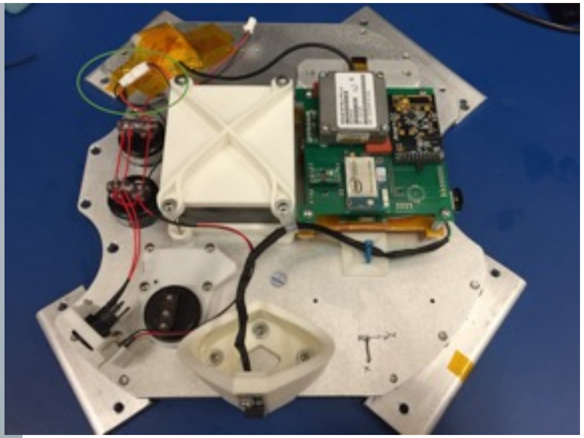
Element	Status	Comment	Applied To Future Project
S-Rocket Deck Battery/PWR (Milwaukee!!) [first time!]	**Worked!** Yes	 Simplifies on-pad Ops/ Interface	Sub-orbitals
C-band	**Worked!**	Independent Tracking	Ubiquitous
Module 1 [first time!] T5 core Irid-1 WSM Coord1	**Worked!** Yes Yes Yes	Robust	TechEdSat5/P5 [COM paradigm for nano-sats]
Module 2 [first time!] P5 Core ISM-Band Camera WSM Coord2	**Worked!** Yes Yes Yes Yes	Robust Dual Irid and Coord	TechEdSat5/P5 [1 Mbs solution- Future NanoSats!]
Module 3 [first time!] X-band NanoSat AIM/Thompson CAM	**Delayed** No No	Late delivery; EDU **Worked on bench!** **NEN failed to track!!**	TechEdSat6/P6 SOAREX-9 [10-50 Mbs solution] Future NanoSats/ Interplanetary COM
NoseCone System [first time!] MRMSS WSM3	**Worked!** Yes Yes	New design; future piggy-back flights (first time)	SOAREX-9
Exo-Brake Deployment [first time!]	**Worked!**	42ft2 pneumatic-aided erection	SPQR Planetary Probes
S8 Box Deployment	**Partial!**	Partial ejection from ejector after apogee; stiction!	SPQR Planetary Probes

