Subcooled Pool Boiling in Variable Gravity Environments

FAST 2009

Test Plan and Objectives

Technology Description: Pool boiling heat transfer in microgravity environments are needed to properly size future two-phase heat exchangers. Such heat exchangers would be more compact and lighter weight than those used currently, allowing more cargo to be carried with less fuel.

Planned Test Objectives: Study subcooled pool boiling over a continuous range of acceleration levels to:
1. Understand boiling at different acceleration levels
2. Develop a mechanism based model for pool boiling
3. Understand the similarity in effect of heater size and gravity on heat transfer to save experimental costs at low- g

Test requirements:
Number of flight days: 4
Number of personnel: 3
Project dimensions: Rack 1: *609x609x1070* Rack 2: *563x648x1270* (all dim. in mm)
Gravity level(s):0g<a<1.8g
Special Needs: NONE

Value & Relevance to NASA

Primary Relevant Mission Directorate:

Primary Relevant NASA Center: Glenn Research Center

Technology Focus Area:
- Thermal management
- Cryogenic fuel storage
- Design of space based hardware
- Efficient recycling of water for manned space explorations

Specific Benefits of Technology: The results obtained from the proposed work will help in identifying the critical issues that would require attention during NASA's prospective ISS based Microheater Array Boiling Experiment. The proposed experiment will be a step towards the realization of phase-change based thermal technologies for space explorations. The opportunity to perform further variable gravity experiment in parabolic flight environment will help generalize boiling behavior across gravity levels of interest to NASA.

Team Members and Resources

Primary Organization Name:
University of Maryland

Project Manager:
Dr. Jungho Kim (kimjh@umd.edu)

Current or Past Government Contracts or Agreements:
NASA Grant No. NNX08AI60A

Image or Schematic of Experiment

Two racks aboard ESA's ZERO-G Flight, March 2008

FAST 2009

Free-Fall Regolith Heating

Test Plan and Objectives

Technology Description: A novel means of oxygen extraction from regolith shows metrics 3X higher than all other methods. A new technology requires demonstration – the ability to inductively heat molten regolith as it falls under lunar gravity.

Planned Test Objectives: Characterize heating rates and vapor pressure for a variety of analog simulants. Demonstrate free-fall heating and generation of supersonic vapor flow.

Test requirements:
Number of flight days: 3
Number of personnel: 3
Project dimensions (meters): 0.95 x 0.95 x 0.65
Gravity level(s): 0.16g
Special Needs: 1 kW electrical power, exhaust to outside

Value & Relevance to NASA

Primary Relevant Mission Directorate: ESMD

Primary Relevant NASA Center: MSFC, GRC, JSC

Technology Focus Area:
- ISRU – Oxygen extraction

Specific Benefits of Technology: The Dust Roaster can produce 47X its launch mass in oxygen over 1 year of operation (70% sunlight assumed), making it the best oxygen extraction method ever invented. Further along, it can be ganged with a method to extract silicon, aluminum and iron in a process which has already received 3 US Patents. This will be the first factory to operate on the moon.

Team Members and Resources

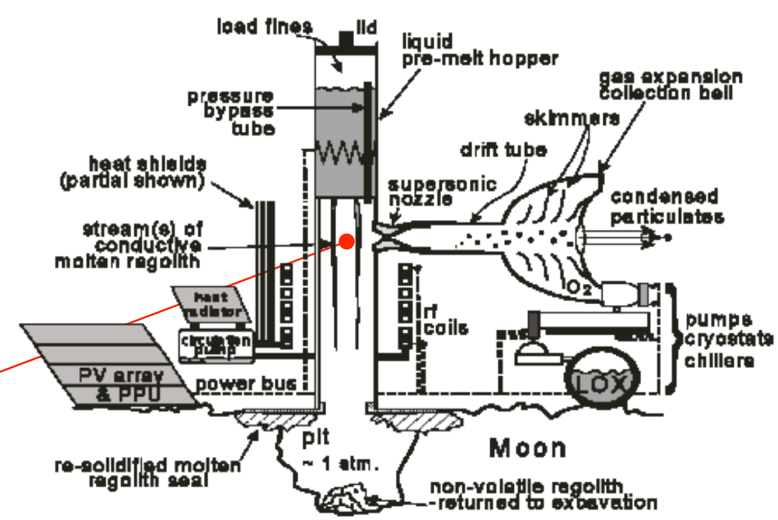
Primary Organization Name:
Packer Engineering, Inc.

Project Manager:
Peter J. Schubert, Ph.D.
pschubert@packereng.com 630-577-1928

Current or Past Government Contracts or Agreements:
NASA SBIR 2007 Phase I, where the oxygen extraction means was invented. Phase II received excellent marks, but did not receive funding due to budget constraints.

Image or Schematic of Experiment

This is the portion which will be demonstrated



Magnetic Unjamming and Flow Control of Lunar Soil

FAST 2009

Test Plan and Objectives

Technology Description: An Electromagnet Pulse Control Unit provides an optimized pattern of magnetic pulses that effectively un-jam lunar soil and restore hopper discharge (or flow in other equipment.) It also provides magnetic fields capable of stopping flow to act as a valve with no moving parts.

Planned Test Objectives: Optimize energy usage vs. hopper discharge rates by varying magnetic pulse patterns in low-g

Test requirements:
Number of flight days: 4
Number of personnel: 4
Project dimensions (meters): 1.168 x 0.559 x 0.432
Gravity level(s): 1/6, 1/3 (desirable, not mandatory)
Special Needs: none

Value & Relevance to NASA

Primary Relevant Mission Directorate: ESMD

Primary Relevant NASA Center: JSC, KSC

Technology Focus Area:

- In Situ Resource Utilization

Specific Benefits of Technology: Hopper flow jamming or other flow problems in ISRU is a serious risk. Soil jams in a piece of equipment will render it unusable unless a crew member visits the hardware and finds a way to manually unjam it. However, this technology will need very little mass or energy and no crew time to provide reliable, remotely-monitored unjamming of any equipment processing lunar soil.

