

Near Space and Beyond

Student-Driven Payload Projects at UND

Ron Fevig

2011 May 09



UND High Altitude Balloon (HAB) Program



First launch = 1998 Oct 24
Total launches to date = 38

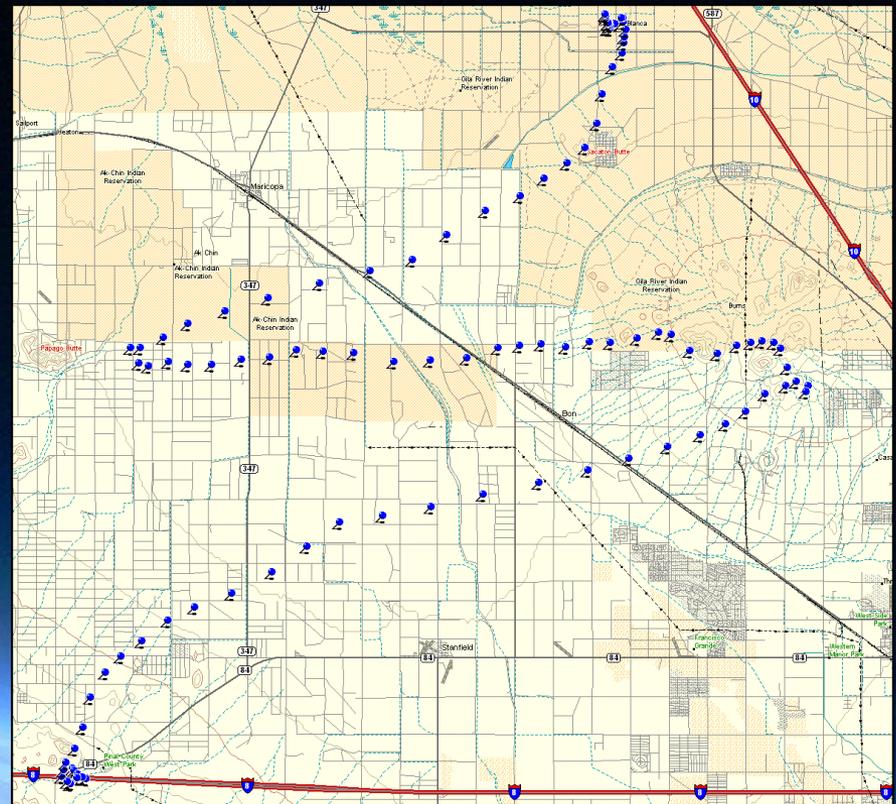
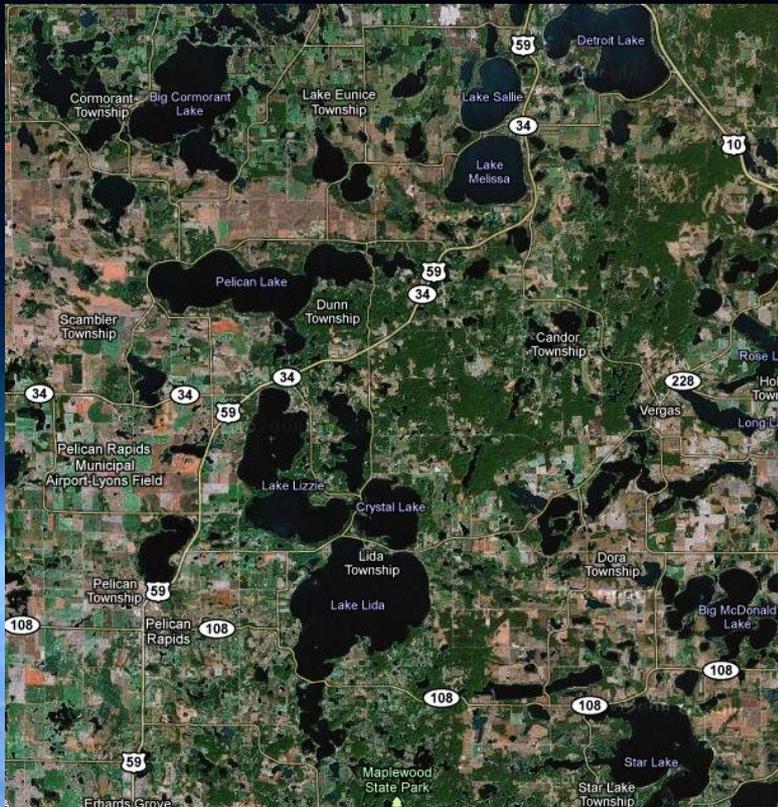
UND HAB Coordinators
Ron Fevig (SpSt)
John Nordlie (RWIC)



Near-Space Recovery Technology (NSRT)

Passive (prediction)

Active (cut-down, steerable parachute)

