Title: Microgravity Research Experiment Payload

Sponsor: Jeff Ganley, The ACCESS for Education Foundation / Microgravity Enterprises, Inc.

Overview

Recent microgravity research has shown that promising research areas exist for sub-orbital and/or orbital return missions which take advantage of the microgravity environment of space. These areas include the production of novel and/or improved pharmaceuticals, metallurgy, crystal growth, protein growth, nanomaterials, etc. However, these microgravity research areas are almost entirely unexplored in that they focus on potential commercial applications that utilize the space environment. Past and present research experiments that have utilized NASA and/or Air Force launch vehicles have, by design, addressed Government research interests. These experiments/missions have by definition not addressed the potential commercial applications listed above, as this would have represented a conflict of interest for the Government agencies providing the launch.

As an example of how the system has and is currently functioning, consider a recent NASA experiment that was launched in September of 2006 on the Space Shuttle (STS-115), and was designed to measure the effects of microgravity and other aspects of the space environment on salmonella bacteria. The experiment results were that the salmonella did indeed show increased virulence due to spending their life cycle in the microgravity environment of space. This result is interesting and has clear application for future long duration space flights. What is missing from this paradigm, however, are more near term applications which likely hold similar promising results. One potential example is protein and/or crystal growth for pharmaceutical applications, the foundations of which (i.e. crystals and proteins grow larger and more pure in a microgravity environment than in the 1g environment of Earth) have already been clearly established.

Under the ACCESS for Education Program, Microgravity Enterprises, Inc. will be providing regular sub-orbital short duration (2-3 minutes nominal, 5-10 minutes maximum) access to the microgravity environment of space. The goal of the ACCESS Program is to foster and implement commercial application focused microgravity research and development using these flight opportunities. This will in turn establish the theoretical research foundation for future commercial applications that utilize the microgravity environment of orbital and/or sub-orbital space flight.

In this project, you will research potential microgravity research applications (either from the potential topic list given above, or a novel topic that you have discovered), then design a sub-orbital experiment payload based on your chosen microgravity research application.

Requirements

The top level requirements for the microgravity research experiment payload are summarized below. Your design work should flow directly from these requirements.

1. The microgravity research experiment payload shall conform to the requirements as specified in the "ACCESS for Education Payload User's Guide," Rev. -, January 2008. Detailed programmatic, as well as mass, volume, interface and environment specifications can be found in the User's Guide.
2. The ACCESS for Education Payload User's Guide is meant to convey all ACCESS Program requirements. Requirements questions that cannot be answered by the ACCESS Program User's Guide should be directed to the ACCESS Program Coordinator, Jeff Ganley (505-239-8159, jeff.ganley@ACCESSforEducation.org).

Major Tasks

1. Perform a literature search to determine potential microgravity research applications. Students and/or professors are also encouraged to discuss potential microgravity research applications with other professors within the University (e.g. medical school, materials engineering, biological engineering, etc.).
2. Select a candidate microgravity payload from the list of applications generated in step 1 above to proceed to detailed design.
3. Conforming to the requirements in the ACCESS for Education Payload User's Guide, design an experiment payload (which can be part of a series of incremental experiments) based on the candidate microgravity research payload selected in step 2 above.

Expectations

1. Provide detailed results from the potential microgravity research applications literature search, including a list of potential microgravity research topics, as well as top level supporting rationale for each topic.
2. Explain why your group chose the selected microgravity research payload over other possible candidates.
3. Perform a detailed design of the selected microgravity research payload, including drawings, parts lists, and supporting analysis.

Groups

Once the microgravity research payload is chosen, the following subsystem groups may be designated:

- Microgravity Payload Experiment Subsystem
- Microgravity Payload Mechanical / Pressure Subsystem
- Microgravity Payload Thermal Subsystem
- Microgravity Payload Electrical Subsystem

- Microgravity Payload Computing / Data Collection Subsystem

References

1. "ACCESS for Education Payload User's Guide", Rev. -, The ACCESS for Education Foundation, January, 2008.
2. "UP Aerospace SpaceLoft XL Mission Planner's Guide", Rev. 2.3, UP Aerospace, Inc., 2006.
3. Wertz, James R. and Larson, Wiley J., *Space Mission Analysis and Design*, 3rd Edition, Microcosm Press, El Segundo, CA, 1999.
4. Marianna Long, John Bishop, Tattanahalli Nagabhushan, Paul Reichert, G. David Smith, Lawrence DeLucas, "Protein Crystal Growth in Microgravity, Review of Large Scale Temperature Induction Method: Bovine Insulin, Human Insulin and Human Alpha Interferon," Journal of Crystal Growth, 168 (1996), pp. 233-243.
5. Dr. Baruch S. Blumberg, Dr. Kenneth M. Baldwin, "Summary Report of the Workshop on Space Biology on the Early International Space Station," NASA Ames Research Center, Moffett Field, CA, March 14-15, 2002.
6. Randolph E. Schmid, "Germs Taken to Space come Back Stronger," The Associated Press, Washington, 24 September 07.

Links

http://www.microgravityenterprises.com
http://www.accessforeducation.org
http://www.upaerospace.com