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CubeSat Launchers, ESPA-rings, and Education at the Naval Postgraduate School

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Naval Postgraduate School

2007 Small Satellite Conference

CubeSat Launchers, ESPA-rings, and Education at the Naval Postgraduate School

Dr. Jim Newman (NASA/JSC Visiting Professor at NPS)

Mr. Dan Sakoda (NPS Research Associate)

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Academic Group)*



CAL POLY

CUBESAT

Naval Postgraduate School
Space Systems Academic Group
Monterey, CA 93943



Naval Postgraduate School (NPS)

- NPS – Monterey, CA (120 miles / 200 km south of San Francisco)
 - ~1700 students
 - Mid-career military officers and government employees
 - ~30 to 50 different countries send students to NPS
 - predominately MA degrees, increasing number of PhD degrees
 - Space Systems Academic Group
 - Space Systems Operations
 - Space Systems Engineering





PANSAT

- NPS – payloads and satellites as part of space education
 - Shuttle mid-deck experiments
 - PANSAT (deployed on STS-95 Oct 1998 – the “John Glenn flight”)





PANSAT



S95E5040 1998.10.30 01:48:13

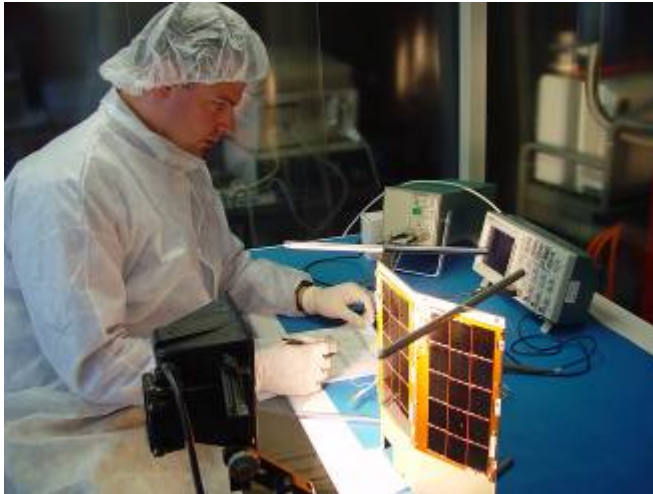


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NPSAT1 Update

- Education



- Research and technology demonstrations



NPSAT1 Update

- Flight-qualified structure
- Working processor board & CFTP experiment
- Flight batteries built
- Flight ACS components on-hand
 - Magnetometer
 - GPS receiver
 - Torquer coils
 - Momentum wheel
 - MEMS rate sensor flight-build in progress
- Solar panel flight-build in-progress
- Ground station antenna build in-progress
- 19 Master's theses to date
- ~5+ Students actively participating during any given academic quarter

- Target completion: Jan. 2009



Genesis of a CubeSat Launcher (NPSCuL)

- STP-1 Mission launched March 2007
 - One empty slot
 - NPSAT1 Mass Simulator





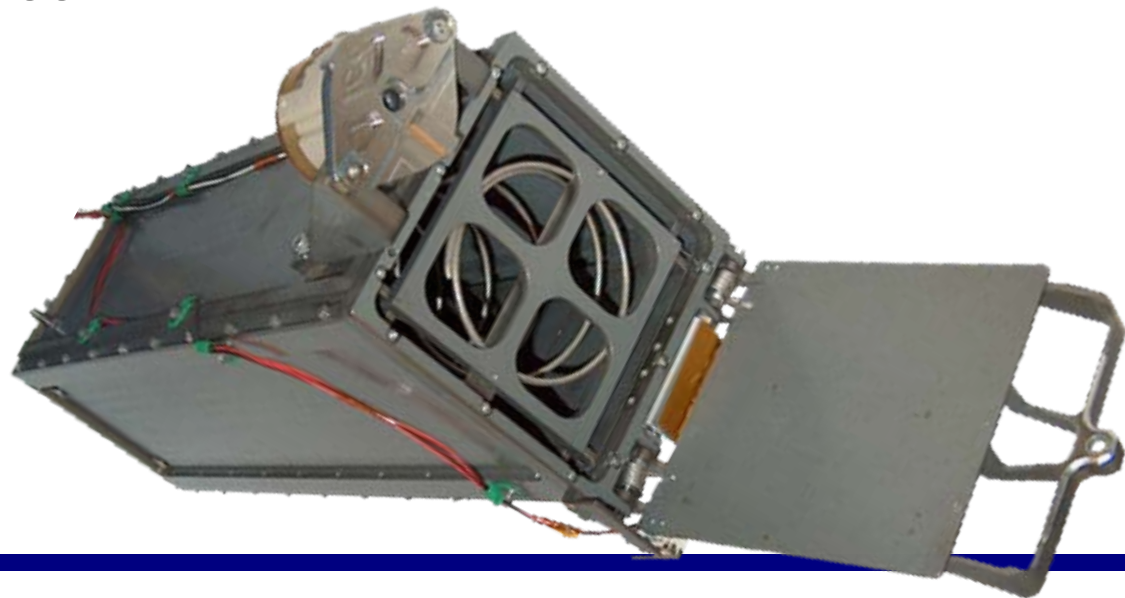
Genesis of a CubeSat Launcher (NPSCuL)

