

REPORT DOCUMENTATION PAGE

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6. AUTHOR(S) PROFESSOR LIGHTSEY	5d. PROJECT NUMBER 2305/IX
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	5f. WORK UNIT NUMBER

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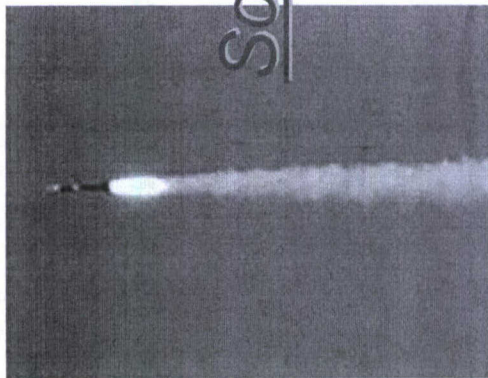
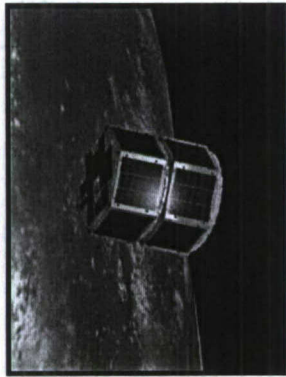
12. DISTRIBUTION/AVAILABILITY STATEMENT DISTRIBUTION STATEMENT A: UNLIMITED	AFRL-SR-AR-TR-08-0136
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13. SUPPLEMENTARY NOTES

14. ABSTRACT - Detailed subsystem designs have been completed including communications, power, GPS, thruster, structure, and separation system - Most of these subsystems have had working engineering models fabricated and tested - A detailed project document tree has been created and populated with requirements, subsystem designs, operational modes, and system test procedures - A KC- 135 weightless experiment was conducted by students to demonstrate and measure the tip off properties of the Lightband separation system for dynamics analysis
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15. SUBJECT TERMS	20080331069
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16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
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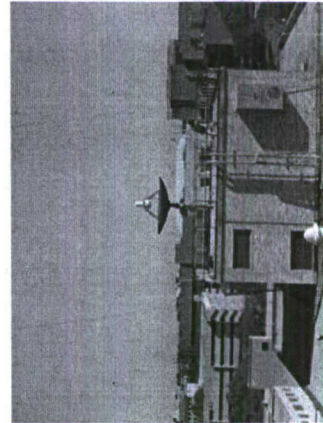


So, You Want To Build A Satellite?

**E. Glenn Lightsey,
Associate Professor
Dept. of Aerospace Engineering**



January 17, 2007



<http://fastrac.ae.utexas.edu>



Satellite Design Lab Students: A Partial List!



“Scientists discover the world that exists;

Engineers create the world that never was.”

-Theodore von Karman,
Aerospace Engineer

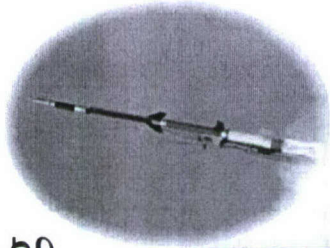
...And Many More!! (more than 100 students)



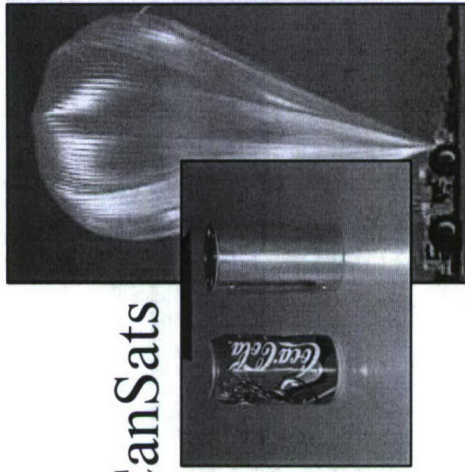
UT Austin Satellite Design Laboratory (SDL)