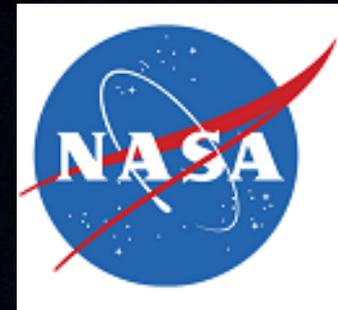




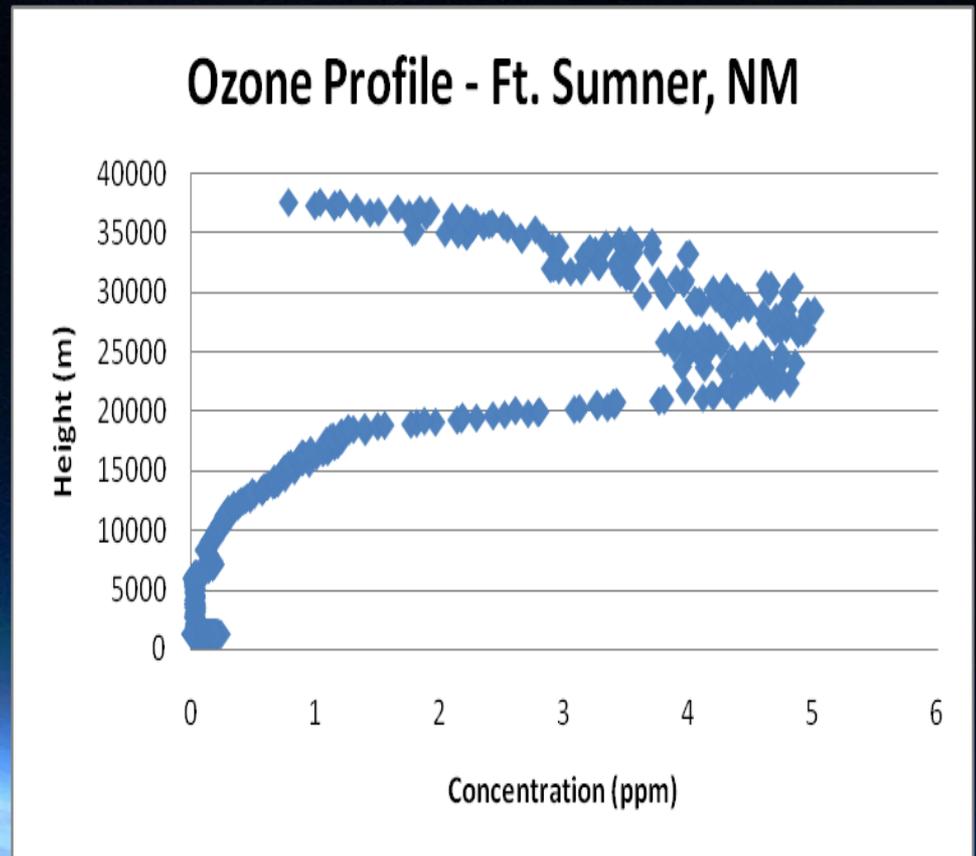
UND HASP

(High Altitude Student Platform)

- HASP provides flights for student-built payloads on NASA zero-pressure balloons.
- HASP provides power and a data link for these payloads.
- Altitude \approx 36 km
- Duration = 15 - 20 hours
- UND DSS applied for and was awarded a flight.

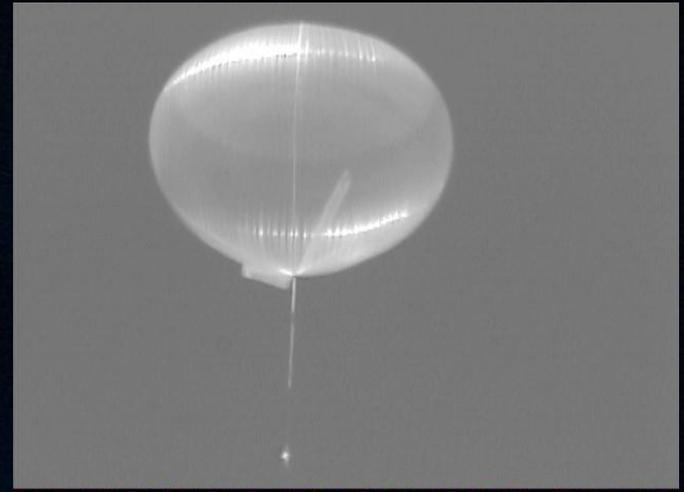


UND HASP 2008 Flight - SUCCESS! -



UND HASP 2009

- Launch Date = 2009 Sep 11
- Our second successful flight



UND HASP 2010 & 2011

- Upcoming flights of our third and fourth payloads this year



High Altitude Student Platform



Call for Payloads 2011

Issued October 7, 2010 by

Department of Physics & Astronomy
Louisiana State University
Baton Rouge, LA 70803-4001