- As NPSAT1 nears completion, NPS will evolve to the use of CubeSats in its educational program
- There “should” be ESPA carrier missions in the future
- There already exists a strong university CubeSat development community
- There appears to be a scarcity of U.S. launch opportunities for CubeSats
- It appears that an ESPA-compatible CubeSat Launcher could be of value
 - NPS will need to launch NPS CubeSats in the future
 - NPS is forming collaborations with other USG organizations and universities interested in flying CubeSats
 - This is also an educational outreach opportunity for NPS
 - A CubeSat launcher could ensure utilization of ESPA slots
 - Seek STP dedicated slot for the CubeSat Launcher for NPS CubeSats
 - Be mass and cg reconfigurable and ready to “fill in” for a payload not ready to launch due to development schedule issues or late problems in test or integration



Concept

- Utilize existing standards and processes
 - ESPA carrier interface
 - Cal Poly Cubesat organization
 - Broker for university satellites
 - Standards for Poly-Picosatellite Orbital Dispenser (P-POD)
 - STP launch process



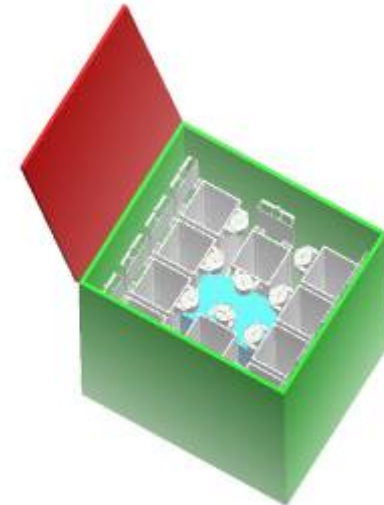


Requirements

- Programmatic Requirements
 - Cal Poly as broker for university CubeSats
 - NPS liaison to STP
 - Completion of survey form
 - Mission: description, objectives, schedule, etc.
 - Technical: mechanical, electrical, orbital, safety, etc.
 - ESPA-compatible payload flight request to STP
 - Earliest launch target: FY09 – FY10



ESPA Ring



Notional concept of launcher
(10 P-PODs)



