National Aeronautics and Space Administration

# Rocket Report

2 2009

Sounding Rockets Program Office

## What's Inside...



## In Brief...

NASA's Jet Propulsion Laboratory (JPL) has been selected for the Hands on Project Experience (HOPE) mission. The mission will demonstrate terrain relative navigation techniques and will be flow from White Sands Missile Range, NM in a little over a year.

Future student missions were discussed with Penn State University. Penn State is developing a strategic plan and hope to continue student missions.

36.244 UG Green was launched on June 27, 2009 from White Sands Missile Range, NM. The Diffuse Interstellar Cloud Experiment (DICE) is designed to study the interstellar medium.

The Sounding Rocket Working Group (SRWG) meeting was held at Greenbelt on June 18 - 19, 2009. Visit the SRWG website at: http://rscience.gsfc.nasa.gov

Photo by Berit Bland

Murbach payload on the vibration table ready for testing.

## 41.080 Murbach – Re–entry research with Sounding Rockets

Sounding rockets prove their applicability for NASA exploration missions and hypersonics resarch by offering a unique opportunity to test possible re–entry body shapes for future planetary missions.

Marc Murbach, NASA Ames Research Center, is the Principal Investigator for the Sub–Orbital Aerodynamic Re–Entry Experiments VII (SOAREX) payload. These experiments have a launch history beginning with a comprehensive success of SOAREX I, launched from White Sands Missile Range in 1998.

Continued on page 2.

## RockOn! launches second mission

Students and faculty from universities around the country participated in the second RockOn! workshop and launch event. In addition to the workshop experi–ments, 10 university teams flew RockSat modules with experiments of their own design.

RockOn! is a collaborative effort between the NASA Space Grant Office, Colorado and Virginia Space Grant Consortia and the NASA Sounding Rocket Program Office.

More on page 3

Lift–off of 41.083 Koehler, RockOn!.

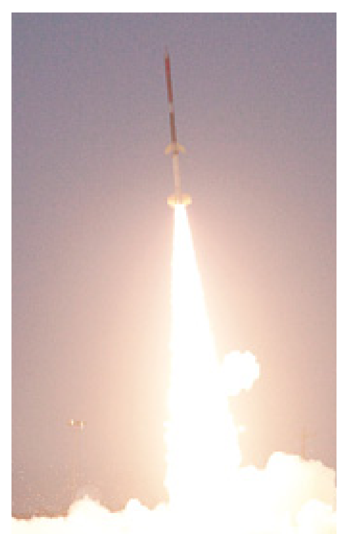


Photo by Wallops Imaging Lab

Rocket Report

## 41.080 Murbach continued...

Early in the development of rockets and space vehicles, the conventional wisdom was to design sharp reentry vehicles to reduce atmospheric friction. This thinking changed in the 1950s when a NASA engineer, H. Julian Allen, theorized that a blunt body design would better survive reentry by creating a shock wave in front of a vehicle's heat shield, thereby reducing heat on the vehicle. Since then, every major reentry vehicle has employed Allen's design concept. NASA is challenging the conventional wisdom again with a new reentry vehicle design that could lead to the development of lightweight, self–orienting, super–stable reentry probes.

This Slotted Compression Ramp, or SCRAMP, design concept situates the payload in front of the heat shield. The concept originated with the Sub–Orbital Aerodynamic Reentry Experiments, or SOAREX, Project. SOAREX is a multi–year hypersonic flight test development project at NASA's Ames Research Center at Moffett Field, Calif.


Photo by Berit Bland

Photos: Above: Team photo from left Ed White, Herb Morgan, PI Marc Murbach and Bruce White. Below: Ed White and Marc Murbach working on flare.


Photo by Berit Bland


Photos probided by Marc Murbach/NASA Ames

A special mechanism developed in the arc–jet permits the study of shock–interactions and in particular, the material response.

The classic SCRAMP probe, flown in SOAREX I, IV and VI missions, is analogous in design to a badminton birdie, with a slotted flare skirt attached to a spherical or blunt–nosed cylinder. This serves to push the center of gravity forward, providing nose–forward stability. The diameter of the flare skirt is larger than the diameter of the cylinder nose. During reentry, both the flare skirt and the cylinder nose will produce shock waves. The bow wave produced by the cylinder nose will collide with a larger, stronger wave produced by the flare skirt. A slot around the inner circumference of the skirt will permit the thin layer of air next to the vehicle –– called the boundary layer –– to be swallowed, leading to the interaction between the shock waves. This interaction and resulting redirection of energy creates sufficient drag to slow down and stabilize the vehicle during reentry.

