



A “Small” Satellite Revolution

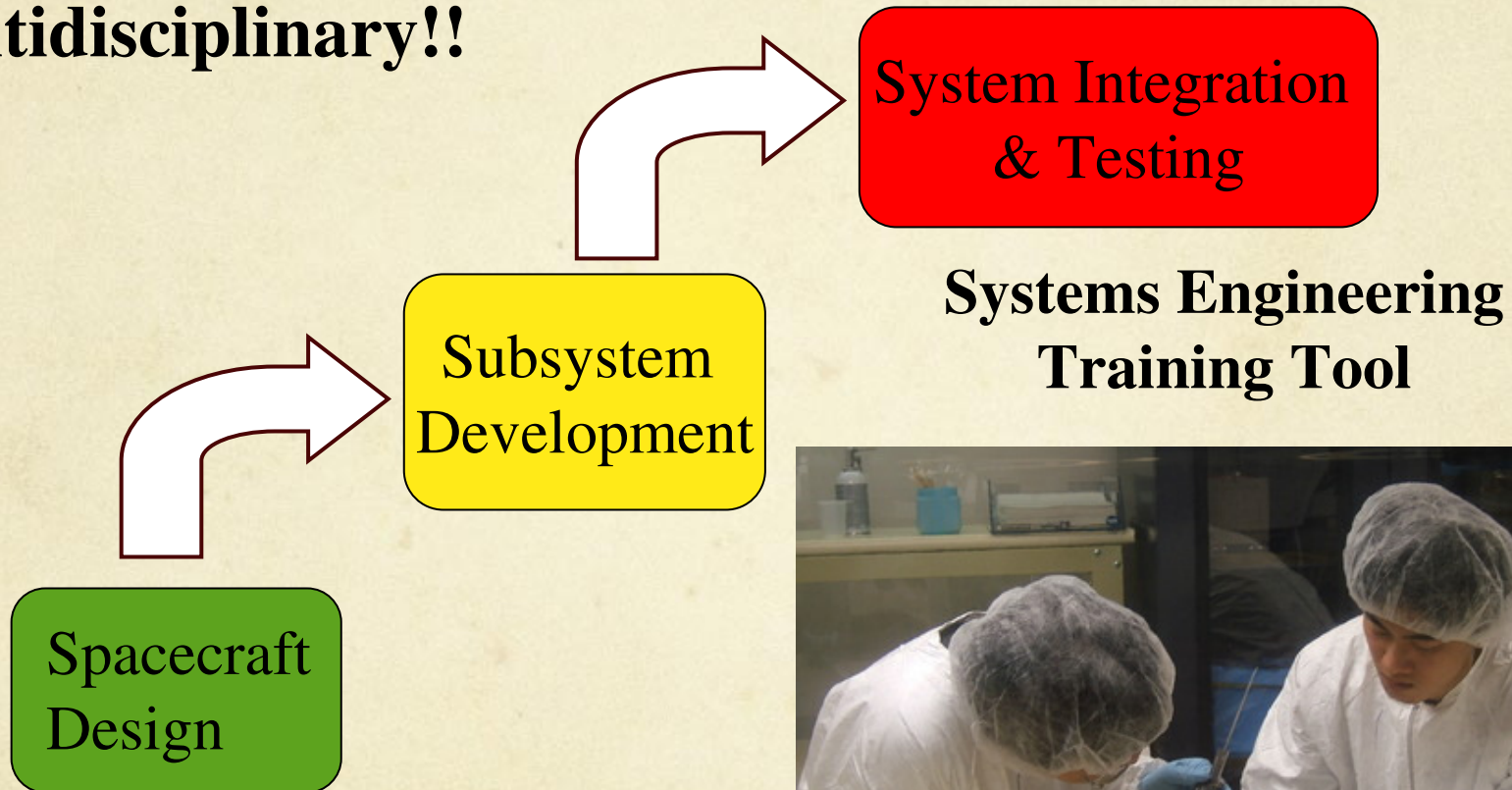
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ALC 2011, Mombasa, Kenya
September 2011

Student Satellites: Education Tools

Multidisciplinary!!