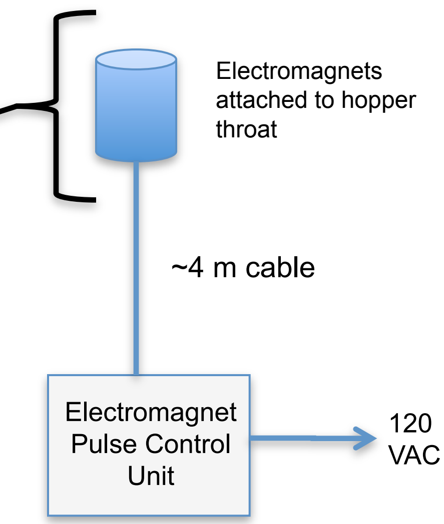
Team Members and Resources

Primary Organization Name:
NASA/KSC/Applied Technology

Project Manager:
Dr. Philip T. Metzger
Philip.T.Metzger@nasa.gov

Image or Schematic of Experiment

Experiment in prior flights (prior to integration of electromagnets and EPCU)



OSIRIS-REx Low-Gravity Regolith Sampling Experiment Step 2

FAST 2009

Test Plan and Objectives

Technology Description: Regolith is picked up with a new technology sampler

Planned Test Objectives:
1. Perform the sampler head touch to the regolith simulant with the planned force (in Step 1 the head rested on regolith).
2. Acquire the regolith sample
3. Measure the collected sample post flight.
4. Compare the collected sample with those collected in the Step 1 flights.

Test requirements:
Number of flight days: *2*
Number of personnel: *4*
Project dimensions (meters): *1.118 L x 0.685 W x 1.295 H*
Gravity level(s): *<0.01 g*
Special needs: *Vent to outside of aircraft*

Value & Relevance to NASA

Primary Relevant Mission Directorate: SMD & ESMD

Primary Relevant NASA Center: GSFC

Technology Focus Area:
- In-Situ Resource Utilization – Regolith excavation and material handling
- New Frontiers 2009

Specific Benefits of Technology: Acquisition of regolith samples from asteroid or comet surfaces

Team Members and Resources

Primary Organization Name:
Lockheed Martin

Project Manager:
Kevin Payne, kevin.s.payne@lmco.com

Partner Organization Name:
University of Arizona

POC:
Dr. Dante Lauretta, lauretta@lpl.arizona.edu

Partner Organization Name:
NASA Goddard Space Flight Center

POC:
Dr. Joseph Nuth, Joseph.A.Nuth.1@gsfc.nasa.gov

Image or Schematic of Experiment

Successful Step 1 Experiment

Evaluation of Tribocharged Electrostatic Beneficiation of Lunar Simulant in Lunar Gravity

FAST 2009

Test Plan and Objectives

Technology Description: With the method of electrostatic beneficiation, dust or powder particles are first tribocharged (the act of charging a particle by contact with another material) by materials of a different composition and then passed through an electric field to enrich for a target mineral

Planned Test Objectives: To document lunar regolith simulant mineral enrichment levels that can be achieved by the beneficiation chamber while experiencing 1/6 of the gravitational pull experienced on Earth.

Test requirements:
Number of flight days: 4
Number of personnel: 3
Project dimensions (meters): 0.6 m^3
Gravity level(s): 0.165 g
Special Needs: none

Value & Relevance to NASA

Primary Relevant Mission Directorate: ESMD

Primary Relevant NASA Center: JSC and KSC

Technology Focus Area:

- In Situ Resource Utilization

Specific Benefits of Technology: Beneficiation is a mineral enrichment technique that when coupled with an oxygen production system will allow for smaller batch treatment systems, thereby reducing the size of equipment on the lunar surface.

Team Members and Resources

Primary Organization Name:
NASA Kennedy Space Center

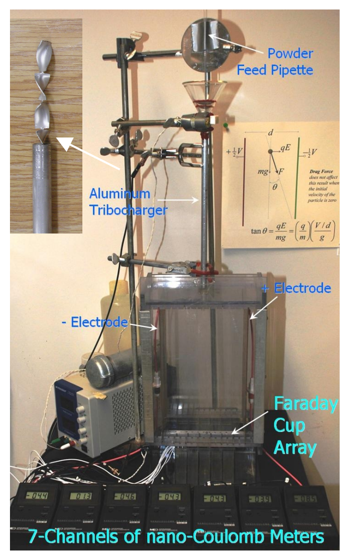
Project Manager:
Jacqueline W. Quinn, Ph.D. Jacqueline.W.Quinn@nasa.gov

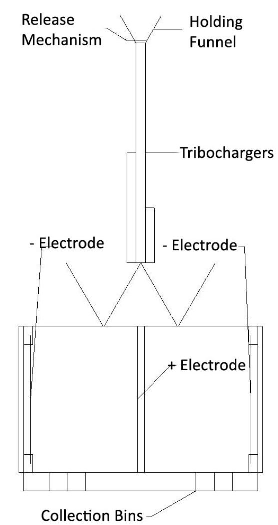
Partner Organization Name:
ASRC Aerospace

POC:
Steve Trigwell, Ph.D. Steven.Trigwell-1@nasa.gov

Current or Past Government Contracts or Agreements:
BOA with ASRC Aerospace as on-board Technology Development Contractor

Image or Schematic of Experiment





Development of Antimicrobial Materials for Microgravity Environments

FAST 2009

Test Plan and Objectives

Technology Description: Passive technologies (e.g., antimicrobial materials, residual biocides) that work in combination with active physical disinfection to provide a layered defense against microbial growth, biofouling, and microbiologically induced corrosion on wetted surfaces in ECLS systems.

Planned Test Objectives: To develop a low-impact test stand and standardized test methods to evaluate emerging antimicrobial technologies in reduced gravity environment.