The Tube–Deployed Re–entry Vehicle (TDRV) flown on SOAREX VII, Murbach 41.080, is somewhat different in design to the classic SCRAMP. While the design still uses a blunt–nose cylinder with a flare skirt, there is no slot between the body and the skirt. The flare in the TDRV is made of a combination of high–temperature flexible materials, some of which were developed during the shuttle program. Higher temperature material combinations have been identified and would be included during proposed orbital re–entry tests. Instrumentation on the TDRV included pressure sensors, radiometers, thermo–couples, rate gyros, accelerometers, and a video camera.

Preliminary analysis of the data show the probe quickly orienting nose–down after deployment validating the predicted stability and the high drag coefficient.

Sounding Rockets, with short design and fabrication lead times and performance envelopes that can be tailored to mission requirements are ideal launch vehicles for hypersonics experiments, decelerators and re–entry experiments.

Information for this article provided by PI Marc Murbach/NASA Ames & Bruce White/NASA Ames.
References: NASA Ames Media Background Fact Sheet for SOAREX, published for the SOAREX VI mission & 41.080 Design Review Data Package.

# It's RockOn! time again!

Students and faculty from universities around the country are participating in the 2009 RockOn! flight opportunity. Arranged jointly by the Colorado and Virginia Space Flight Consortia and supported by the NASA Space Grant Program and NASA Sounding Rockets Program Office, RockOn! is a hands–on workshop teaching participants how to create a spaceflight experiment, program a flight computer, and collect and analyze data. Additionally, in 2009, 10 universities were selected to fly experiments of their own design by participating in the RockSat portion of the program.

The RockOn! workshop participants arrived at NASA's Wallops Flight Facility on Sunday, June 21, 2009 and were greeted by Chris Koehler Director of the Colorado Space Grant Consortium and his team of student and Mary Sandy Director of the Virginia Space Grant Consortium. This team of experts will guide the RockOn! groups through construction, integration and testing of their experiment kits, and on the last day of the workshop, the launch of a NASA two–stage Terrier–Orion sounding rocket.

There is definitely a lot to learn. The AVR microprocessor and the sensor suit, consisting of accelerometers, pressure sensor, Geiger counter, and temperature sensors, are integrated to form a complete experiment system capable of taking measurements and collecting and storing data during flight. Before any data can be collected, however, the AVR has to be programmed and the students are familiarized with the C programming language.

The Idaho team working on their RockOn! experiment.

In a room with 50 people in 20 teams, the silence tells of the intense focus of the experimenters. Chris Koehler teaches the workshop in a very systematic fashion and the team of student assistants are on standby, ready to fan out into the classroom to help the groups complete the various tasks. The goal is clear; all experiment boards have to be in working order before installation in the canisters, two days before launch. There is no time to waste.

The faculty/student team from Northwest Nazarene University, Idaho lead by Lawrence Miles are first time participants in the RockOn! workshop. The team is actively involved with the Idaho Space Grant Consortium and has launched BalloonSats in the past. They plan to incorporate their RockOn! spaceflight experiment into future BalloonSat launches.

Chris Koehler, Director Colorado Space Grant Consortium (left) inspect the Syracuse University team's experiment.

Peter Plumley faculty member from Syracuse University, NY is here for the second time. Last year he attended as part of a faculty team, this year he brought along a student, Aaron Orbaker. Aaron appreciates the value of hands–on experience, particularly when added to a solid theoretical foundation.

# It's RockOn! time again! continued

Jahnieka Griffin, a physics major and freshman from Hampton University in Virginia, is exploring her career options. "This work–shop gives me an opportunity to explore space and spaceflight related careers," she says while inspecting the experiment board with her teammate Jayrik Hayes. Jayrik, a senior, also from Hamp–ton University, will focus on Aerospace engineering next year and is graduating in May 2010. "This is an awesome hands–on workshop and an invaluable learning experience," Jayrik says enthusiastically.