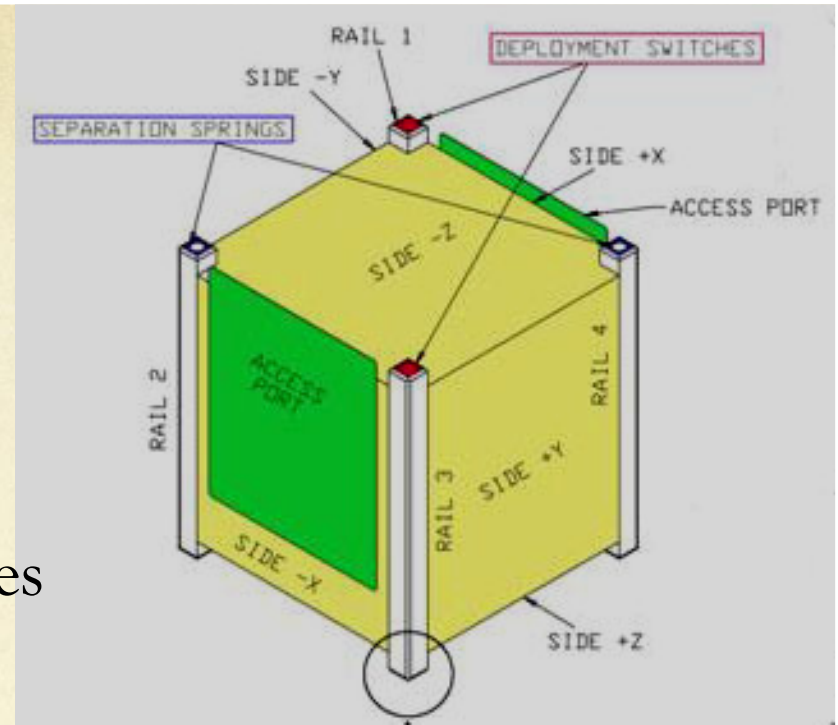
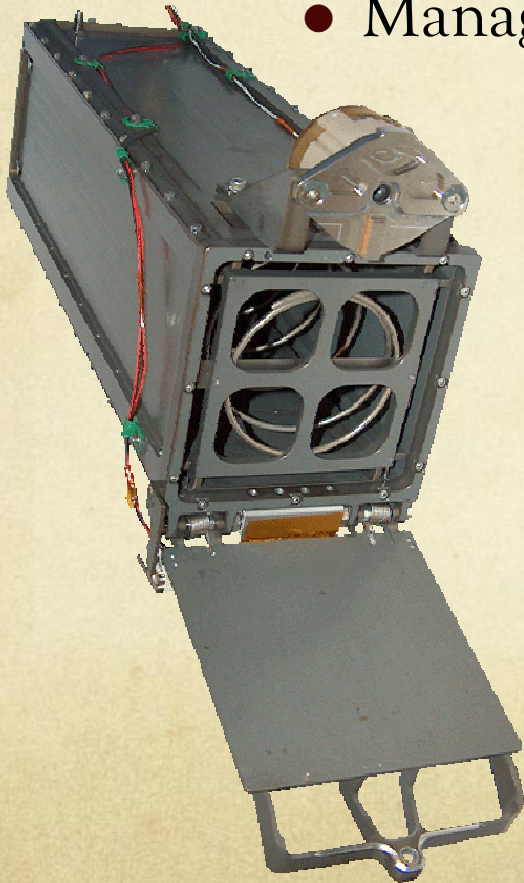
CubeSat Program Objectives

- Started in 1999: Stanford-Cal Poly Team
- Facilitate Access to Space:
 - Rapid Development Time
(1-2 years, Student academic life)
 - Low-Cost
 - Launch Vehicle Flexibility
- Use Standards
- University Projects
- Industry Testbed