Test requirements:
Number of flight days: 2
Number of personnel: 3
Project dimensions (meters): ≤1m ; FASTRACK compatible
Gravity level(s): microgravity; ⅙ gravity

Value & Relevance to NASA

Primary Relevant Mission Directorate: ESMD

Primary Relevant NASA Center: KSC, JSC, MSFC

Technology Focus Area:
- Prevention of microbial growth
- biofilm formation and microbiologically induced corrosion in potable water
- Environmental Control & Life Support (ECLS) systems

Specific Benefits of Technology:
1. *System mass reduction in ECLS systems by replacing metal bellows-tanks and distribution lines with polymeric resins;*
2. *Prevention of corrosion and precipitation on wetted surfaces;*
3. *Improved antimicrobial control through use of a sustainable, passive biocide delivery system with antimicrobial materials;*
4. *Reduction of maintenance, monitoring, and re-supply requirements for currently specified biocides.*

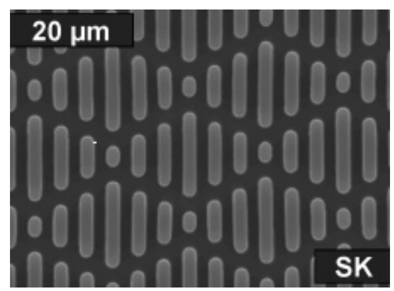
Team Members and Resources

Primary Organization Name:
KSC Applied Technologies

Project Managers:
Luke Roberson (NASA-KSC)
Michael S. Roberts (DYN-KSC)

Current or Past Government Contracts or Agreements:
Supported by partial IPP-SEED funding warded in FY08.

Image or Schematic of Experiment



A

B

(A) Sharklet engineered, antimicrobial topography pattern on PDMSe material.
(B) Individual BRIC with an open and closed PDFU.

The Effect of Electrophoresis on a Fluidized Bed in a Variable Gravity Environment

FAST 2009

Test Plan and Objectives

Technology Description: Beds of particles become fluidized when the weight of the particle is overcome by the passing fluid. When no gravity is present, a new force must be introduced in able to have a controllable fluidized bed.

Planned Test Objectives: Create a fluidized bed in microgravity by submitting particles to an electric force created by electrophoresis to mimic the force of gravity. Be able to control the height of the fluidized bed and overall activity of the bed by use of this electric force.

Test requirements:
Number of flight days:1
Number of personnel:6
Project dimensions (meters):
Gravity level: Micro/ lunar gravity

Value & Relevance to NASA

Primary Relevant Mission Directorate: SMD

Primary Relevant NASA Center: Glenn Research Center

Technology Focus Area:
- Fluidized beds

Specific Benefits of Technology: Fluidized beds are used primarily in the energy field to produce a cleaner type of combustion and also to mix materials. It is important to study the behavior of fluidized beds in space because they could be used for in situ space resource utilization, energy conversion, and life support.

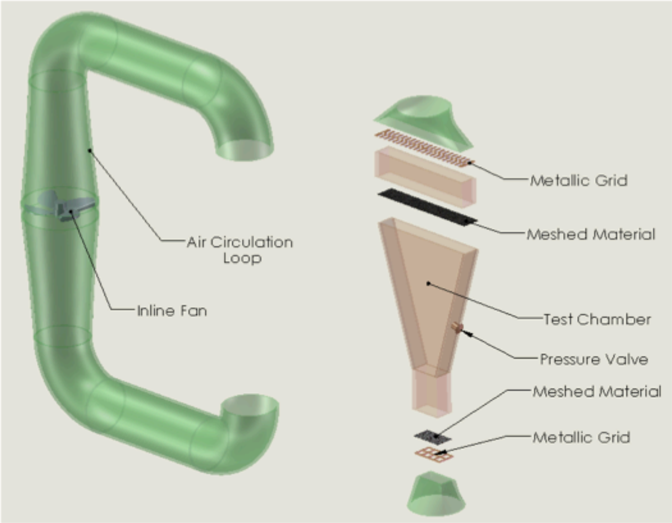
Team Members and Resources

Primary Organization Name:
West Virginia University Microgravity Research Team

Project Manager:
Zachary Merceruio zmerceru@mix.wvu.edu

Other members:
Katherine Gatian, Kyle Potts, Ryan Pekar, Justin West, Timothy Rouse

Image or Schematic of Experiment



Vacuum-Compatible Multi-Axis Manipulator/Machining Center (M/MC) for Long-Duration Space Missions

FAST 2009

Test Plan and Objectives

Technology Description: Our M/MC satisfies many NASA needs for maintenance and repair technologies for long-duration space missions, including complex manipulation during layer-additive and subtractive manufacturing.

Planned Test Objectives: (1) demonstrate subtractive manufacturing of example parts in a reduced-gravity environment; and (2) identify potential problems with swarf (chips) management.

Test requirements:
Number of flight days: 4.
Number of personnel: 1.
Project dimensions (meters): 0.99x0.81x1.29+0.91x0.66x0.76.
Gravity level(s): 0 g; 0.16 g; and 0.38 g.
Special Needs: None.

Value & Relevance to NASA

Primary Relevant Mission Directorate: SOMD

Primary Relevant NASA Center: JSC

Technology Focus Area:

- Space Operations

Specific Benefits of Technology: Our M/MC will provide complex manipulation during: layer-additive manufacturing; collection of geometric data for reverse-engineering; real-time non-destructive evaluation; and non-destructive material property determination. Our M/MC will also finish-machine near-net-shape parts produced using layer-additive manufacturing.

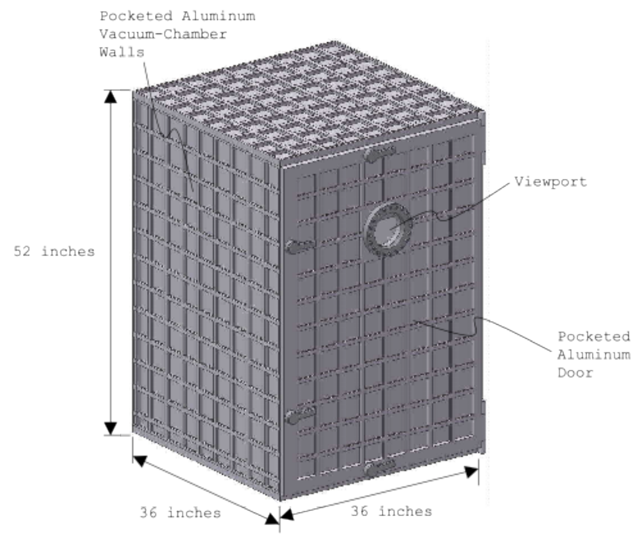
Team Members and Resources

Primary Organization Name:
Beck Engineering, Inc.