Mission Progression

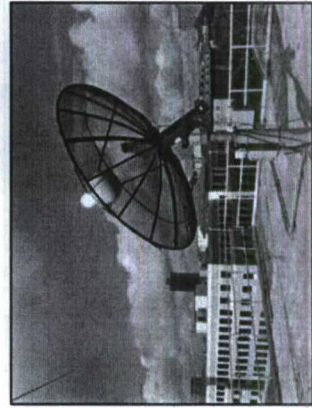
Sounding
Rockets



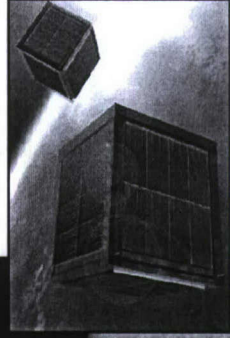
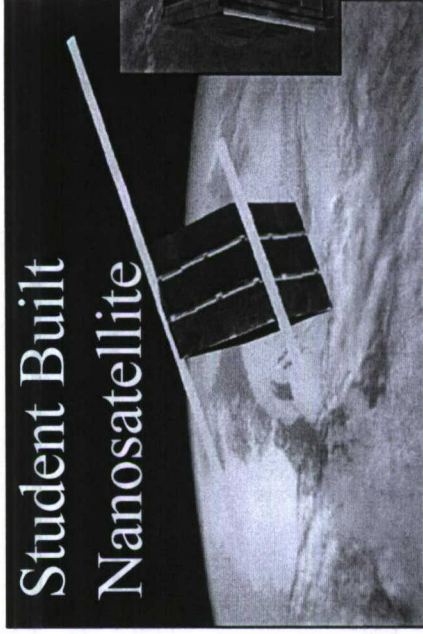
CanSats



High Altitude
Balloons

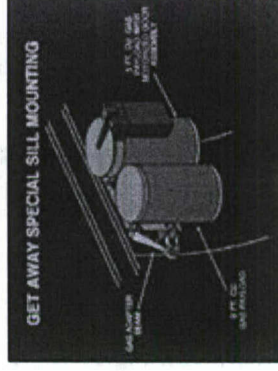
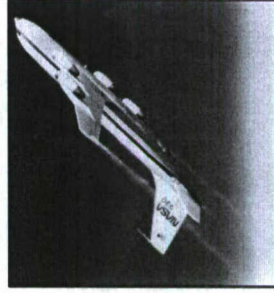