and

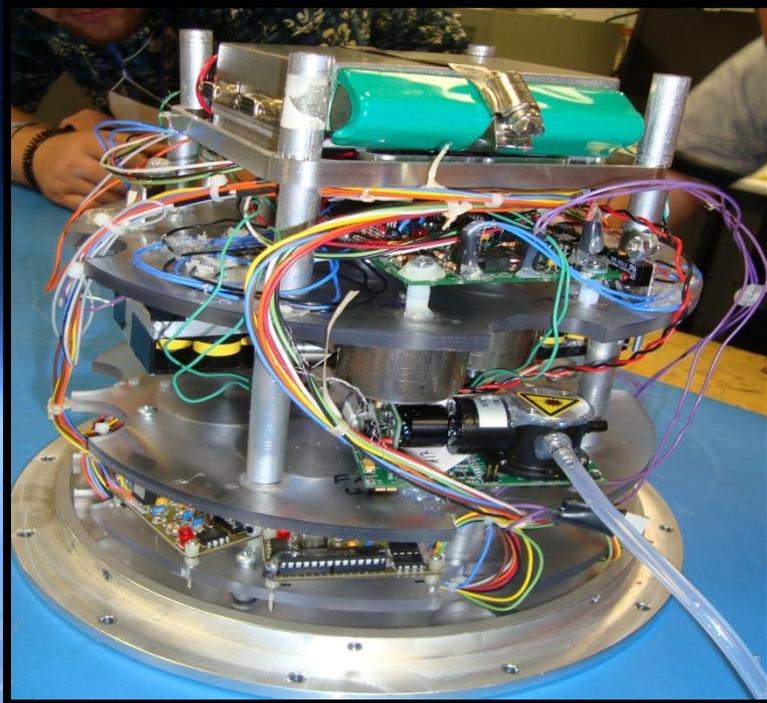
Balloon Program Office
NASA Wallops Flight Facility
Wallops Island, VA

Q&A Teleconference: November 12, 2010
Application Due: December 17, 2010

2009 RockSat

“The Next Step in Low Cost Student Access to Space”

- UND’s payload sampled gases in the mesosphere
- Launch date = June 26, 2009



Virtual Engineering Teams

Coordinating with our canister partners in CO

RockSat Design Review | Connect Pro Meeting

Meeting Present Layouts Pods Help

Chat

Matthew Voigt: Hey Ron
Ronald Fevig: Hi Matt. Did you get my phone message?
Matthew Voigt: Oh, I may have, but I haven't checked my voice mail
Matthew Voigt: Sorry about not getting your message on time.
Ronald Fevig: No worries.
Matthew Voigt: I hope that tonight will be short, just update both Zach and Matt of the status of the can as far as ME goes
Matthew Voigt: ya
Matthew Voigt: Ron, people are having to request access.
matt: hi
Matthew Voigt: hey matt
matt: never again on fridays
Matthew Voigt: tonight is going to be as quick and sweet as we can make it
matt: hey i dont have a mic control
Matthew Voigt: You've been super busy at work huh? What do you do?
Matthew Voigt: Mic should work now
kai: are u able to hear me
matt: no
kai: ok
kai: i will put up presentation
kai: and will type simultaneously
matt: k
kai: the camera mounting location has been assumed to be at center .. and the new camera dimension
kai: were updated according to matt hanleys email
kai: ya
kai: with assumption of mounting loaction at center

To: Everyone

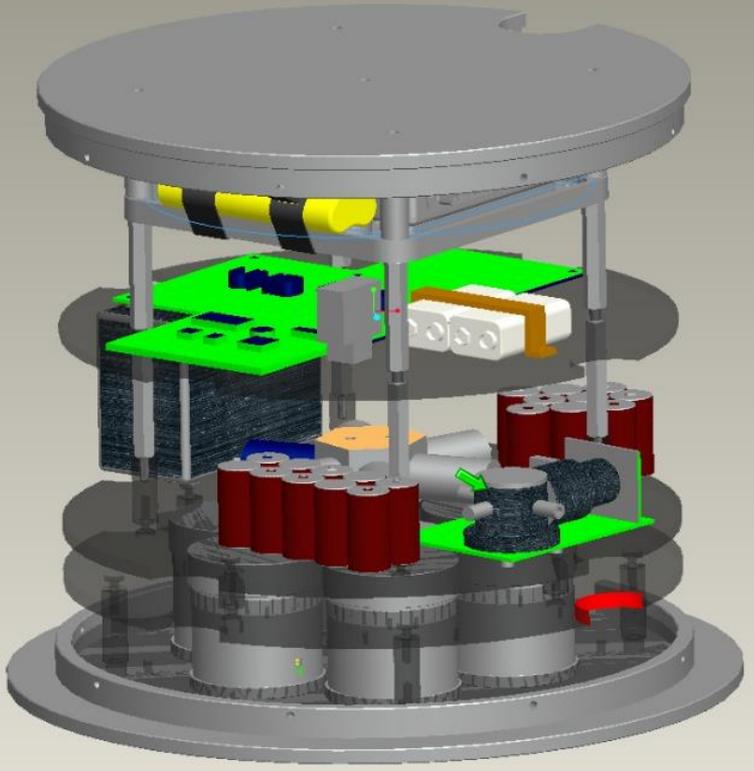
File Share

Name	Size
CanonA570HATCH.jpg	46 KB
summary_data.JPG	129 KB
316399_canister.JPG	146 KB
canister_UND_METRO_CSU.txt	3 KB
csu_ramrack_v005.txt	3 KB
metro_assembly_payload.txt	4 KB