Project Manager:
Douglas S. Beck, dbeck23@aol.com

Current or Past Government Contracts or Agreements:
NNJ08JA63C (Phase II SBIR); NNJ07JB28C (Phase I SBIR).

Image or Schematic of Experiment



Microgravity Fluid Separation: DYNASWIRL Free Vortex Separator

FAST 2009

Test Plan and Objectives

Technology Description: *Phase separator using DYNASWIRL, a DYNAFLOW swirling cavitating flow nozzle*

Planned Test Objectives: *Validate the performance of DYNASWIRL phase separator under zero-gravity condition.*

Test requirements:
Number of flight days: 2
Number of personnel: 2
Project dimensions (meters): 1 m x 1 m x 0.5 m
Gravity level(s): 0 g
Special Needs: 110 V power supply during tests. Water (5 gal) needs to be filled prior to the flight.

Value & Relevance to NASA

Primary Relevant Mission Directorate: ESMD

Primary Relevant NASA Center: GRC, GSFC, SSC, MSFC

Technology Focus Area:
- Phase Separation in Microgravity

Specific Benefits of Technology: The technology will provide a reliable and efficient phase separator for NASA's exploration missions and the space station. The proposed test is a for gas-liquid separation, but the principle of operation can be extended to liquid-liquid separation in the future.

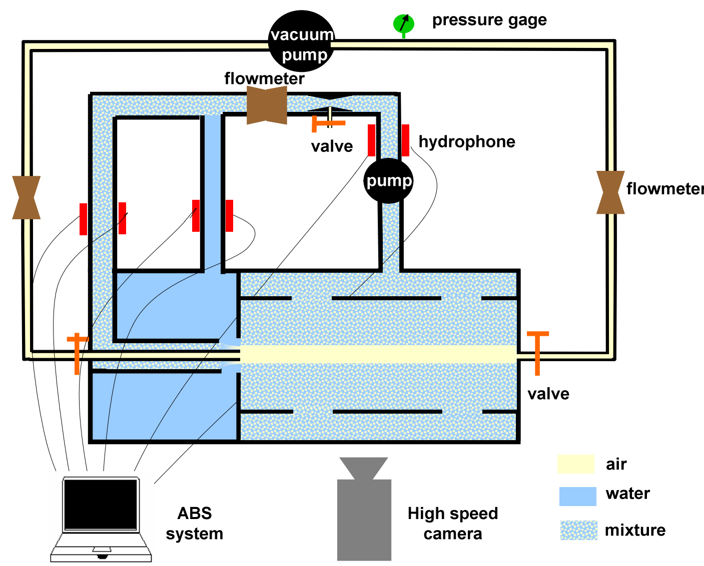
Team Members and Resources

Primary Organization Name:
Dynaflow, Inc.

Project Manager:
Dr. Georges Chahine

Current or Past Government Contracts or Agreements:
NASA Research Announcement (NRA) funding $100K awarded for current development work (Mar. 2009 – Mar. 2010)

Image or Schematic of Experiment



Flowing and Sifting Lunar Soil Simulant

FAST 2009

Test Plan and Objectives

Technology Description: Hopper flow and sieving performance are crucial in powder technologies. Gravity effects on their performance has not been established. Lunar operations cannot be designed without knowledge of gravity effects.

Planned Test Objectives: Will advance design rules for hoppers and sieving equipment in partial gravity. Lunar powder handling operations cannot be designed without this knowledge.

Test requirements:
Number of flight days: 4
Number of personnel: 2-3
Project dimensions (meters): 0.6(D)X1.2(W)X1(H)
Gravity level(s): Lunar
Special Needs:

Value & Relevance to NASA

Primary Relevant Mission Directorate: ESMD

Primary Relevant NASA Center: GRC

Technology Focus Area:
- ISRU Operations

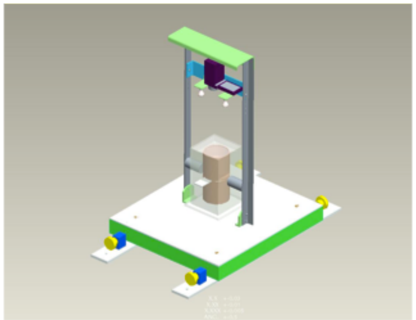
Specific Benefits of Technology: Imporved design rules for hopper flow and sieving equipment with gravity level properly taken into account.

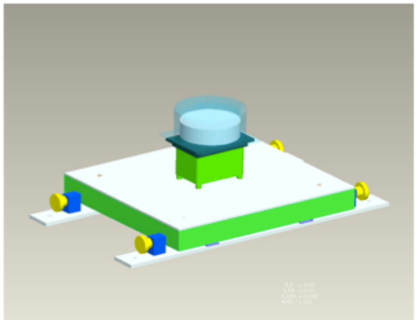
Team Members and Resources

Primary Organization Name:
NASA Glenn Research Center

Project Manager:
Enrique Rame, enrique.rame@grc.nasa.gov

Image or Schematic of Experiment





High-Accuracy Eye-Movement Monitor

FAST 2009

Test Plan and Objectives

Technology Description: Head-mounted unit, contact lens with coil, and associated electronics, provides lab-quality eye position while allowing the subject free movement.

Planned Test Objectives: Test subject makes standardized head and eye movements. Measurement accuracy is assessed in different g levels and while free floating.

Test requirements:
Number of flight days: 4
Number of personnel: 3
Project dimensions (meters): 2x3 (approx)
Gravity level(s): 0g, 1.8g
Special Needs: Brief level flight for contingency procedures.

Value & Relevance to NASA

Primary Relevant Mission Directorate: ESMD

Primary Relevant NASA Center: JSC

Technology Focus Area:
- Crew Support & Accommodations
- Crew health care systems

Specific Benefits of Technology: Ability to measure eye movements with high temporal and spatial accuracy, during natural (unimpeded) head and body motions. This will improve the assessment of sensorimotor alterations during long-duration flight, including those that have a functional impact on manual-control and piloting performance.