CubeSat Standard

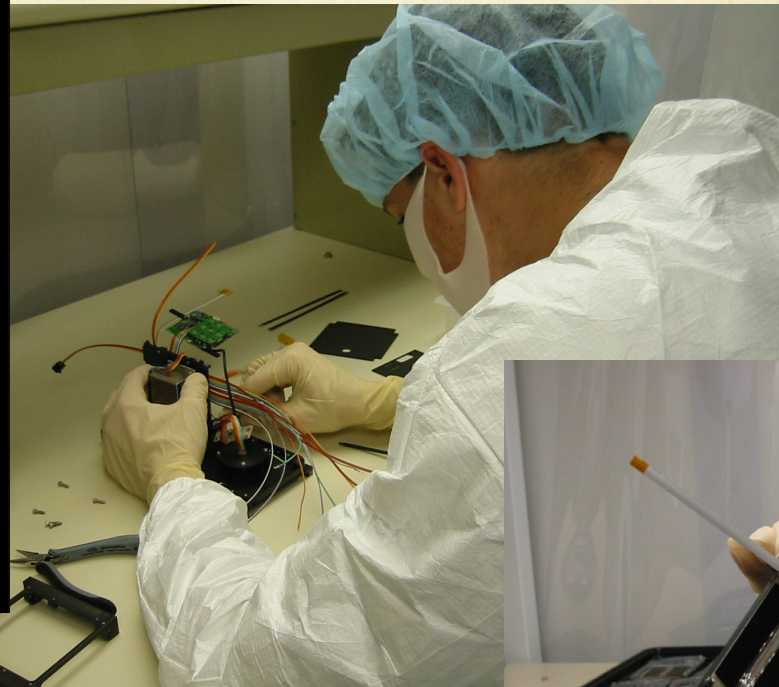
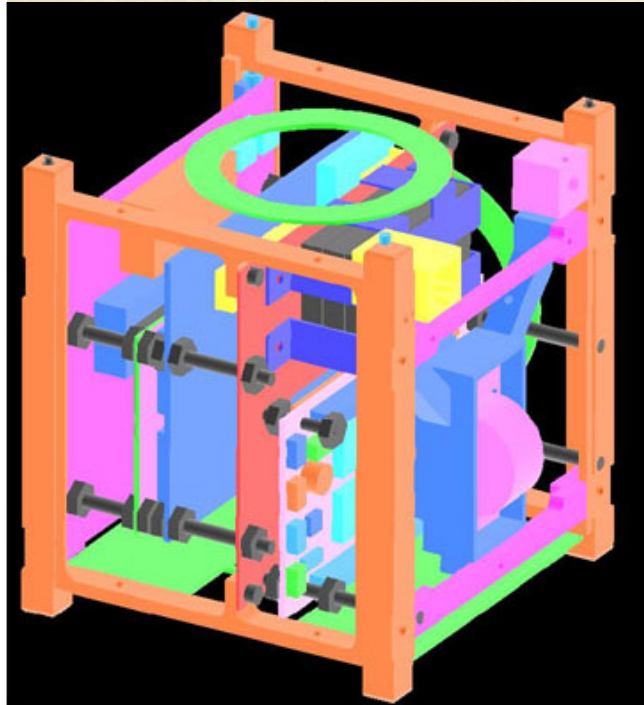
- PicoSatellite (Small)
- Simple Standard
 - Manageable by universities



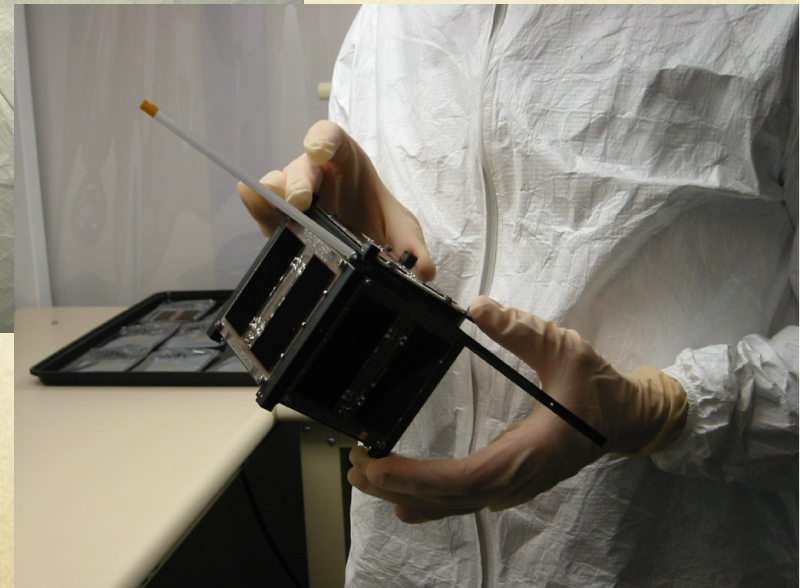
- P-POD Deployer
 - Protect Primary & Launch Vehicle
 - Launch Vehicle Flexibility
 - Simplicity
 - 3 CubeSats (or 3U spacecraft)