Concept

University CubeSat
Flight Experiments

CubeSats from NPS and
other USG partners

Cal Poly
Cubesat
Program

Space Test Program



CubeSat Launcher

- Integration
- Test
- Payload Processing



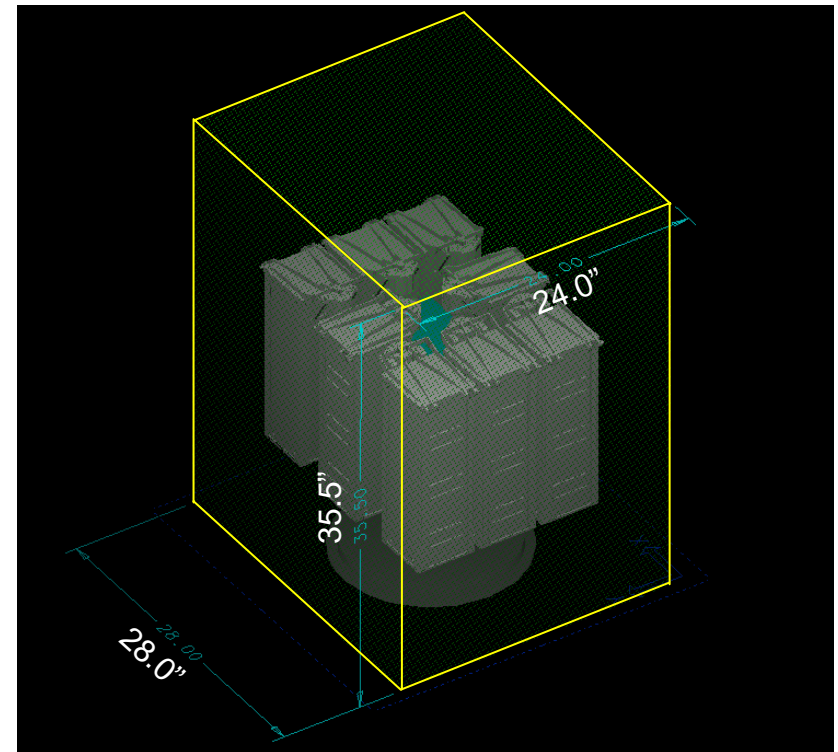
Integration & Launch

University CubeSat
Flight Experiments



Requirements

- Technical Requirements
 - Integrate multiple P-PODs
 - Maximize CubeSat volume
 - Be ESPA-compatible (mechanical / electrical)
 - Reconfigurable mass & distribution (functional mass simulator)
 - Meet all safety requirements
 - Ease of manufacturability
 - Implement certification & verification program
 - Allow experimenter access up to final P-POD assembly

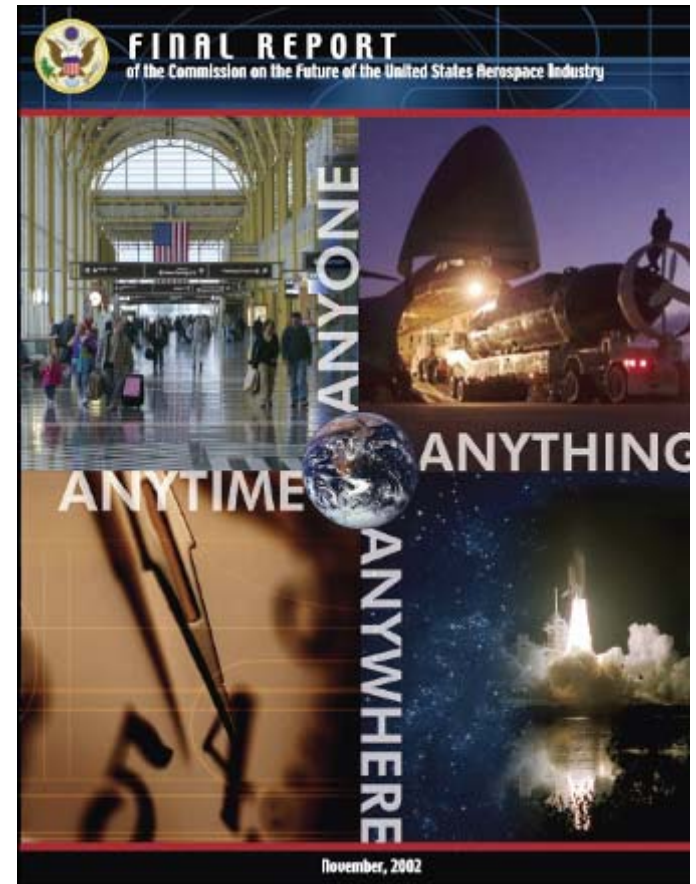


Notional concept of launcher (8 P-PODs)
within ESPA payload envelope



Objectives fulfilled

- Provide a launcher capability to meet objectives of:
 - NPS Space Systems Education
 - Hands-on satellite development and operations
 - Shorter development cycle
 - Technology innovations for DOD
 - Encourage creative minds in higher education
 - Advance S&T for spacecraft technology (flight demonstrations)
 - Encouraging students to join the aerospace work force
 - Provide exposure to DOD / USG aerospace professionals by working on projects of mutual interest





NPS CubeSat Missions



Current NPS CubeSat projects:

- Solar cell measurement system
- 3-axis stabilized imager

Potential NPS CubeSat projects:

- Ship tracking
- Formation flying / docking
- Max. power tracking circuit
- Configurable, fault-tolerant processors (CFTP)
- Technology demonstrations
 - Attitude control
 - Energy storage devices