MSU's computer system for space attracts NASA attention

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Martin Mason, left, from Mount San Antonio College in California; Raymond Weber, center; and Justin Hogan, both from MSU, hold their electronics payload and payload canister. The payload was mounted with others inside the canister and launched on a sounding rocket above Wallops Island, Va. (Photo courtesy of Justin Hogan).

(Phys.org) -- Two Montana State University graduate students who are building a radiation-proof computer system for use in space have received an extra boost from NASA.

Justin Hogan and Raymond Weber recently learned that their project with faculty member Brock LaMeres was one of 14 selected by NASA for development and demonstration on commercial launch vehicles in 2013 or 2014. LaMeres, the project manager, is an associate professor in

MSU's Department of Electrical and Computer Engineering. Weber, from Bozeman, and Hogan, from Albuquerque, N.M., are doctoral students in electrical and computer engineering.

"I was excited to hear the news," Weber said. "It will be nice to be able to fly our research on a rocket and be able to apply what we learned to our actual research."

Hogan said, "Being selected for flight is a tremendous opportunity for us to test our research systems in an environment in which they're designed to work. It's a huge leap from having a system that should work in space to a system that has been demonstrated in space, and I'm excited about the experience we'll gain in the process of making that happen."

NASA's Space Technology Program announced that the chosen projects offer innovative cutting-edge ideas and approaches that NASA needs for current and future missions in exploration, science and space operations. The projects also address high-priority technology needs identified in the recent National Research Council's Space Technology Roadmaps and Priorities report.

"These technology payloads will have the opportunity to be tested on commercial suborbital flights, sponsored by NASA, that fly up to and near the boundary of space," said Michael Gazarik, director of NSA's Space Technology Program at NASA headquarters. "The flights will ensure the technology fidelity before they're put to work in operational systems in the harsh environment of science."

MSU will receive anywhere from $125,000 to $500,000 to continue designing and building an "environmentally aware" computer system that will work in space even if it's bombarded by radiation or high-energy particles. Work on the project began in 2010 with a three-year, $750,000 grant LaMeres received from NASA EPSCoR.

Radiation and high energy particles can cause even shielded computers to crash or malfunction.

"It's a major problem specifically for manned missions where computers aren't allowed to fail," LaMeres said.

Right now, the older the technology, the larger it is. Therefore, it's less sensitive to radiation, LaMeres said. Older computers have larger transistors, however, so they are slow. Today's computers contain very small transistors, which means that several can be placed on an integrated circuit. Small transistors result in faster computers, but the transistors are more responsive to radiation.

MSU's computer system is designed to lay on top of a reprogrammable hardware fabric, LaMeres said. If the system works the way it's designed, it will detect radiation and high-energy particles. If radiation strikes - or looks like it will strike - an active circuit, the computer system can shut down the active circuit and use one of the abundant spare circuits. As a result, astronauts may be able to get by with less shielding than they currently carry into space to protect their computers. They should also be able to work without stopping to fix computer malfunctions.

The recent NASA announcement came in the midst of Hogan's and Weber's participation in two NASA programs, one involving a rocket launch over the Atlantic Ocean, and the other a high-altitude balloon over New Mexico.

From June 16 through 22, Hogan and Weber attended "RockOn," a rocket training workshop at the Wallops Flight Facility on Wallops Island off the coast of Virginia. Among other things, the MSU graduate students received hands-on training in building experiments for space flight. They assembled instruments, including a Geiger counter and

accelerometers, found in a standardized kit.

The workshop payloads were circuit boards attached to a 9.5-inch circular disk, Hogan said. MSU's disk was then stacked with others and secured in the payload section of a 35-foot-tall, two-stage Terrier-Improved Orion sounding rocket.

NASA launched the rocket at 6:40 a.m. June 21. The rocket soared 73 miles above the Atlantic Ocean, exposing the experiments to zero-gravity and the radiation found in 11 miles of space. Within 15 minutes of launch, the rocket splashed down about two miles from Wallops Island. A commercial fishing boat retrieved the experiments and returned them to the students for analysis.

The workshop was "definitely" worthwhile, providing experience they will use now and in the future, the students said. After earning his doctorate, Hogan is thinking about working locally for a small company as an embedded system design engineer or working as a research engineer in an aerospace-related field. Weber is thinking about becoming a research engineer or professor.

Back at MSU, Hogan and Weber are wrapping up their work on their radiation-tolerant, reconfigurable computer system so it will be ready to fly on a high-altitude balloon. When finished, the system will fit into a cube approximately four inches on each side. That's about the same size as the William A. Hiscock Radiation Belt Explorer, the MSU satellite that has been orbiting the Earth since Oct. 28, 2011.

The cube will head to the Columbia Scientific Balloon Facility at Fort Sumner, N.M. at the end of July, Hogan said. It is scheduled to be launched in early September as part of the High Altitude Student Platform (HASP) program through NASA and the Louisiana Space Consortium. The high-altitude balloon is expected to carry the computer

system 22 miles above Earth and stay aloft for 15 to 20 hours.

LaMeres said each level of testing becomes more rigorous, helping ensure that the computer system will work properly in space. Noting that NASA's recent announcement will turn a dream into a plan, he said he doesn't know what kind of commercial vehicle the new grant will provide MSU, but said it will more than likely be the kind of rocket that carried Hogan's and Weber's payload high above Wallops Island.

Provided by Montana State University