Student Built
Nanosatellite



Nanosat
Groups

KC-135/C-9

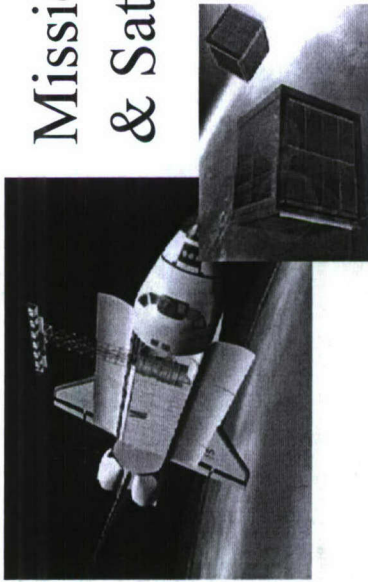


Get Away Special

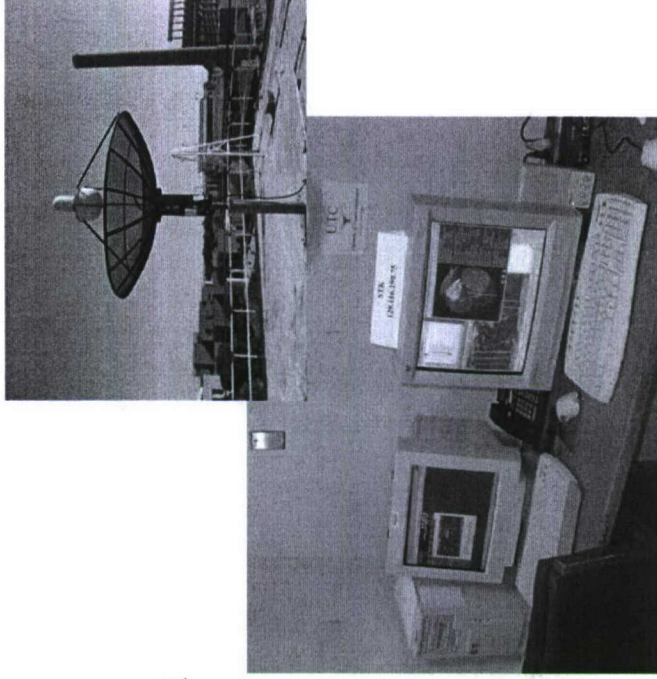
Satellite Ground Station



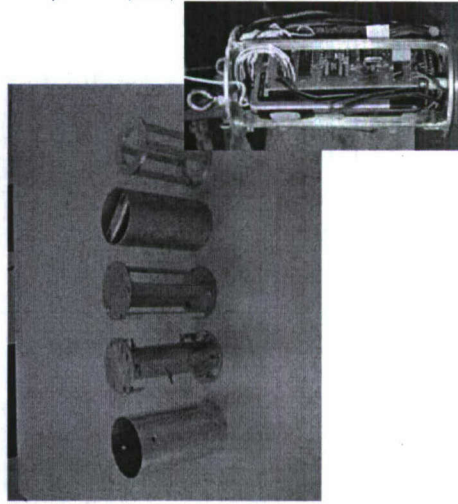
Product Life Cycle Engineering



Mission Planning
& Satellite Design



Flight Support
& Tracking

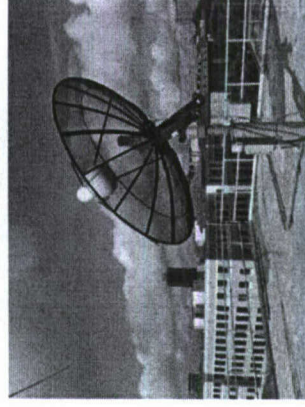
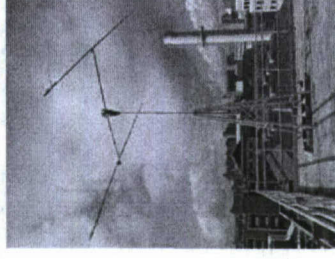


Vehicle
Integration
& Testing



Satellite Ground Station

- Antenna Motion Control
 - APRS Based Tracking
 - Signal Strength Based Tracking
 - RF Environment Mapping
- Transceiver Control
 - Doppler Correction
 - Scanning Algorithms
- TNC Control
 - Multi Mode Decoding APRS, AMTOR, RTTY, AX.25 Morse, etc.
 - Graphical User Interface
- RACE Network
 - Scheduling and Remote Control



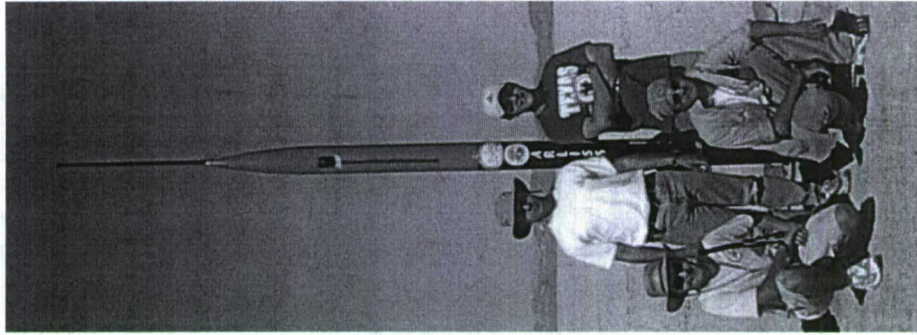


We Started Small: CanSat...