Upload File Save To My Computer

Presentation 1.ppt

The complete Canister assembly



Share Stop Sharing Full Screen Sync

Talk Sharing Discussion Collaboration

HAB Biological Payload Team

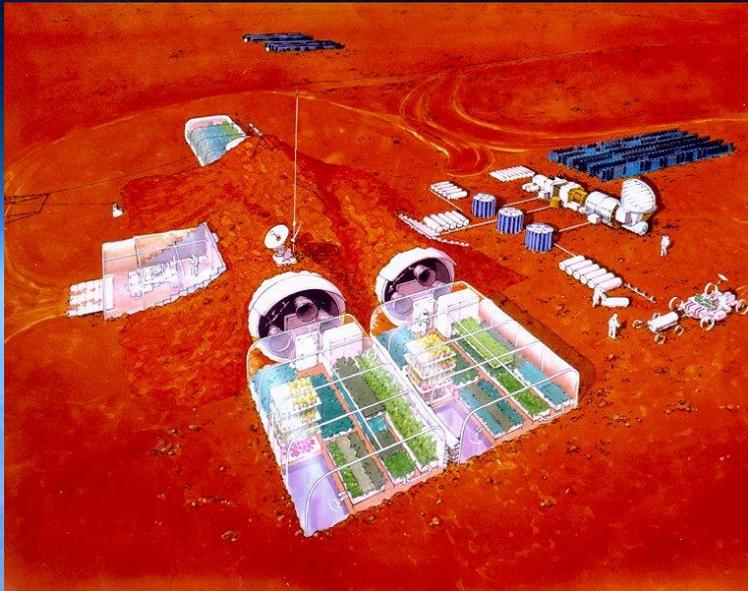
McNutt, Marty (Lead)

Booth, David

Borzych, Todd

Howell, Elizabeth

Perks, Theresa



HAB Imaging Payload Team

Holland, Timothy (Lead)

Doby, John

Howell, Elizabeth

Spencer, Earl



Image taken from a locally-flown, UND high-altitude balloon at about 85,000 ft.

HAB Launch and Tracking Operations Team

Shallbetter, Wyatt (Lead)

Fitzgerald, Nicole

Haag, Lauren

Ray, Ron

Woida, Matthew



Superpressure Balloon Mission Architecture Team

Meeks, Denise (Lead)

Booth, David

Borzych, Todd

Boyce, Patrick

Doby, John

Perrin, Thomas

Wilkins, Mary



Satellite Ground Station Team

La France, Kayla (Lead)

Spencer, Earl

Anderson, Travis

Dusterhoft, Zachary



Small Satellite Mission Architecture Team

Lilko, Randall (Lead)

Anderson, Travis

Boyce, Patrick

Perks, Theresa

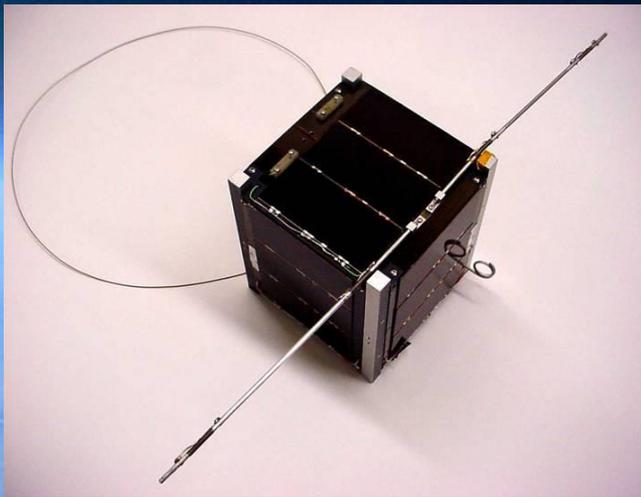
Perrin, Thomas

Wilkins, Mary



Getting involved

- Local projects
- Partnering with UND on existing projects
- Undergraduate course offerings
 - Space Mission Design
 - Introduction to Orbital Mechanics
- Future projects?



Questions?