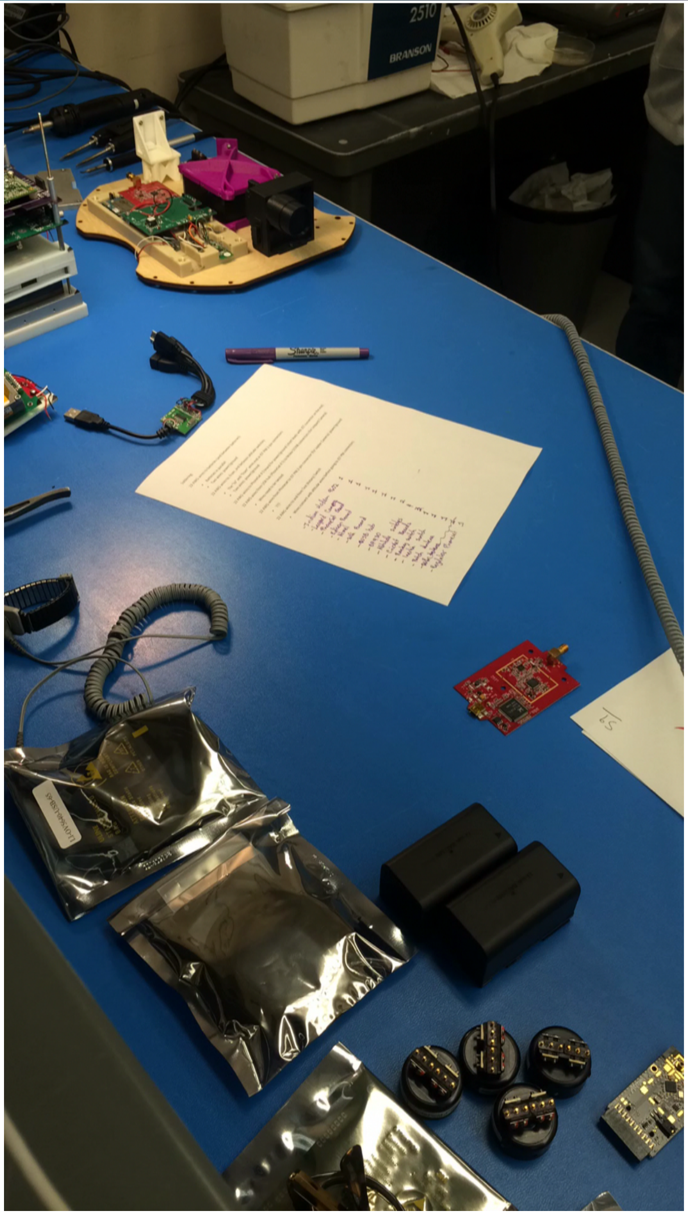


SOAREX-9 Flight Payload

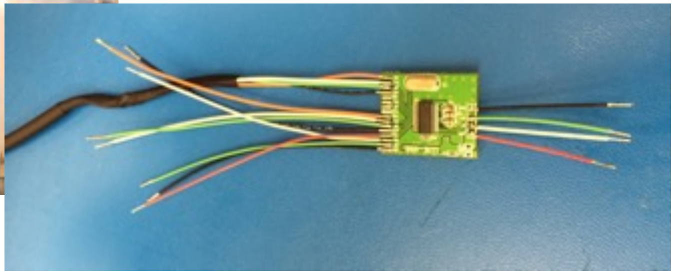


SOAREX 9 Mission

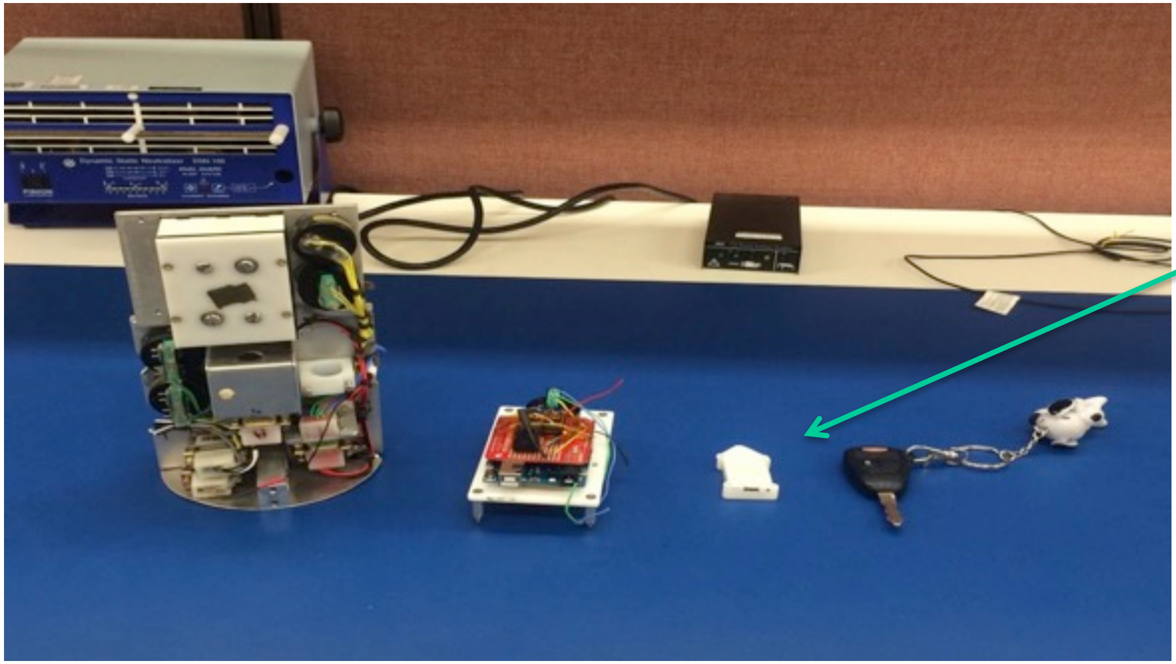




Flight Mission



WSM Experiment



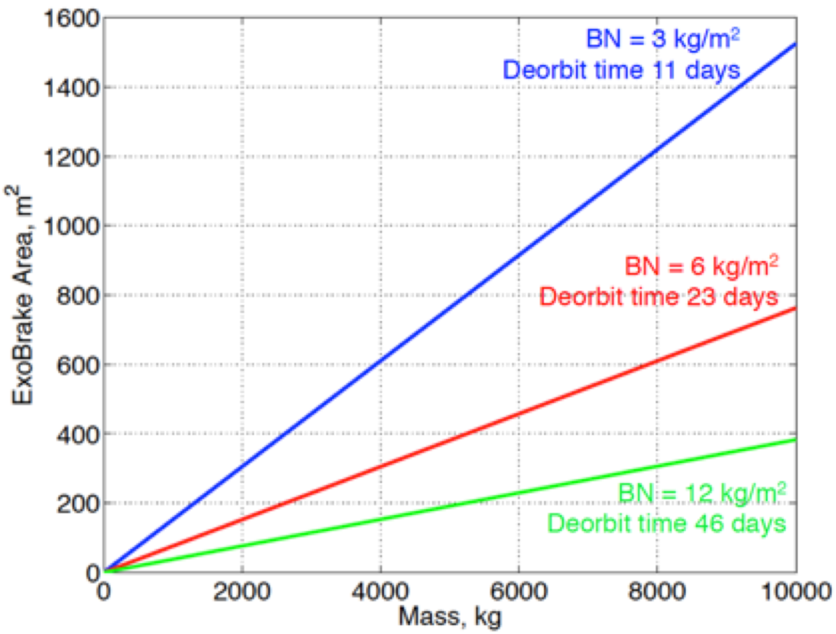
WSM 2.0 Experimen t on TES-5

Evolution of unique Wireless Sensor Module

Far left: Original SOAREX-1 data acquisition module
Second from left: SOAREX-9 WSM 1.0 trial version
Third from left: currently developed system for SOAREX9 and TES-5
Fourth from left: Marc's key chain…

De-Orbit Interest…

Results ***Exo-Brake***



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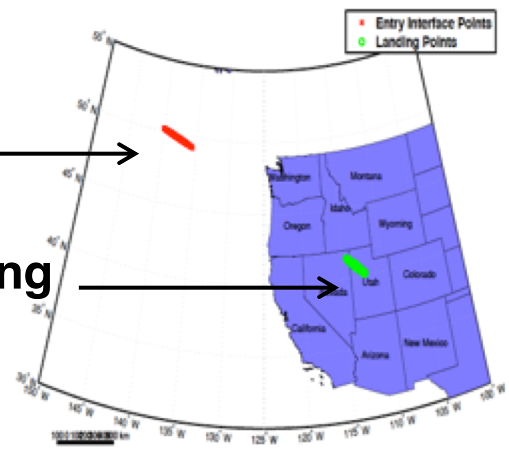
Dutta/LaRC

Sample Return/Re-entry Targeting With Modulated Exo-Brale: Validation – !