Mission Profile

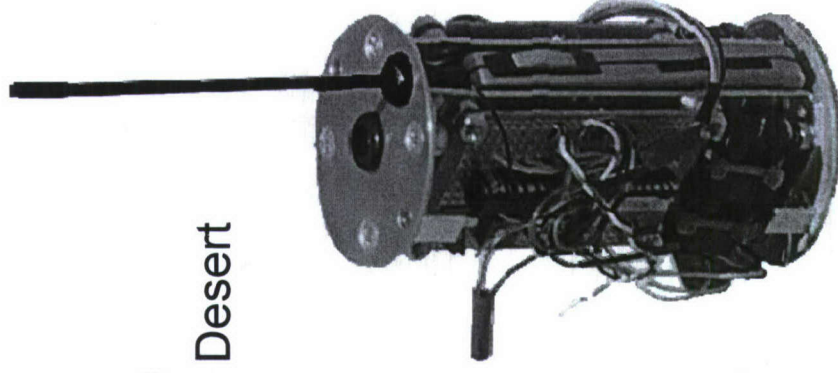
- "Starter Project" : 6 students, 6 months, \$2,000
- Sounding Rocket Launch to 12,000 ft. AGL
- 35-g Launch Load Typical
- Parachute Descent Emulates Satellite Pass
- First UT Launch: Summer 2002 Black Rock Desert



2003 Launch Team

• CanSat 2002:

- Coke Can Sized
- Weight: 166 gm.
- Two-way Telemetry 9600 bps.
- Pressure and Temperature sensors
- Recorded Accelerometer Data
- Uplink Commands