At 4:00 a.m. on launch day, the teams leave their hotel on Chin–coteague to arrive Wallops Island in time for the 5:30 a.m. launch window opening. For most of the participants, this is their first sounding rocket launch and they are clearly excited, as are the Wallops staff members out on the Island watching the launch. At T–10 seconds the audience helps with countdown and at exactly 5:30 the Terrier–Orion rocket lifts–off and the RockOn! and Rock–Sat experiments are on their way to space. The rocket reaches an altitude of 117 km and the payload starts its descent. A parachute slows the descent and softens the impact and sealed sections keep the payload afloat in the ocean until a recovery boat picks it up. When the payload returns to Wallops Flight Facility, approxi–mately four hours after launch, the experiments are returned to the teams and the data analysis can begin. Initial assessment indicates that all the RockOn! experiments worked. Data analysis for the more complicated RockSats will take a few days.

Back in the classroom at Wallops, Jahnieka is downloading the Hampton University team's RockOn! data and is relieved to see the data file stream from the experiment to the laptop. "The launch was definitely exciting, but learning how to build circuits and use microcontrollers is the most important part of the workshop. We're already discussing a RockSat experiment for next year," Jahnieka says while the data is downloading.

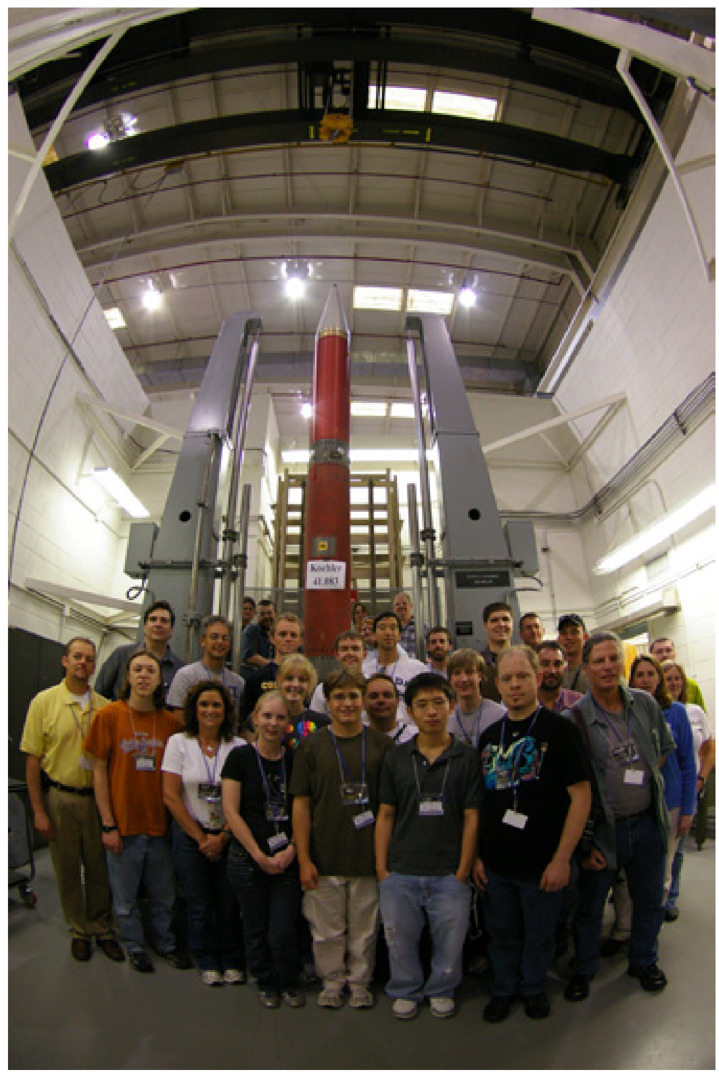
To find out more about this flight opportunity visit the Colorado Space Grant Consortium on the web at:
http://spacegrant.colorado.edu/rockon/

or the

Virginia Space Grant Consortium at:
http://www.vsgc.odu.edu/

For information about the Space Grant program visit:
http://www.nasa.gov/offices/education/programs/national/spacegrant/home/index.html

Jahnieka (right) and Jayrick (center) with Hampton University faculty advisor John McNabb (left) working on their RockOn! experiment.



RockOn! group photo in front of the payload in the spin/balancing bay at Wallops.

Rocket Report

# Integration and Testing

## Hall 12.067 GT – Terrier – Improved Malemute Test flight

Photo by Berit Bland

Jeff Cain and Brian Rose with Hall 12.067 GT

12.067 GT Hall is the first test flight of the new Terrier–Improved Malemute vehicle. The predicted performance envelope for this vehicle allows payloads weighing between 600 and 1200 pounds to be launched to altitudes between 150 and 300 kilometers.