RESULTS

From Design

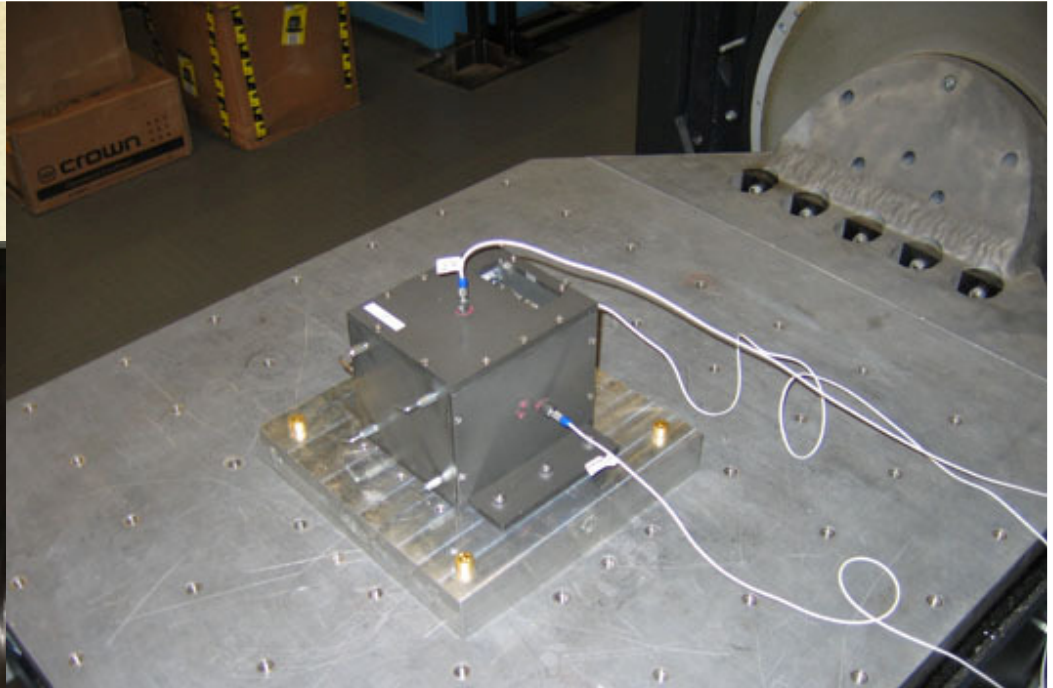
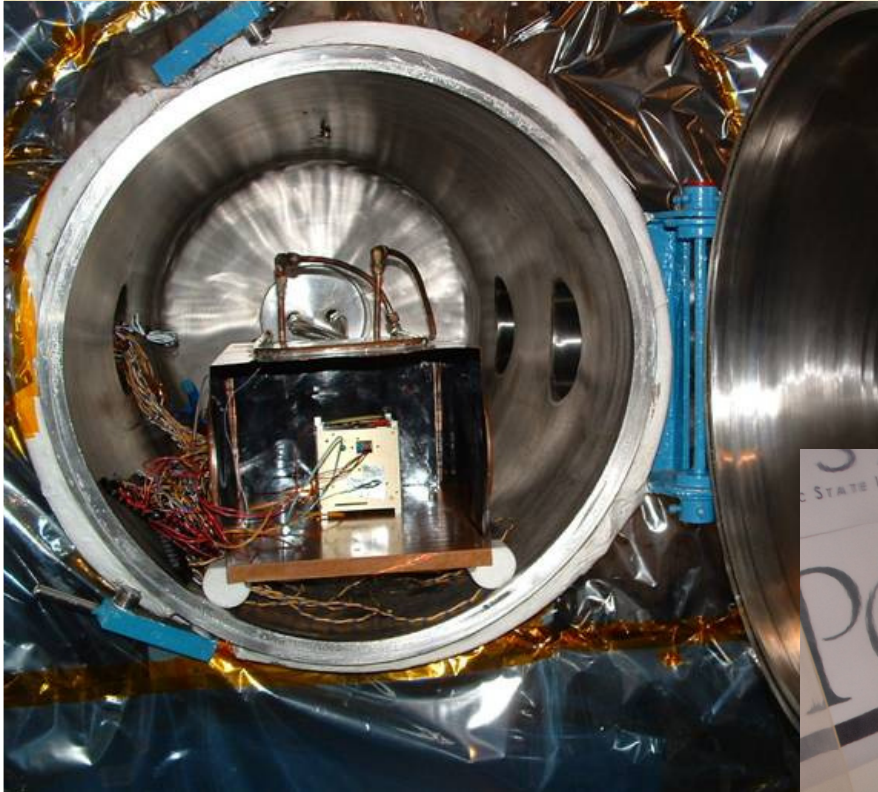


To Spacecraft



SUCCESS !!