Team Members and Resources

Primary Organization Name:
Johns Hopkins University, School of Medicine

Project Manager:
Mark Shelhamer, mjs@dizzy.med.jhu.edu

Current or Past Government Contracts or Agreements:
NSF grant DBI-9876635, April 1999-March 2003
NIH grant R01-EB001914, September 2003-July 2009

Image or Schematic of Experiment

Martian and Lunar Dust Mitigation (MLDM)

FAST 2009

Test Plan and Objectives

Technology Description: Test chamber with triboelectric charging and deployment system, monitored by video cameras. Flew for EGM-001 experiment from NASA GRC.

Planned Test Objectives: Characterize unit for Martian and lunar gravity levels. Determine whether charged particles will be uniformly dispersed and re-dispersed using a variety of dispersal rates, charge levels, geometries, and angles.

Test requirements:
Number of flight days: 4
Number of personnel: 3 (per day)
Project dimensions (meters): 0.94 L × 0.56 W × 1.25 H
Gravity level(s): Martian, 0.38 g; lunar, 0.16 g
Special Needs: External vent accommodation (may be waived)

Value & Relevance to NASA

Primary Relevant Mission Directorate: Applied Technology (KT)

Primary Relevant NASA Center: KSC

Technology Focus Area:
- Dust mitigation systems and test

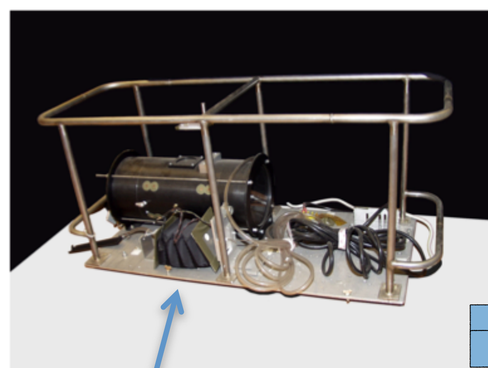
Specific Benefits of Technology: This device will further research on mitigation of dust effects on Martian and lunar surface missions. Technology and method have been proven in microgravity flight environment.

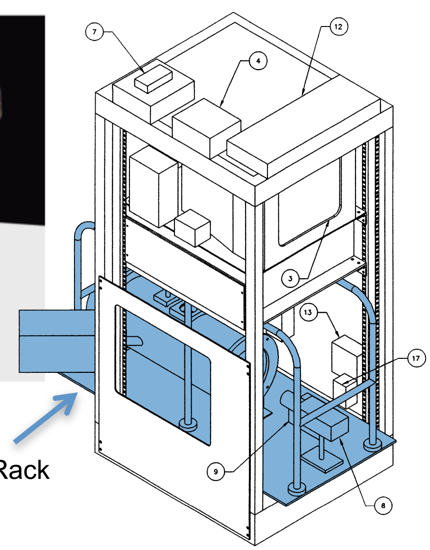
Team Members and Resources

Primary Organization Name:
ASRC Aerospace Corporation

Project Manager:
Walt Turner (walter.b.turner@nasa.gov)

Image or Schematic of Experiment





Float Plate stows in Floor-mounted Rack

A Countermeasure for Motion Sickness during Parabolic Flight: Autogenic Feedback Training Exercise

FAST 2009

Test Plan and Objectives

Technology Description: A psychophysiological training method that has been shown to significantly reduce space motion sickness.

Planned Test Objectives: 1) Develop a preflight training program that can be used by space tourists and astronauts, 2) Evaluate the efficacy of AFTE during parabolic flight and 3) Test smart fabric sensors for measuring physiology in parabolic flights.

Test requirements:
Number of flight days: 2
Number of personnel: 12 (6 per flight)
Project dimensions (meters): Participant worn equipment
Gravity level(s): Zero gravity or reduced gravity
Special Needs: None

Value & Relevance to NASA

Primary Relevant Mission Directorate: SOMD

Primary Relevant NASA Center: JSC, ARC

Technology Focus Area:
- Optimizing crew health and performance.

Specific Benefits of Technology: 1) Increased knowledge of the impact of reduced gravity on human health and performance and 2) Validation of non-drug countermeasure for space motion sickness.

Team Members and Resources

Primary Organization Name:
NASA Ames Research Center

Project Manager: and POC's
Patricia S. Cowings, patricia.s.cowings@nasa.gov
William B. Toscano, william.b.toscano@nasa.gov

Partner Organization Name: Zephyr Technology Ltd.

POC: Brian Russell Brian.Russell@zephyr-technology.com

Current or Past Government Contracts or Agreements:
Life Science Dedicated Space Shuttle Experiments STS-51C, STS-51B, STS-47, and Russian MIR Space Station (1996-1998)

Image or Schematic of Experiment

Preflight Training

Flight Hardware

Zero G and Me: Modeling Cardiovascular Dynamics from Echocardiography and Impedance Cardiography during Parabolic Flight

FAST 2009

Test Plan and Objectives

Technology Description: Noninvasive method for measuring cardiac function during reduced gravity

Planned Test Objectives: 1) To obtain data from echo and impedance cardiography during preflight and parabolic flight , and 2) Develop a mathematical model to extrapolate echocardiography findings based on data captured by impedance cardiography.

Test requirements:
Number of flight days: 2
Number of personnel: 12 (6 per flight)
Dimensions(m): Mindware (0.2x 0.1x0.04), Sonosite (0.3x0.3x0.08)
Gravity level(s): Reduced gravity (0.16g and 0.38g)
Special Needs: 30 parabolas at each g-level

Value & Relevance to NASA

Primary Relevant Mission Directorate: Space Operations Mission Directorate

Primary Relevant NASA Center: ARC, JSC

Technology Focus Area:
- Optimizing crew health and performance

Specific Benefits of Technology: Provide a real-time tool for evaluating the potential effects of g-transitions on cardiovascular function of crews during extended duration lunar or Mars flights, and the possible need for countermeasures.