Supplementary Slides

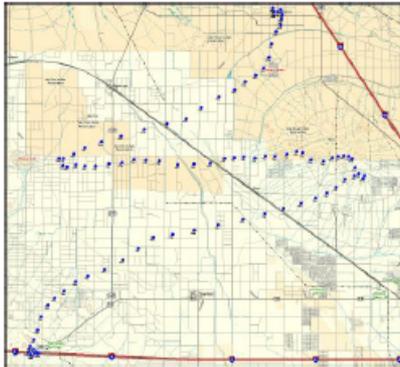


Project Title: Near-Space Recovery Technology (NSRT) 09/01/2010

Faculty Advisor(s): Ron Fevig, John Nordlie

Partners: UND Space Studies, RWIC

Near-Space Recovery Technology (NSRT)



Description:

Winds aloft data acquired via GPS during the ascent of a high-altitude balloon (HAB) will be used to predict and control the landing location of a 2.5 kg HAB payload. Several delivery concepts will be assessed, including the use of a steerable parachute, before settling on the final design for a near-space recovery system.

Problems to Solve (Why work on this project?):

1. This delivery mechanism would increase the chance of successfully recovering a HAB payload.
2. NSRT hardware would diminish the hazards to people, property and HAB instrumentation.
3. Development of emergent aerospace technologies.

Technical Proposal:

Electrical: PIC-based flight computer. GPS, and possibly IMU, flight data acquisition. Servo-control. Power system. Telemetry and command RF equipment.

Mechanical: Servos. Parachute. Parachute deployment mechanism. Cut-down mechanism. Payload housing. Thermal management.

Software: Winds aloft data logging. Descent ground track prediction. Descent flight control.

System Integration & Test: (1) Feed simulated GPS data to flight computer. (2) Test in ME thermal/vacuum chamber. (3) Parachute drop tests (with UAV?) (4) High-altitude balloon flights.

Anticipated Customer Base:

NOAA, University researchers, NASA, DOD

Cost Proposal:

Funds are available to cover the initial cost estimate of \$1600.

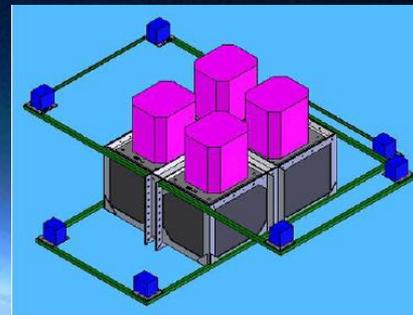
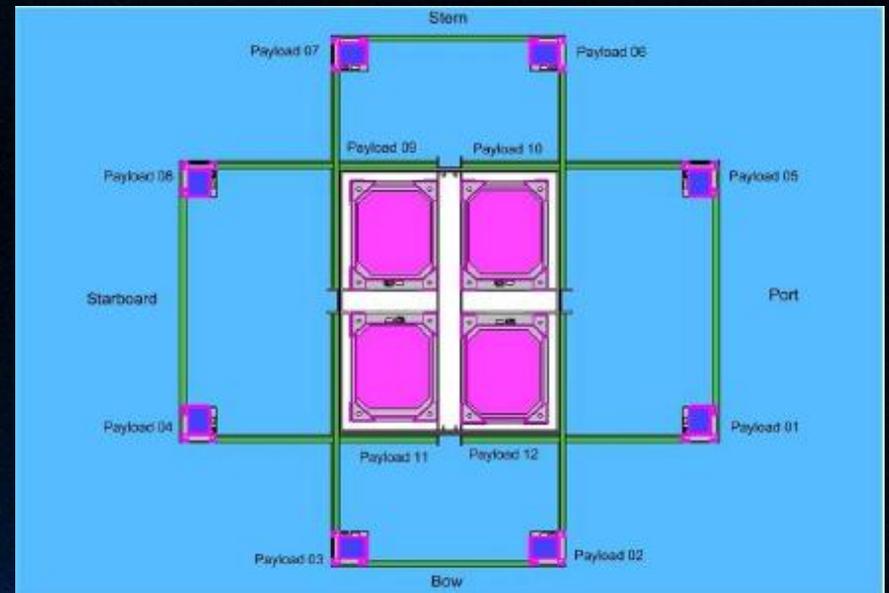
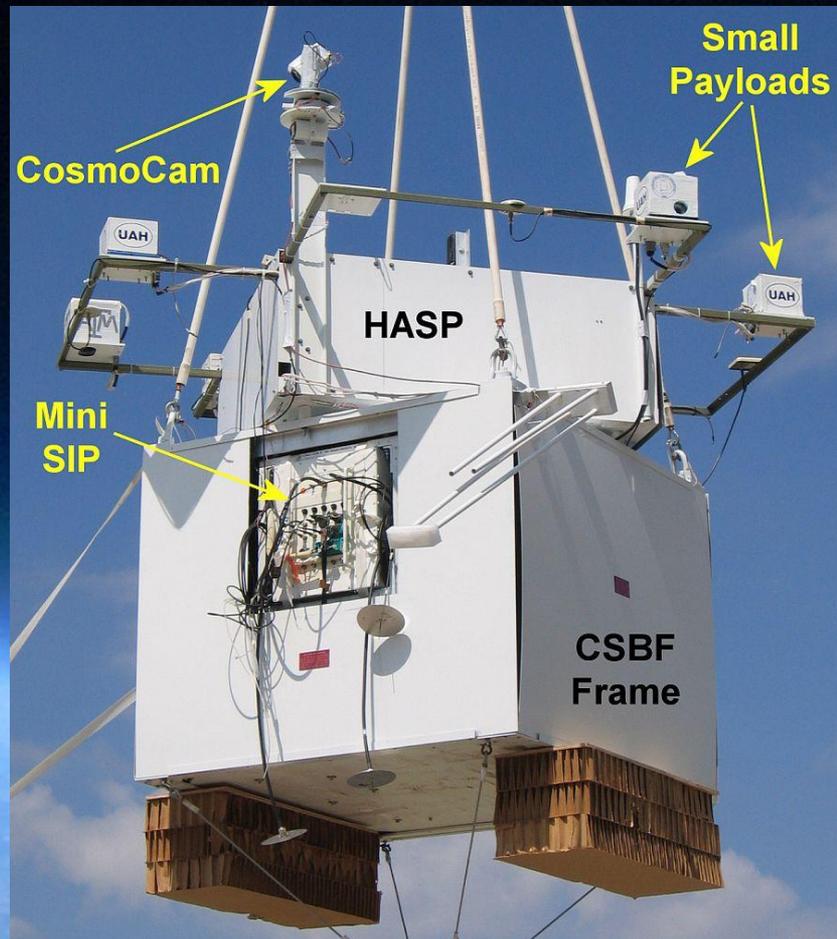
Deliverables:

Conceptual Design Review (1 month), Preliminary Design Review (3 months), Critical Design Review (4 months), Assembly, Integration, Testing Report (6 months), Flight Readiness Review (7 months), High-altitude Balloon Flight (8 months), Final Report (8.5 months),

Point of Contact:

Ron Fevig
Assistant Professor
UND Space Studies Department
Room 526 Clifford Hall
(701)777-6790, rfevig@space.edu

HASP & Gondola



•(HASP Manual, 2008)

Airborne Real-Time Embedded Mosaicking Imaging System (ARTEMIS)

- Collaborative effort between the Departments of Electrical Engineering and Space Studies
- Imaging system is currently being developed for UAVs
- May be implemented on balloon-borne and space-borne platforms

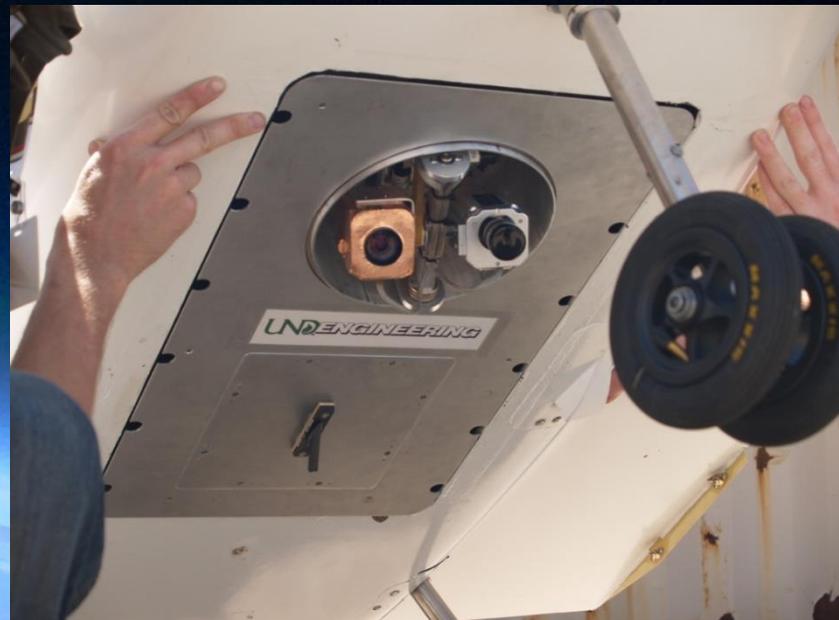
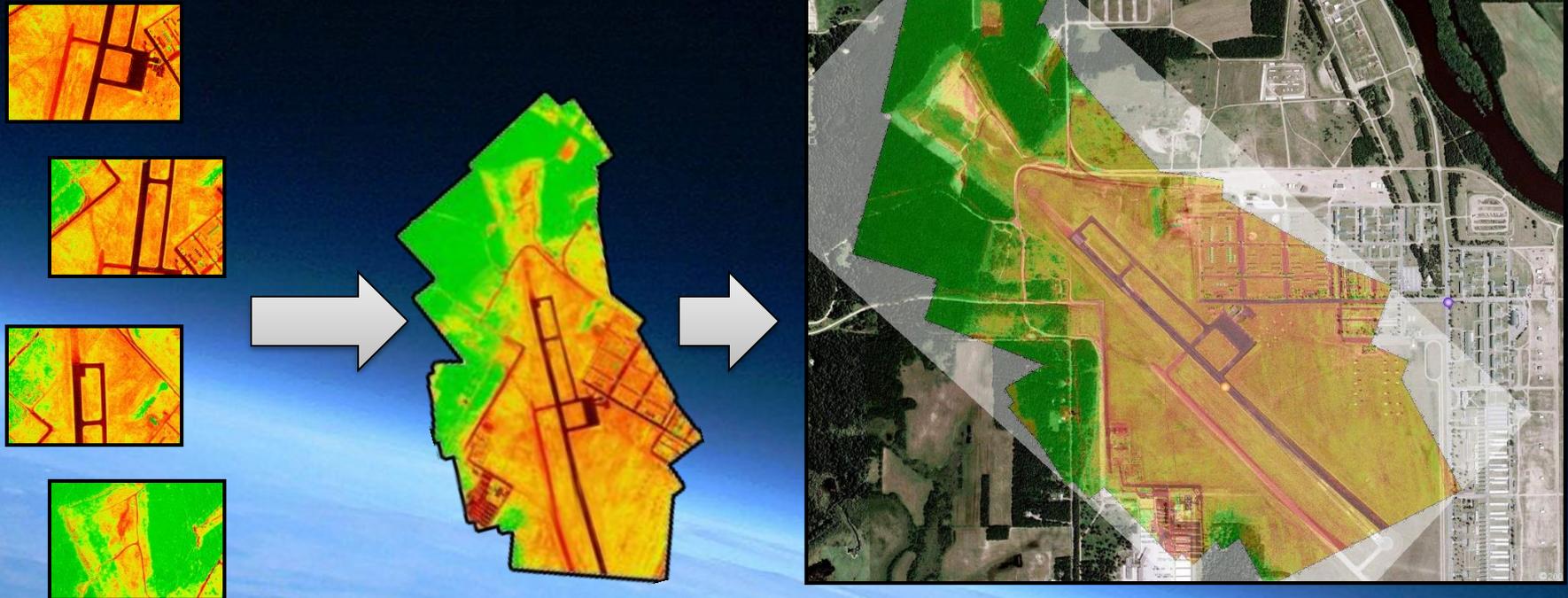