Two university CubeSats will be flown on this mssion. The CubeSats are being supplied by the University of Kentucky and Cal Poly. The Sub Orbital Cubesat Experimental Mission (SOCEM) includes University of Kentucky's Antenna Deployment and Mono–filament Actuator satellite (ADAMASat), consisting of a nichrome and mono–filament actuator experiment. Cal Poly is also providing the Poly CubeSat Launcher (PCL), which is a stripped down P–POD . A skin door is deployed allowing the CubeSats to be ejected.

## Cheatwood 36.254 NR – Inflatable Reentry Vehicle Experiment (IRVE) II

IRVE–II is the second in a series of flight tests designed to develop and validate an inflatable decelerator ballute concept. The tests will be conducted in a stair–step manner, each test building on the previous test, to achieve increasingly difficult technical objectives. IRVE–II will demonstrate inflation and survivability at a realistic dynamic pressure and ballistic coefficient. The follow on flights will demonstrate survivability and performance at relevant heating and relevant vehicle size.

Specifically, the IRVE–II mission will 1) execute a flight–test that demonstrates inflation and survivability at a relevant dynamic pressure, 2) assess the performance of the vehicle from a thermal, and structural dynamics perspective, and 3) validate the analysis and design techniques used in the development of the Reentry Vehicle.

IRVE II will be flown on a Terrier–Black Brant vehicle to an estimated altitude of 207 km. 150 seconds prior to atmospheric interface (80km descending), the inflatable aeroshell will be deployed when the restraint cover is released with a pyrotechnic cutter. After deployment, the RV will begin its inflation process. Inflation will occur over roughly a 120 second interval. Video cameras located within the RV will monitor targets on the aft of the inflatable.

## Bull 41.082 NR – Sub–TEC III

Photo by Berit Bland

Greg Waters (left) and Chris Purdy (right) testing the Ordnance Firing Circuit Simulator Box for the Autonomous Flight Safety System (AFSS). The AFSS is the primary experiment on Bull 41.082 NR Sub–TEC III.

The Sub–TEC technology initiative serves to improve technical capabilities of the Sounding Rocket Program and other users by providing a standardized carrier platform to flight demonstrate new technologies. Sub–TEC missions provide opportunities for multiple experiments and organizations to share the cost of a flight. Sub–TEC III is currently scheduled for flight at the end of July 2009.

NASA Photo\Sean Smith

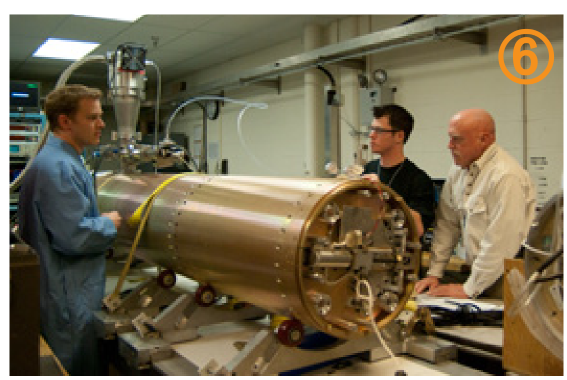
Photo by Berit Bland

Above: Inflated IRVE at ILC, Dover Right: IRVE in te stoved configuration on the spin/balance machine at Wallops with Steve Hughes, LaRC (left) and Rob Marshall (right).

# Rocket Report

## Picture Place...

1. Clay Merscham and Ed White with 41.080 Murbach on balancing table
2. NSROC interns on Wallops Island for the launch of 41.080 Murbach
3. Nate Wroblewski and Andy Owens testing Mesquito fin mounts.
4. Harold Cherrix preparing decks for the ARAV FTM 06, to be launched in July, for vibration testing.
5. Dave Burkhead certifying Nick Cranor and Nate Wroblewski for pyro use.
6. 36.244 Green science team with their telescope.



Rocket Report

## Want to contribute?

Working on something interesting, or have an idea for a story? Please let us know, we'd love to put it in print!