Team Members and Resources

Primary Organization Name:
NASA Ames Research Center

Project Manager:
Patricia S. Cowings, patricia.s.cowings@nasa.gov
William B. Toscano, william.b.toscano@nasa.gov

Partner Organization Name:
University of Akron – Ohio

POC:
Bruce Taylor, btaylor@uakron.edu

Current or Past Government Contracts or Agreements:
Life Science Dedicated Space Shuttle Experiments STS-51C, STS-51B, STS-47, and Russian MIR Space Station (1996-1998)

Image or Schematic of Experiment

Mindware MW1000A

Sonosite Titan

Reduced-Gravity Cryo-Tracker® Operation Testing

FAST 2009

Test Plan and Objectives

Technology Description: The Reduced-Gravity Cryo-Tracker® is being developed to improve the accuracy of liquid level measurements in reduced gravity environments.

Planned Test Objective: Demonstrate agreement with analytical predictions. Demonstrate that liquid drops and films on the cone surface in low gravity are moved away from the sensing element. Success will move the Technology through TRL 5.

Test Requirements:
Number of Flight Days: 3
Number of Personnel: 2
Project Dimensions: 0.9 m x 0.6 m (footprint) by 0.9 m high
Gravity Levels: Zero
Special needs: No special needs

Value & Relevance to NASA

Primary Relevant Mission Directorate SOMD, ESMD

Primary Relevant NASA Center KSC, MSFC, JSC

Technology Focus Area:
- Space Transportation
- Propulsion
- Cryogenics

Specific Benefits of Technology
RGCT detects Liquid/Vapor interfaces in 0-g environment
Enables accurate measurement of propellant location and conditions (temperature)
Increases safety and mission assurance (operational awareness)
Base lined on CRYOTE Flight Experiment and Altair Lander

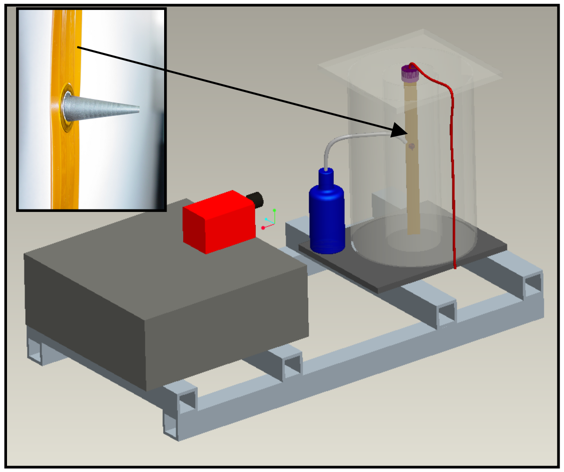
Team Members and Resources

Primary Organization Name:
Sierra Lobo, Inc.

Project Manager:
Mark S. Haberbusch, mhaberbusch@sierralobo.com

Current or past Government Contracts or Agreements
SBIR Phase II contract F29601-02-C-0210 (Jun. 2002 to Aug. 2004)
SBIR Phase III contract NNK05OB14C (Jun. 2005 to May 2006)
SBIR Phase II contract NNK07EA01C (Mar. 2007 to Mar. 2008)
SBIR Phase III contract NNK07EA71C (Sep. 2007 to Mar. 2009)
SBIR Phase III contract NNC08CB04C (Aug. 2008 to Apr. 2009)
Purchase Order Contract NNK08LB39P (Sep. 2008 to Apr. 2009)
Purchase Order Contract NNK08LB19P (Sep. 2008 to Mar. 2009)

Image or Schematic of Experiment



Investigation of pneumatic mining system under lunar gravity and vacuum.

FAST 2009

Test Plan and Objectives

Technology Description: Pneumatics (gas) can be used as means of excavating, 'drilling' and transferring of regolith over large distances.

Planned Test Objectives: We plan to complete the tests interrupted by Hurricane Ike in 2009 and assess gas lifting efficiencies (mass of gas required to lift given mass of soil) and velocity of simulant. The tests will be done in a vacuum chamber and at lunar gravity conditions.

Test requirements:
Number of flight days: 4
Number of personnel: 3
Project dimensions (meters): 2.4m x 1.2m x 1.0m
Gravity level(s): Lunar (1/6 G) required, Mars (3/8 G) desired.
Special Needs: Forklift on the 1st day and on the last day

Value & Relevance to NASA

Primary Relevant Mission Directorate: ESMD, SMD

Primary Relevant NASA Center: KSC, JSC, JPL

Technology Focus Area:
- Excavation
- regolith moving
- O2 extraction
- cleaning of seals
- connectors using pneumatic system

Specific Benefits of Technology: Pneumatic systems is simple and robust having few moving parts. The gas source can be pressurant from Altair propulsion system or residual propellant. The gas can be recycled. The gas can enhance heat transfer during ISRU O2 extraction process.

Team Members and Resources

Primary Organization Name:
Honeybee Robotics

Project Manager:
Kris Zacny, zacny@honeybeerobotics.com

Current or Past Government Contracts or Agreements:
SBIR Phase 2, SBIR Phase 1, LSS BAA

Image or Schematic of Experiment

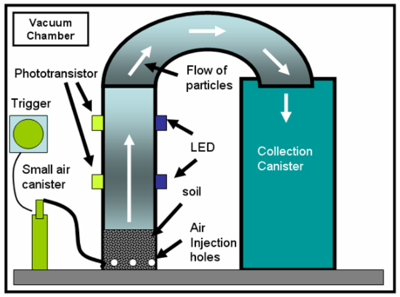


Figure : Test Cell Schematic

Figure : Bank of Test Cells within the LaRC Vacuum Chamber

Rule-Based Analytic Asset Management for Space Exploration Systems (RAMSES)

FAST 2009

Test Plan and Objectives

Technology Description: RFID-based automated, wireless asset tracking and management system for space and ground applications. Implemented in double-sized NASA CTB.

Planned Test Objectives: Characterize prototype performance in reduced gravity environment, testing system recognition of various numbers and types of simulated cargo items. Ground tests indicate that zero-g will maximize system performance.

