White Paper on Re-establishing Access to Space for Student Payloads

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A proposed solution to an urgent national problem

By

An ad hoc coalition of concerned aerospace professionals

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Abstract

Our national civilian, industrial, military and political leaders have frequently warned us of a developing space program workforce gap as our experienced engineering and management personnel retire in ever-increasing waves[1, 2]. These leaders quote alarming statistics that show how far we are falling behind an array of other nations in turning out talented engineers and scientists[3, 4 and 5] to fill this gap. But while they are talking about the problem, our government is simultaneously eliminating or under-funding programs that have historically provided our students with the opportunity to actually build and fly their own experiments in space, which heretofore has been a major impetus to young people pursuing careers in the space field. Dismayed by this shrinkage of opportunities for students to participate meaningfully in the space program, a coalition of concerned aerospace professionals has initiated an effort to enlist the U.S. industrial launch community's help to re-establish access to space for student payloads.

Background

Over the past 35 years, NASA has flown hundreds of U.S. student-built experiments in Low Earth Orbit as a service to the national educational community:

In 1973 and 1974, NASA flew nineteen experiments devised by high school students aboard the SkyLab space station[6]. These student experiments were selected competitively by the National Science Teachers Association and were performed on orbit for the students by three different crews of astronauts.

From 1982 to 1989, NASA flew aboard Space Shuttle missions a total of 18 mid-deck-locker experiments devised by high school students, under the auspices of its Shuttle Student Involvement Project (SSIP)[7]. These experiments were selected competitively by the National Science Teachers Association. The flight hardware for the experiments was built for the students by various U.S. companies and universities, and the experiments were conducted on orbit by eighteen different crews of astronauts. This program was terminated by NASA in 1989.

From 1982 to 2001, NASA flew over two hundred canisters of experiments in Space Shuttle Orbiter cargo bays under its Small Self-Contained Payload program (popularly known as the Get Away Special, or GAS, program)[8]. Many of the experiments contained in these canisters were devised and built by pre-college and college students from the U.S. and other countries. No government oversight was involved in the selection of these GAS experiments, except for safety and good taste. However, in 2001, NASA terminated the GAS program, re-assigned its personnel and has recently declared its flight hardware surplus to the agency's needs.

From 1982 to 2001, NASA flew a large number of Hitchhiker canisters in Shuttle cargo bays, containing experiments by universities, corporations, and government agencies, both domestic and international. Among the experiments were two STARSHINE mirrored satellites whose mirrors were prepared and visually tracked in orbit by tens of

thousands of students in 43 countries. An additional STARSHINE student satellite was deployed in 2001 from an Athena expendable launch vehicle (ELV) flown out of Kodiak Island, AK. However, in 2002, NASA terminated the Hitchhiker program, re-assigned its personnel and has recently declared its flight hardware surplus to the agency's needs.

During the decades that NASA provided the above-described orbital flight opportunities, thousands of students in the U.S. and abroad were able to acquire direct experience with the science and engineering of space launch vehicles and satellites. Many of the students who have flown experiments under the auspices of these programs have made substantive contributions to the U.S. civil, commercial and national security space programs and/or applied valuable lessons learned from their experiences to other high-tech fields.

Since 2001, NASA has flown no student experiments in low earth orbit. The agency has sponsored the development of a Multiple Payload Ejector intended for use to deploy student payloads from a DARPA ELV from Wallops Island, VA and other ELVs on a non-interference basis. However, the agency has stated that it has no current schedule for flying student experiments on ELVs.

The U.S. Air Force is making a commendable attempt to develop a source of future engineers and scientists by sponsoring dozens of U.S. university undergraduate engineering teams to design and build prototype spacecraft. However, due to budget constraints they are able to select only one of these teams, every other year, to build a flight-worthy spacecraft. And then the U.S. Department of Defense requires the selected university team to compete with all of the professional organizations in the military space program for the opportunity to launch their satellite into orbit. Not too surprisingly, the undergraduate teams wind up near the bottom of the Space Experiments Review Board priority list and have to wait in a long line for their new technology and science instruments to fly in space.

A group at Stanford University and Cal Poly-San Luis Obispo has stimulated the design and construction of a range of "Cubesat" satellites by a collection of 80 university student teams, worldwide, over the past several years. The desire amongst these students is so strong that they self-fund these programs. However, the group has been consistently rebuffed in their attempts to launch their miniature satellites on U.S. launch vehicles. They have therefore been forced to resort to paying Russian launch vehicle providers to fly their satellites. The resulting extraordinary time, complexity and expense involved with ITAR, export licensing, shipping logistics, and travel costs have posed major difficulties for these institutions. To their credit, they have persisted in their efforts and have flown nine university satellites, to date. Unfortunately, however, a Dnepr launch vehicle carrying a collection of 18 U.S and international Cubesats and other spacecraft failed to reach orbit on July 26, 2006, wiping out three years of effort.

Many more university students could be involved in the Cubesat program if only their satellites could be flown on U.S. launch vehicles.

Proposed Solutions

An ad hoc coalition of aerospace educators, engineers, scientists and administrators, **believing that there is no substitute for the hands-on approach to producing the workforce talent that this country's aerospace community needs,** has begun to develop an independent set of solutions to the problem of providing space access for student payloads. An inaugural meeting of some of the members of this coalition and interested observers was held at the Twentieth National Space Symposium of the Space Foundation in Colorado Springs on April 4, 2006, to establish a course of action.

The initial action items agreed upon were:

1) Work with U.S. launch vehicle providers to add provisions for "secondary" educational payloads to all their vehicles.

2) Investigate the use of tax credits to reimburse these launch vehicle providers for each educational payload they fly.

3) Encourage the U.S. Department of Defense to increase the funding for the Air Force Research Laboratory's University NanoSat program and provide recurring annual DOD launch allocations dedicated specifically to university payloads.

4) Investigate the use of tax credits to reimburse U.S. commercial telemetry ground system operators to receive telemetered data from student payloads in orbit and to distribute these data to the students via the Internet.

5) Request NASA and other U.S. civilian government space agencies to provide support for travel, transportation and integration of student payloads that will be flying on U.S. launch vehicles as a result of the initiatives described above.

6) Encourage NASA and industry to include accommodations for student payloads in new launch vehicle designs.

7) Establish policies to encourage space-related Federally Funded Research and Development Centers, University-Affiliated Research Centers and government agencies to make their surplus and prototype flight hardware and their test facilities available to student experimenters for building and flight-qualifying their payloads.

8) Create a bridge between university-level space experiment programs and K-12 science, technology and math initiatives underway across the country.

A second meeting of the coalition is scheduled for Tuesday, August 15, 2006, at the Twentieth Annual AIAA/USU Conference on Small Satellites in Logan, UT. All interested parties are encouraged to attend and contribute their ideas to a solution of the student space experiment access problem.

References

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3) **Rising Above The Gathering Storm: Energizing and Employing America for a Brighter Economic Future**, National Academy of Sciences, National Academy of Engineering, Institute of Medicine, Washington, D.C., 2006.
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8) **Shuttle Student Involvement Program (SSIP)**, NASA/JSC 24005, Internal Note on the Final Reports of Experiments Flown, published by the Man-Systems Division of the NASA Lyndon B. Johnson Space Center, Houston, TX 77058, October 20, 1989.