Entry

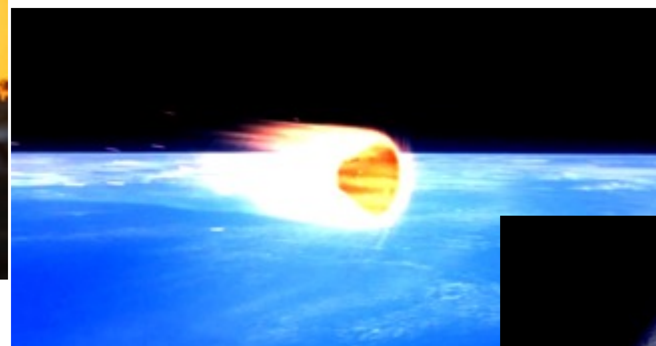
Landing

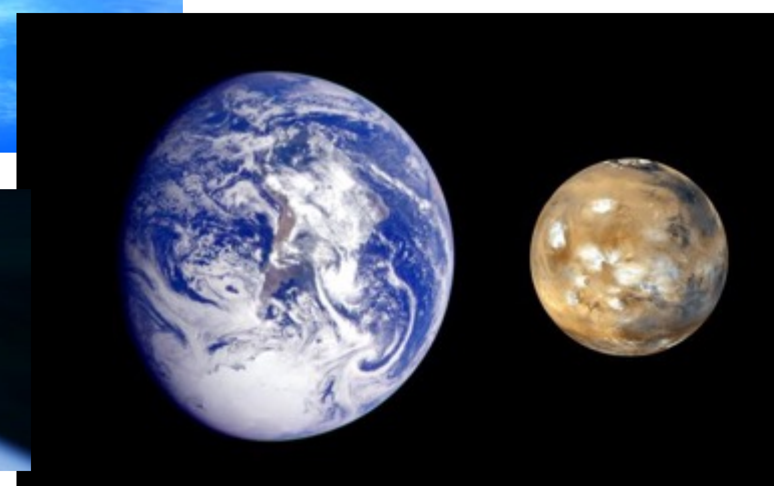


S. Dutta, A. Cianciolo, R. Powell , (LaRC)

ORION

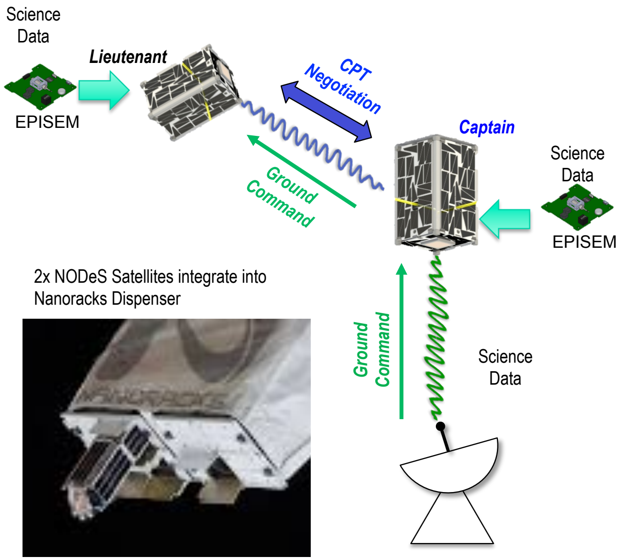
Mars is similar to Earth in many respects, has many of the same "systems" that characterize our world , home.
Like Earth, Mars has an atmosphere, hydrosphere , cryosphere and lithosphere . In other words , Mars has air systems , water , ice and geology all interact to produce the Martian atmosphere.
NASA's Orion spacecraft launched successfully atop a United Launch Alliance Delta IV Heavy rocket Dec. 5





NODES and Science with Swarms

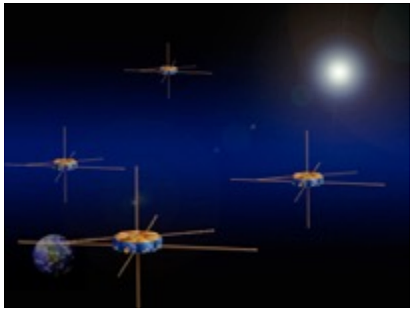
The Nodes satellites are two cubesats that will be jettison from ISS in the near future. Spacecraft Commanding through the Network



http://www.darpa.mil/.../System_F6.aspx

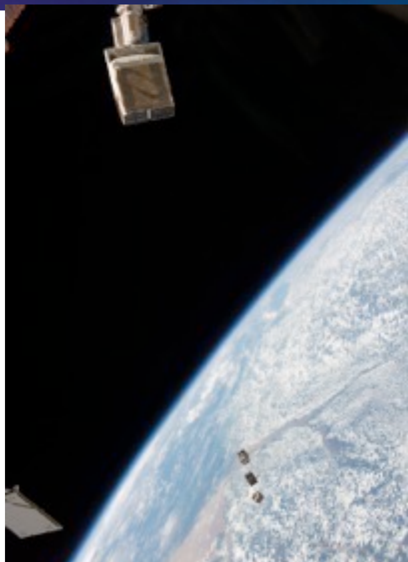
- Probing Earth-Sun interactions with gradient measurements of magnetosphere properties
- Synthetic aperture radar
- Multi-point tomographic measurements
- Geopotential measurements
- Large sparse array telescopes
- Coronograph based missions
- Explore properties of other planets, comets and near-Earth objects