UT CanSat May 2002

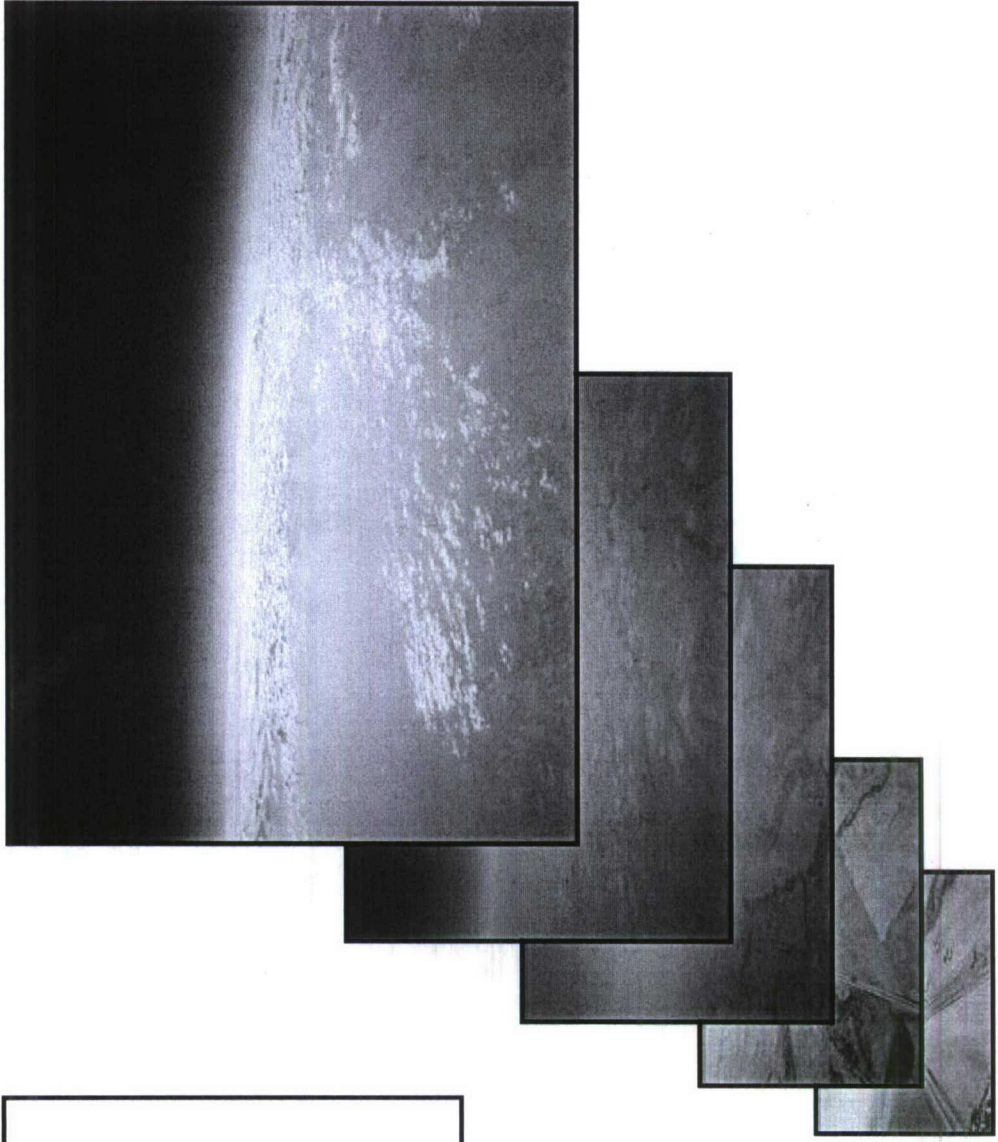


High Altitude Balloon Workshop

July 2003

Successful Outcome

- Solid Core Team
- Increased Confidence
- Experience Gained
- Pretty Pictures
- SDL Altitude Record (100,000 ft)

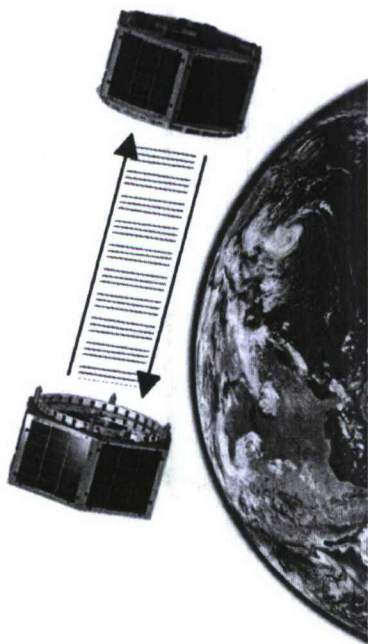




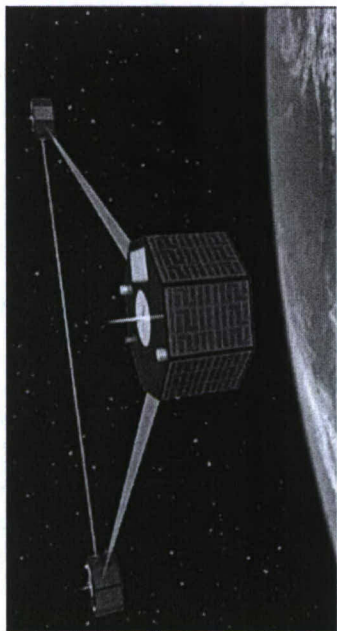
...And Grew to Space Missions: FASTRAC

2003 - 2007

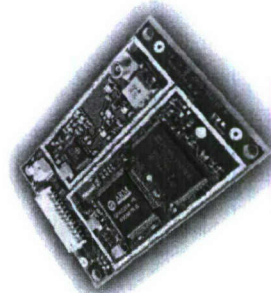
FASTRAC demonstrates many critical unflown technologies for future space applications in one low-cost mission.



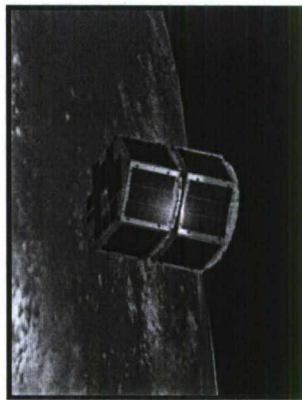
Standalone Relative Navigation



Distributed Formations



Advanced GPS Receiver
(Patented – seeking commercialization)