Image Mosaicking

- Multiple images transformed into a single larger image
- Feature detection (correlation) used to determine overlap
- Mosaicking traditionally involves post processing



• Images courtesy of David Dvorak, Dr. Jeremiah Neubert

Mosaicking from Video

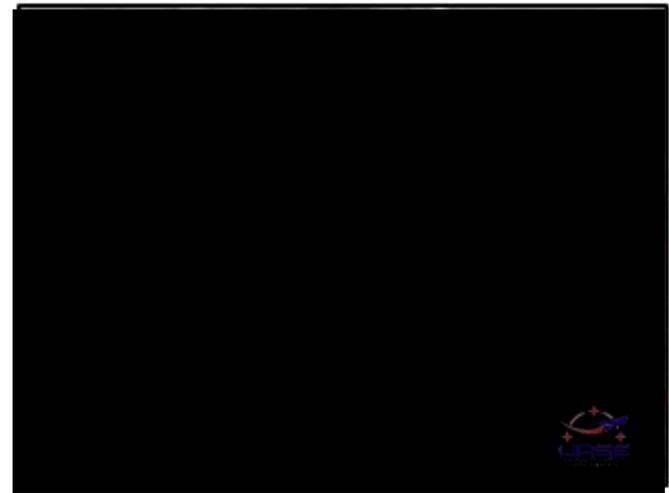
- Feature detection
- Correlation between frames
- Motion estimation
- Image transformation

Size comparison:

Video: 2.78MB (4sec AVI, 15fps)

Image: 25.2 KB (380x290 JPEG)