http://www.esa.int/.../About_Proba-3



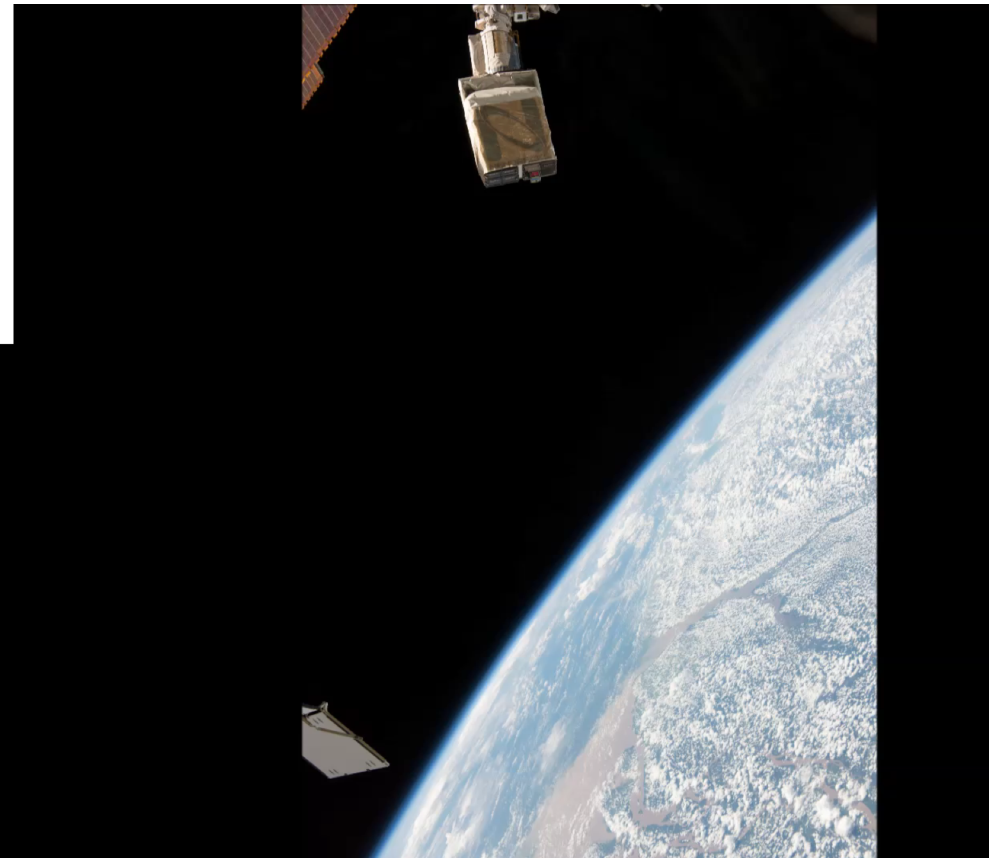
http://mms.gsfc.nasa.gov/

http://gracetellus.jpl.nasa.gov/



NODES Jettison

Monday 16th May 7am-8am PDT

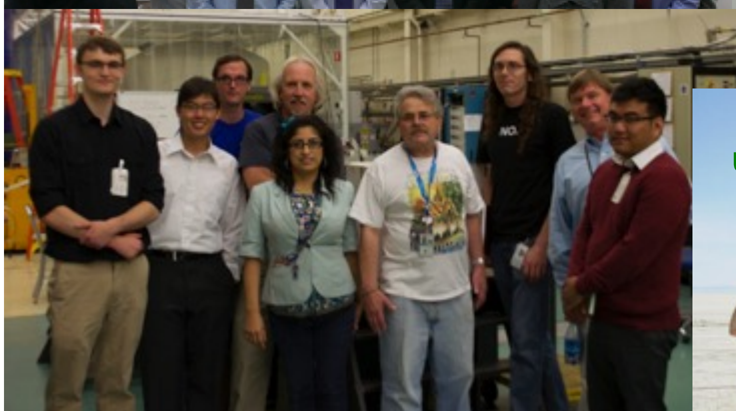


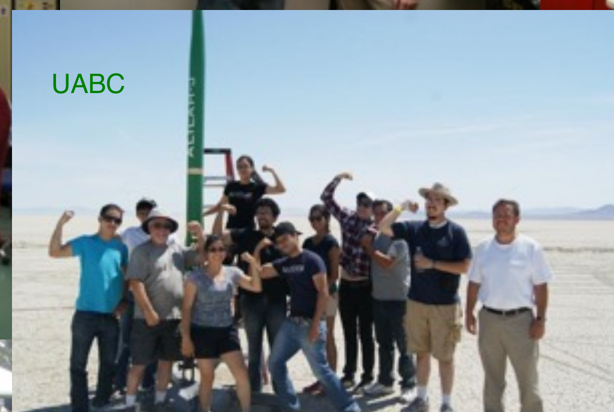
National Aeronautics and Space Administration

Ames

Discovery Innovations Solutions

Working relations





Questions?

[How to Get Research Onto ISS]

[Getting to Space Roadmap]

[Benefits for Humanity]

NASA