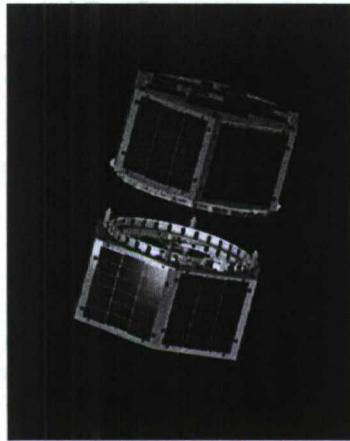
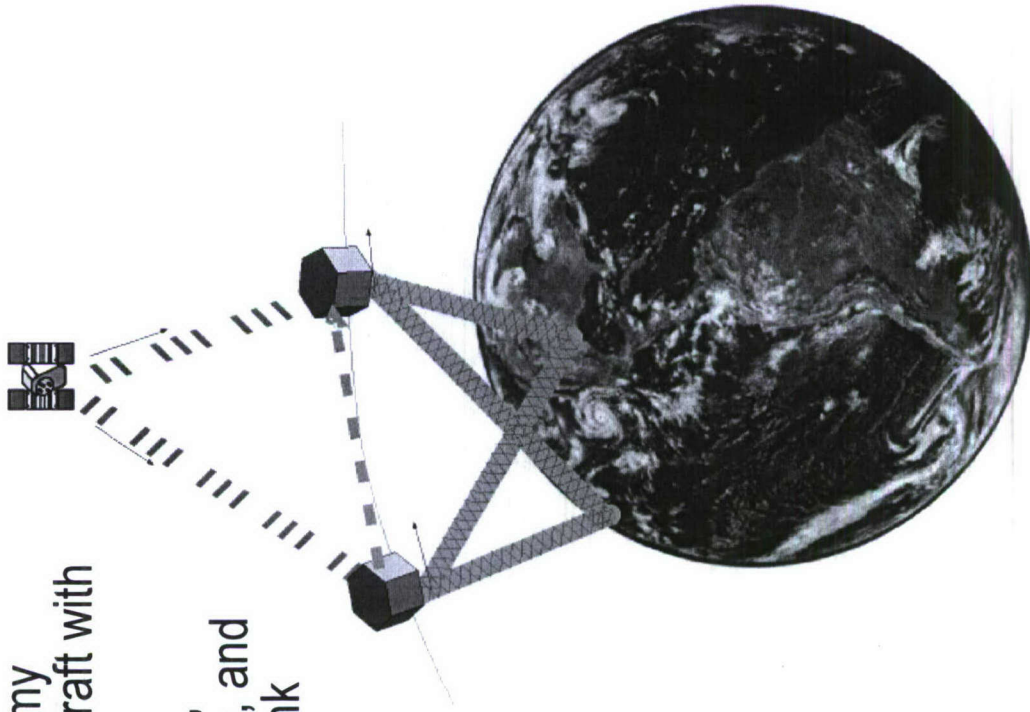


Microthruster Propulsion



FASTRAC Mission Overview

Formation
Autonomy
Spacecraft with
Thrust,
RelNav,
Attitude, and
Crosslink





Satellite Formations Enable New Mission Types and Space Capabilities

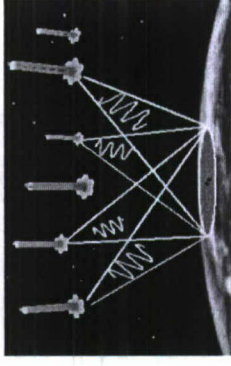
Real-time Reconnaissance and Remote Sensing

- Surface observation (before/after)
 - Global sea height & surface wind measurements
 - Three Dimensional Hyperspectral Imaging
- *Formations allow real-time observation of large areas with greater accuracy than single satellites.*



Rapidly Deployable Communications Arrays

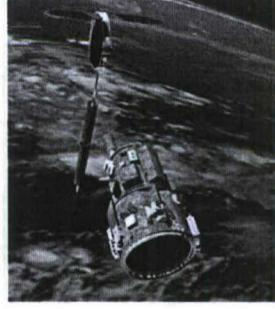
- Over the horizon & Store-and-Forward Comms.
 - Secure & Jam-resistant Comms.
- *Formations provide undeniable communications systems in conflicted air space.*