* Still image is over
100x smaller *



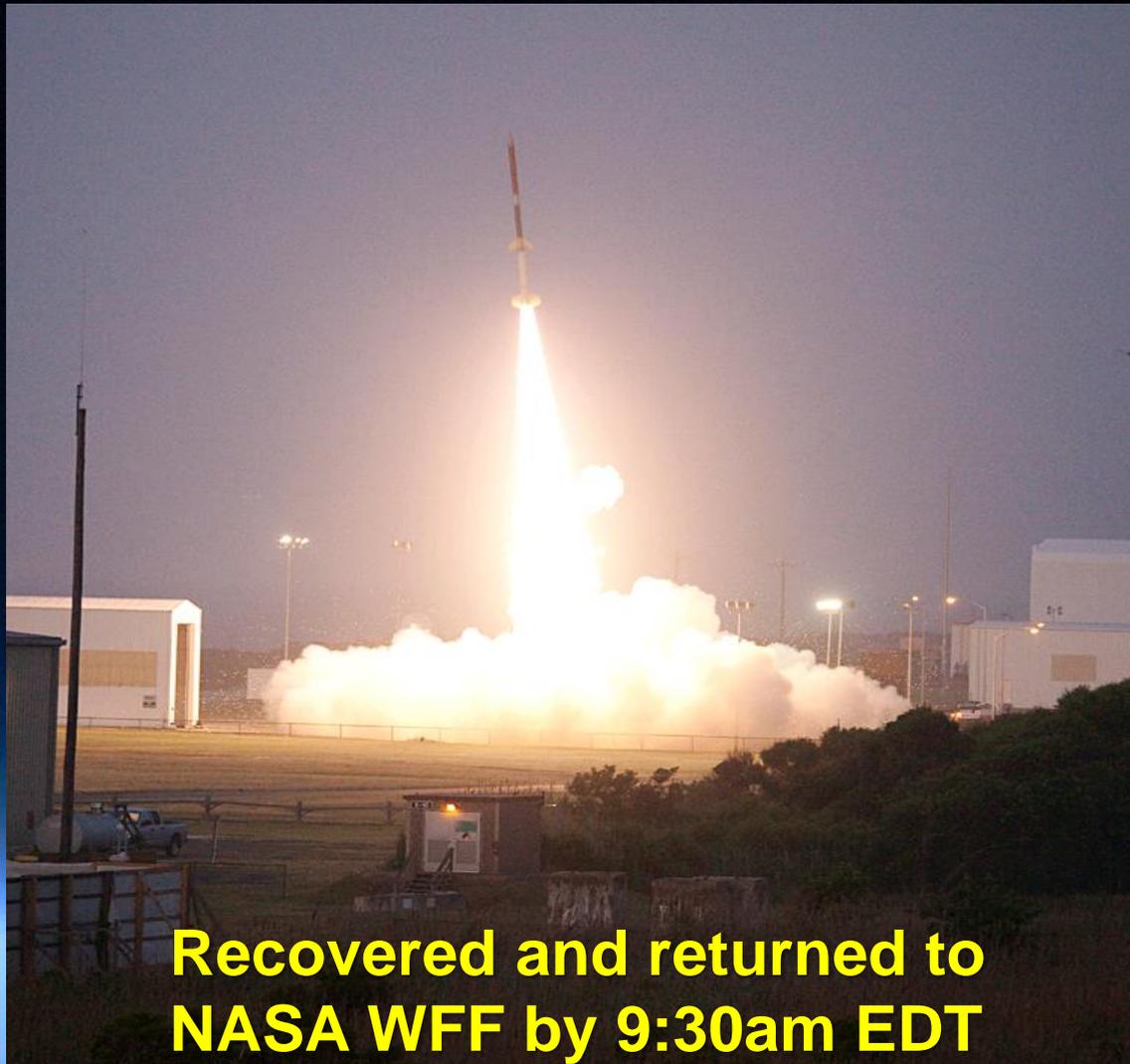
RockSat Timeline

- 08-18-2008 RockSat Payload User's Guide Released
- 09-22-2008 Submit Intent to Fly Form
- 09-29-2008 Initial Down Selections Made
- 10-27-2008 Earnest Payment of \$1,000 Due
- 10-28-2008 Conceptual Design Review (CoDR) Due
- 10-28-2008 Online Progress Report 2 Due
- 11-14-2008 Preliminary Design Review (PDR) Due
- 11-28-2008 Online Progress Report 3 Due
- 12-12-2008 Critical Design Review (CDR) Due
- 12-19-2008 Final Down Select—Flights Awarded
- 01-23-2009 First Installment Due
- 01-30-2009 RockSat Payload Canisters Sent to Customers
- 01-30-2009 Online Progress Report 4 Due
- 02-20-2009 Individual Subsystem Testing Reports Due
- 02-27-2009 Online Progress Report 5 Due
- 03-27-2009 Payload Subsystem Integration and Testing Report Due
- 04-10-2009 Final Installment Due
- 04-17-2009 First Full Mission Simulation Test Report Due
- 04-30-2009 Online Progress Report 6 Due
- 05-22-2009 Second Full Mission Simulation Test Report Due
- 05-29-2009 Online Progress Report 7 Due
- 06-10-2009 Launch Readiness Review (LRR) Teleconference
- 06-(22-24)-2009 MOI and Vibration Testing at WFF
- 06-24-2009 RockSat Payload Canister Integration with WFF
- 06-26-2009 Launch Day!



Wallops Flight Facility
Goddard Space Flight Center

Launch: June 26th, 2009 at 5:30am EDT



**Recovered and returned to
NASA WFF by 9:30am EDT**



Wallops Flight Facility
Goddard Space Flight Center

UND AmSat Ground Station



Laser Communications Hermes

- Digitally modulated laser communication system
- Laser mounted on a UAV gimbal system
- Current design goals
 - 1.5 km fixed ground-ground communication
 - 8 cm receiver aperture
- EE System components
 - Camera
 - Laser transmitter
 - Laser receiver
 - Video converters (modulators)



Scope of the UA CubeSat Project

- 56 students (20 extremely dedicated)

Majors from EE, ME, CS, Physics, Planetary Sciences, Optical Engineering, Systems Engineering

- 25 faculty mentors
- 36 sponsors
- Cost/satellite \approx \$250,000 (?)