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# FY '09 Launch Schedule

### July

36.221 DS MOSES/NRL WS
36.213 NS DAVIS/MSFC WS
12.067 GT HALL/NASA–WFF WI
41.082 NP BULL/NASA–WFF WI
12.068 GT HICKMAN/NASA–WFF WI
12.069 GT HICKMAN/NASA–WFF WI
12.070 GT HICKMAN/NASA–WFF WI
12.071 GT HICKMAN/NASA–WFF WI

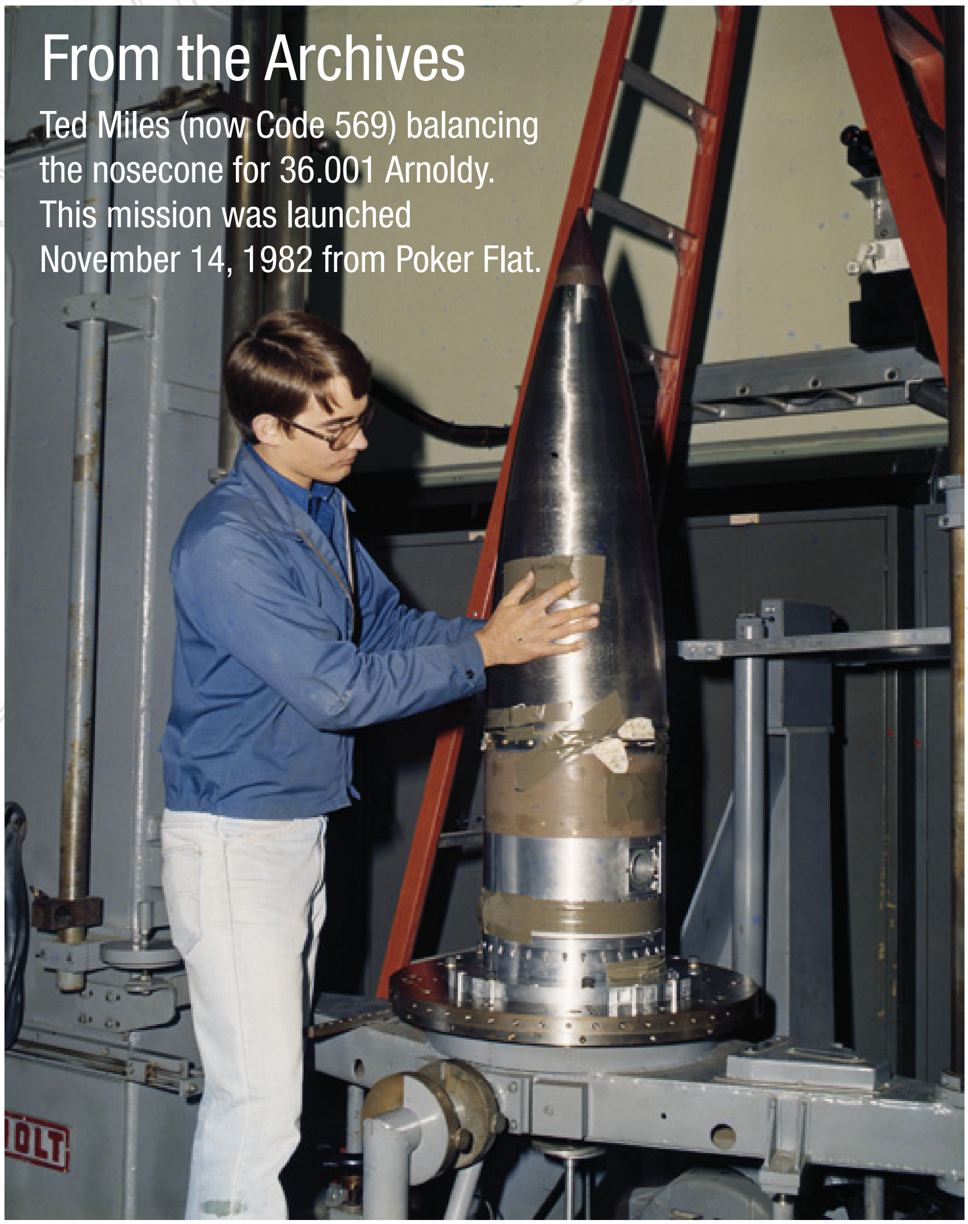
### August

36.254 NR CHEATWOOD/NASA LaRC
41.086 UE ERDMAN/EMBRY–RIDDLE UNIV WS
36.252 UH CASH/UNIVERSITY OF COLORADO WS

### TBD

36.225 UG CHAKRABARTI/BOSTON UNIVERSITY WS TBD

## From the Archives




Ted Miles (now Code 569) balancing the nosecone for 36.001 Arnoldy. This mission was launched November 14, 1982 from Poker Flat.