TechSat 21 Cluster

Multi-vehicle Proximity Missions

- Inspection and Rendezvous
 - Autonomous Servicing, Repair, Upgrade
- *Formations enable satellites to work together autonomously.*



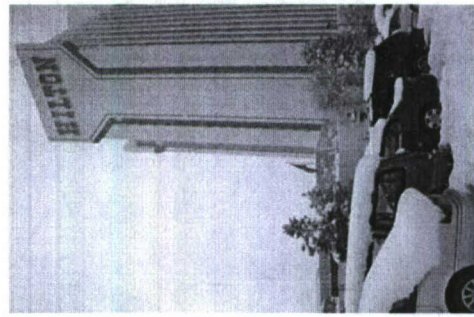
Science Arrays and Virtual Instruments

- Interferometry, Field Measurements
 - Geophysical and Atmospheric Science
- *Formations allow multiple observation locations to be employed simultaneously.*

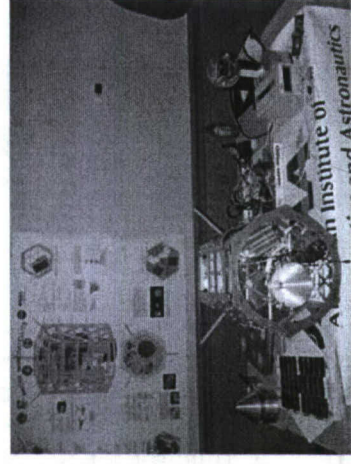


UN-3 Comperition Day January 9, 2005

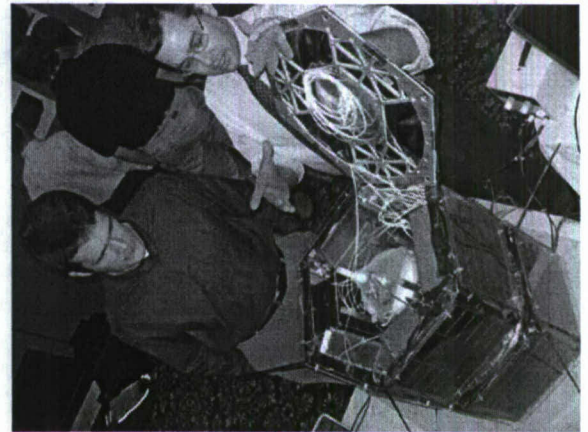
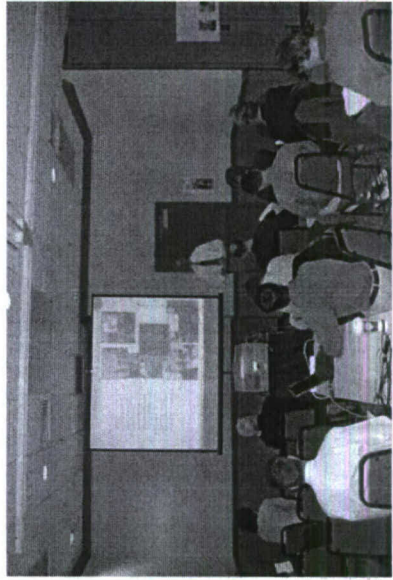
Getting There



The Competition: 12 other Universities



Presentation, Q&A





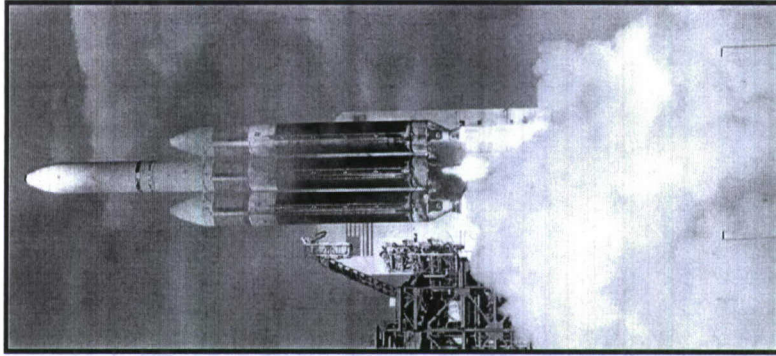
The Result

FASTRAC Wins!