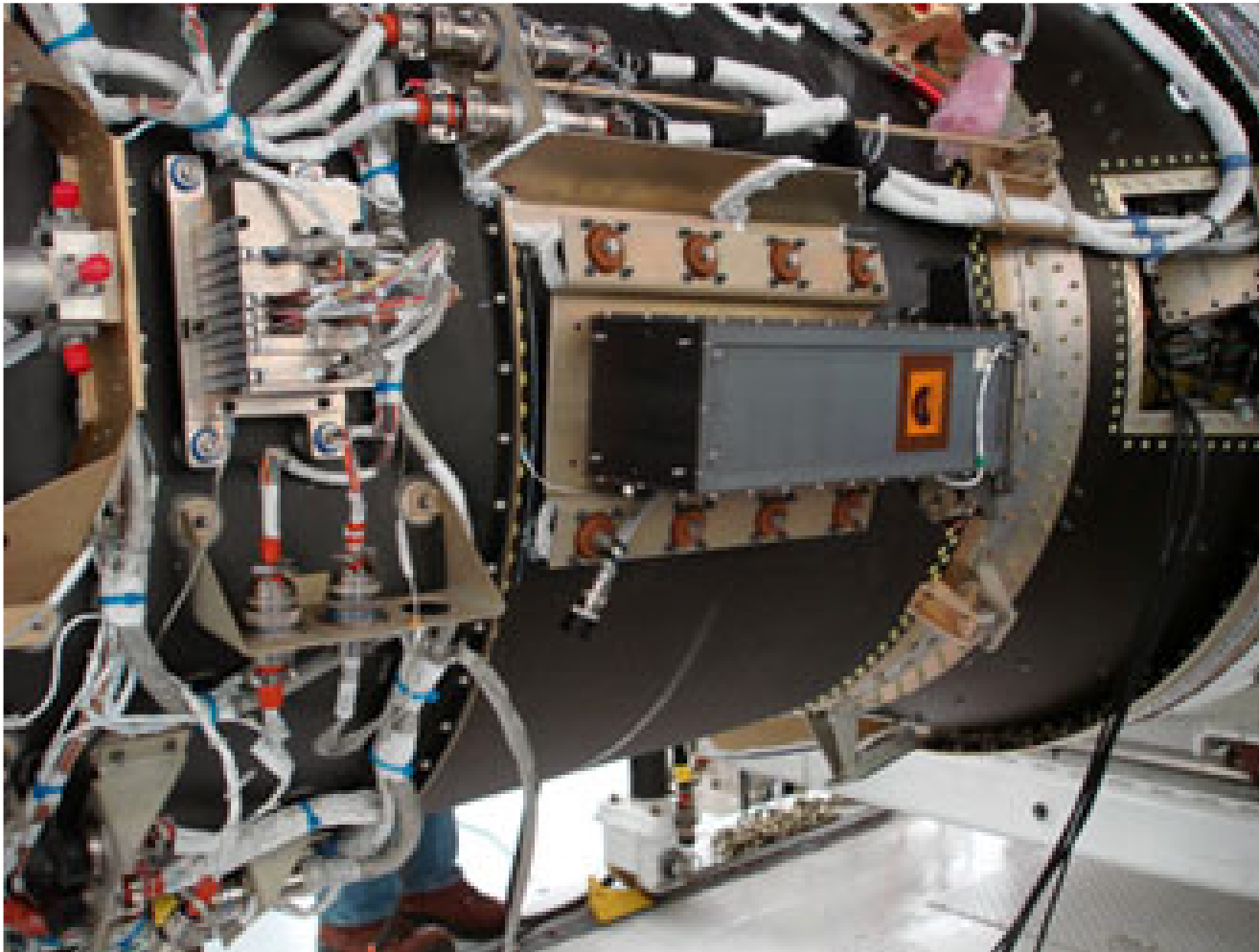
To Testing



To Integration

SUCCESS !!!!





To Launch

SUCCESS !!!!!!!