Test requirements:
Number of flight days: 1
Number of personnel: 3
Project dimensions (meters): 6' x 6' x 8'
Gravity level(s): Zero-g
Special Needs: N/A

Value & Relevance to NASA

Primary Relevant Mission Directorate: SOMD, ESMD

Primary Relevant NASA Center: JSC, KSC, SSC

Technology Focus Area:

- Automated RFID-based asset tracking and logistics management system (hardware and software) for space operations and ground-processing application.

Specific Benefits of Technology: Significantly reduce the amount of time that NASA personnel – in-flight astronauts (up to 4.5 person-months/yr), Mission Control, and ground processing teams – spend on asset tracking and management. Can automate tracking process and provide real-time updates regarding inventory levels.

Team Members and Resources

Primary Organization Name:
MIT

Project Manager:
Prof. Olivier de Weck deweck@mit.edu

Partner Organization Name:
Aurora Flight Sciences

POC:
Mr. Joe Parrish jparrish@aurora.aero

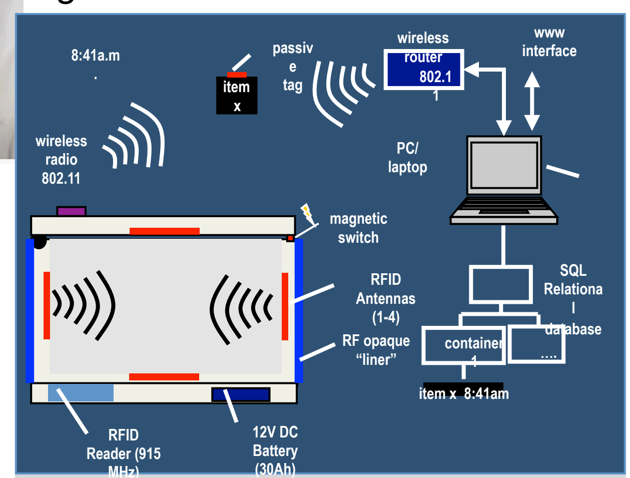
Current or Past Government Contracts or Agreements:
NASA STTR Phase I (NNC06CB58C) & II (NNC07AB25C) - *Rule Based Analytic Asset Management for Space Exploration Systems (RAMSES)*

Image or Schematic of Experiment

0g

1g

RAMSES



Lunar Gravity Testing of an Oxygen Extraction System Design

FAST 2009

Test Plan and Objectives

Technology Description: Roxygen is a project of the ISRU program, the goal of which, is to develop hardware capable of producing a metric ton of oxygen per year on the lunar surface. This reduced gravity test program aims to validate the design of the next generation of Roxygen reactor in a relevant lunar gravity environment.

Planned Test Objectives: The first objective of this reduced gravity test program is to evaluate the effectiveness of a lunar simulant mixing method known as "pulsed flow." The second objective is to test the ease with which simulant can be put into and taken out of a prototype of the next generation of Roxygen reactor. This reactor technology will be advanced from TRL 4 to TRL 5 as a result of this testing.

Test requirements:
Number of flight days: 2
Special Needs: None.
Number of personnel: 4 (2 per flight)
Project dimensions (meters): 0.6 X 1.5 X 1.5 m
Gravity level(s): Lunar gravity (1/6 g).

Value & Relevance to NASA

Primary Relevant Mission Directorate: ESMD

Primary Relevant NASA Center: JSC

Technology Focus Area:
- In-Situ Resource Utilization (ISRU)

Specific Benefits of Technology: Reduces cost and mass, and increases reliability of oxygen production systems for lunar exploration missions. Decreases dependence on Earth based consumables during exploration missions.

Team Members and Resources

Primary Organization Name:
NASA Johnson Space Center
EP3: Energy Conversion Systems Branch - ISRU

Project Manager:
Primary POC: Aaron Paz aaron.paz-1@nasa.gov
Sec. POC: Stuart Pensinger
stuart.j.pensinger@nasa.gov
spensing@purdue.edu

Current or Past Government Contracts or Agreements:
None.

Image or Schematic of Experiment

Fig. 1 – Current TRL 4 test setup for laboratory testing.

Flux-Pinned, Non-Contacting Joints for Small Spacecraft Reconfiguration

FAST 2009

Test Plan and Objectives

Technology Description: A joint for the reconfiguration of modular spacecraft is established by the use of flux pinning, achieved by the use of YBCO superconductors in the presence of magnetic fields. By manipulating the magnetic fields the pinning can function as a non-contacting revolute joint.

Planned Test Objectives: Use the joint in microgravity conditions to reconfigure a two module system between stable equilibrium states. Determine joint parameters through analysis of motion capture data take during testing.

Test requirements:
Number of flight days:1
Number of personnel:3
Project dimensions (meters): 0.5m x 0.2m x 0.2m , 0.02 m^3
Gravity level(s): microgravity

Value & Relevance to NASA

Primary Relevant Mission Directorate: Science Mission Directorate

Primary Relevant NASA Center: Ames Research Center, GSFC, MSFC

Technology Focus Area:
- Novel Platforms – including power and propulsion technologies that can take instruments to new vantage points.
- Large, Lower Cost, Lightweight Mirrors and Space-Deployable Structures – for the next generation of large telescopes and antennas.

Specific Benefits of Technology: New method of connecting modular spacecraft. Flux pinned joints provide non-contacting method for reconfiguration with stiff and damped connection.

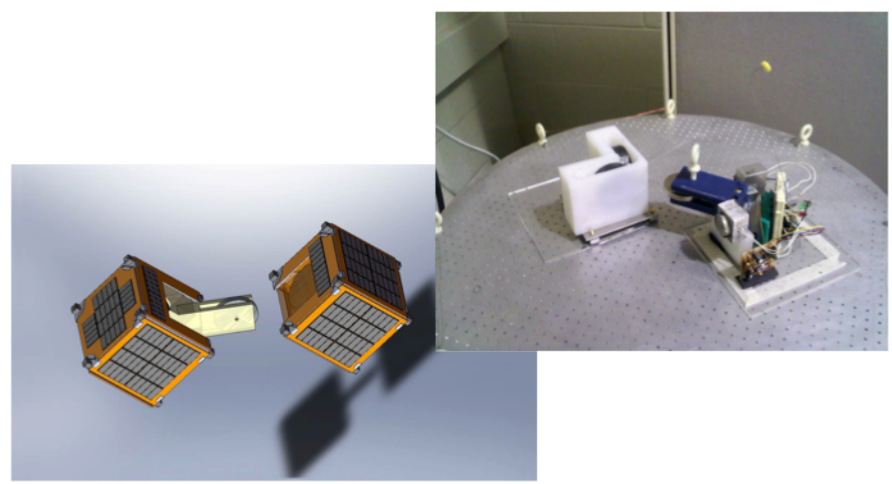
Team Members and Resources

Primary Organization Name:
Space Systems Design Studio, Cornell University

Project Manager:
William Wilson, Cornell MEng student
wrw47@cornell.edu

Current or Past Government Contracts or Agreements:
NIAC Phase I 7605-003-062.
NIAC Phase II 7605-003-071.