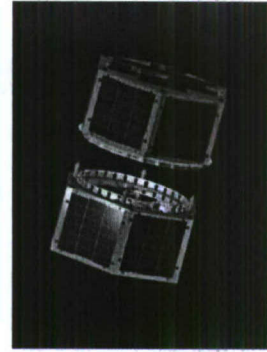




FASTRAC: What's Ahead



Example Launch Opportunity



FASTRAC On-Orbit Separation

Flight Build / Pre-Launch

- **Fall 2005:** Briefed and ranked by the DOD SERB
- **Spring 2006 :** Complete Flight Build in Austin
- **June 2006 :** Deliver Flight Unit to AFRL AEF
- **Summer/Fall 2006 :** Environmental Testing at AFRL
- **Early-Mid 2007:** Manifest to launch vehicle
- **Late 2007-08:** Launch and Mission Operations

Press Opportunities

Mission Operations

- **First 2-weeks:** Stack check-out period
- **2-months:** Primary mission operations
- **4-months:** Amateur Radio Community Outreach and Secondary Mission Operations (extended)

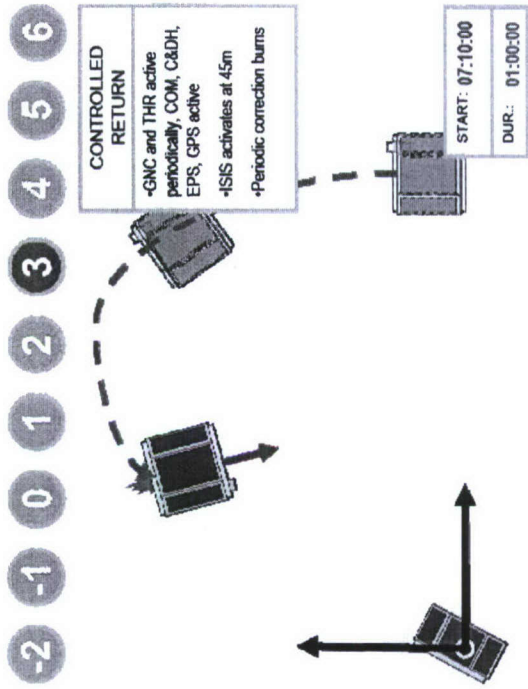
End-of-Mission and Post-Flight

- **Post Flight Analysis and Publication of Results (2007-08)**

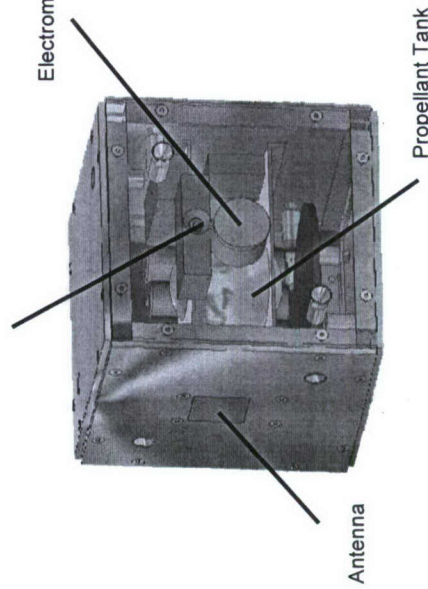


Future Satellite Missions

ARTEMIS: 2005-2010
Autonomous Rendezvous Mission
Selected as Nanosatellite Finalist
Funded \$500K in 2006-07 by DOD
Technology Spinoffs



Laser Rangefinder



PARADIGM: 2006-2014
10 cm cube satellite
Joint Venture with UT-Austin, Texas A&M, NASA
4 Launch Opportunities over 8 year period
Numerous New Technologies

The Future: A major NASA/DOD mission built by The University of Texas