To Operations

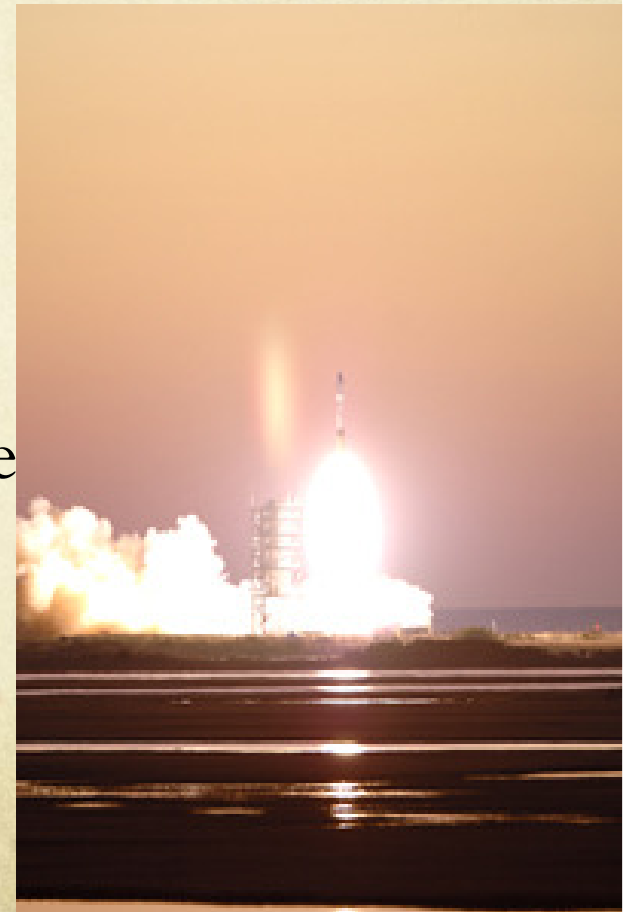


Photograph taken by AeroCube-2, April 17, 2007



CubeSat in Education

- Constraints = Creativity Engines
 - Encourages new thinking
 - Lack of experience can be a plus
- Ideal Workforce Development
 - High Student Motivation
 - Systems Integration Training
 - High tech skills not just aerospace
 - Community = Support Network
 - Launch Opportunities
- Great Entry Point



Status

- 44 CubeSats in LEO (63 Launched)
 - 14 Launches (US, India, Russia)
 - Regular Launches Now Available
- Large Developer Community
 - University/Gov/Industry
 - Worldwide
 - Dedicated Workshops
 - **NEW PLAYERS!!**
 - **New Countries**
 - **New Universities**



Beyond Student Projects

- Worldwide Support of CubeSat Activities
 - NSF, NASA, DoD, ESA, JAXA, IAF, . . .
- Scientific CubeSats: NSF Space Weather, ESA QB50, NASA Astrobiology
- DoD CubeSats: Air Force SENSE, NRO Colony, Army SMDC ONE
- Developing CubeSat Industrial Base: Pumpkin, ISIS, Tyvak, GomSpace, Sequoia (Colombia)

CubeSat is Successful Standard Why?

- Small & Low-Cost
 - Many Developers
- Standardization
 - Developer Community
- Innovation and Creativity
 - New Players
- Commercial Electronics Advances
- Launch Opportunities
 - Primary Payload and Launch Vehicle Protection
- Risk-Posture Change



CubeSat: Revolution or Evolution?

- Evolution:
Smaller Spacecraft
- Revolution:
New Way of Doing Space Business
 - Higher Risk Tolerance
 - More Flexible Launches
 - Higher Production Numbers
 - Lower Cost / Complexity



Conclusion:

- CubeSat is Successful Standard
- Capability is increasing quickly
- Small barriers to entry
- Creative/innovative solutions required
- Perfect Workforce development tool
- Missions beyond education

A photograph of a small satellite in orbit above Earth's cloud-covered surface. The satellite is a small, rectangular, metallic-looking object with some internal components visible. It is positioned in the lower-left quadrant of the frame. The background is a vast expanse of Earth's surface, covered in white and grey clouds, with a blueish-purple hue. The text "Thank You" is written in a large, black, serif font at the top center. Below it, "Questions?" is written in the same font. At the bottom center, the website address "www.cubesat.org" is written in a smaller, black, serif font. In the bottom right corner, there is a small, white, sans-serif font caption: "Photograph taken by AeroCube-2, April 17, 2007".

Thank You

Questions?

www.cubesat.org

Photograph taken by AeroCube-2, April 17, 2007