Image or Schematic of Experiment



Cyclonic filtering of pneumatically conveyed lunar regolith simulant at reduced gravity

FAST 2009

Test Plan and Objectives

Technology Description: Pneumatic conveying of regolith against gravity and electrocyclonic filtration of dusty gas

Planned Test Objectives: Determine the mass flow rate of JSC-1A regolith simulant as a function of gas flow rate during vertical transport and evaluate electrocylonic filtration for 1/6 g.

Test requirements:
Number of flight days: Two (minimum)
Number of personnel: Three for flight team, one backup
Project dimensions (meters): 0.81m x 0.81 m x 2 m
Gravity level(s): 1/6 g (lunar)
Special Needs: None

Value & Relevance to NASA

Primary Relevant Mission Directorate: *ESMD*

Primary Relevant NASA Center: *NASA Kennedy Space Center*

Technology Focus Area:
- *In-Situ Resource Utilization (ISRU)*

Specific Benefits of Technology: *The technology demonstrates vertical pneumatic conveying of lunar regolith to an ISRU reactor combined with a gas-solids separation system that recovers the transport gas for reuse.*

Team Members and Resources

Primary Organization Name:
NASA Kennedy Space Center

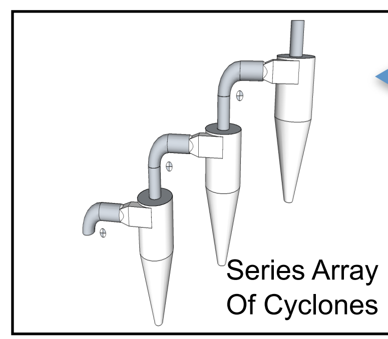
Project Manager:
Jim Mantovani, James.G.Mantovani@nasa.gov

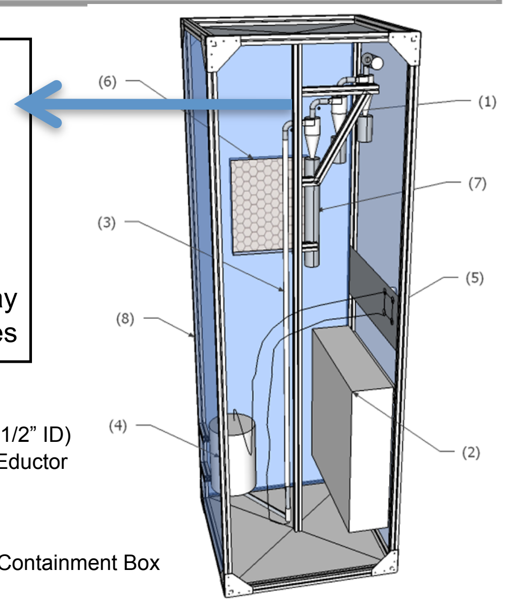
Partner Organization Name:
ASRC Aerospace Corp.

POC:
Ivan.I.Townsend@nasa.gov

Current or Past Government Contracts or Agreements:
None

Schematic of Experiment





(1) Cyclone Array
(2) High Voltage Power Supply
(3) SS Pneumatic Conveying Pipe (1/2" ID)
(4) Input Regolith Hopper / Venturi Eductor
(5) Input Air Ports
(6) HEPA Filter
(7) Regolith Discharge Container
(8) Aluminum Supports and Acrylic Containment Box

Spiderbot Microgravity Flight Experiment II: Demonstrate Complex Task Execution

FAST 2009

Test Plan and Objectives

Technology Description: Spiderbot Microgravity Flight Experiment II: Demonstrate Complex Task Execution

Planned Test Objectives:

- Demonstrate a robust walking algorithm utilizing force feedback from sensors in the legs
- Traverse concave and convex mesh surfaces
- Exit & enter an engineered shelter
- Perform coordinated behaviors in manipulating objects

Test requirements:
Flight days: 2 days at 40 parabolas per day
Personnel: 3
Project dimensions (meters): 0.9x0.6x0.6
Gravity level(s): 1/6g, 0g
Special Needs: Mesh platform to be secured using appropriate restraints as required by parabolic flight experiment guidelines.

Value & Relevance to NASA

Primary Relevant Mission Directorate: ESMD Robotics and Operations – Advanced robotic systems for lunar outpost assembly and maintenance, and supportability technologies such as electronics/wiring inspection and repair.
SMD Intelligent Distributed Systems – that enable advanced communications, efficient data processing and transfer, and autonomous operations of land- and space-based assets.

Primary Relevant NASA Center: JPL, JSC, GSFC

Technology Focus Area:

- Robotics mobility for exploration & task execution
- remote sensor networks
- force sensing in reduced gravity

Specific Benefits of Technology: Low cost, energy efficient technology for robotics mobility in reduced gravity working environments

Team Members and Resources

Primary Organization Name:
BlueSky Robotics, LLC

Project Manager:
Jonathan Wall, *jwall@blueskyrobotics.com*

Partners:
Alberto Behar, Science and Remote Sensing Consultant, Hermosa, CA 90254-4229
Neville Marzwell, Space Technology Development Consultant, Claremont, CA 91711-2211

Current or Past Government Contracts or Agreements:
BSR and Partners are submitting an IPP proposal to partially fund this Spiderbot project.

Image or Schematic of Experiment