MSU satellite surpasses goal; NASA taps MSU to queue up for another launch

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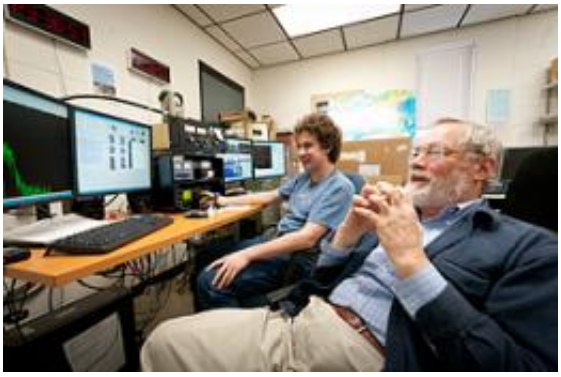

MSU freshman Matthew Handley, left, and SSEL Director David Klumpar watch as information is downloaded from MSU's orbiting satellite. Credit: Kelly Gorham

The Montana State University satellite that rode into space on a NASA rocket has now gathered information longer than the historic U.S. satellite it was built to honor, says the director of MSU's Space Science and Engineering Laboratory (SSEL).

Almost four months after the Oct. 28 launch and shortly after learning that NASA selected another MSU satellite for possible launch on a NASA rocket next year, SSEL Director David Klumpar cheered as he suddenly realized that Montana's only satellite had collected data for 111 days as of Feb. 15. Since then, the satellite has well surpassed the entire 111-day mission of its history-making predecessor, Explorer-1, the first

successful U.S. satellite.

"HRBE is working great," Klumpar said. "On Feb.15, we surpassed our goal."

HRBE, pronounced "Herbie," is the nickname of the tiny student-built satellite that was originally called Explorer-1 [Prime] and is now called the Hiscock Radiation Belt Explorer, or HRBE. The satellite was renamed in November to honor the late William A. Hiscock, an MSU physics professor who headed the Montana Space Grant Consortium and the MSU physics department.

MSU students and faculty were thrilled when ham radio operators, first in Spain, then successively in France, The Netherlands and England reported hearing from the satellite within three hours of its launch from the Vandenberg Air Force Base in California. HRBE later passed through an intense band of energetic electrons that was bombarding Earth's upper atmosphere above Alaska. Since then, HRBE has been monitoring variations in location and intensity of the Van Allen Radiation Belts, which were discovered around the Earth by the original Explorer-1, Klumpar said.

MSU's satellite could orbit for 12 more years before its batteries die or it burns up in the atmosphere, Klumpar said. For an indefinite time before then, MSU students will continue to communicate with the satellite two or three times a day as it passes within range of their antenna on top of Cobleigh Hall. The satellite can be as far east as the Great Lakes or as far west as the California coast and still emit a strong enough signal for MSU to pick up.

On the satellite's 1,705th orbit and a few minutes after Klumpar realized the mission had passed a milestone, MSU freshman Matthew Handley sat down in front of a panel of computers and radio equipment in the

Space Operations Center in Cobleigh Hall. The computers allowed him to see that the satellite was straight south of Mexico City and 305 miles above Earth. It was traveling at 18,000 miles an hour.

About six minutes later, Handley picked up the first beep that indicated HRBE was close enough to download data. Handley directed the satellite to send the information it had gathered since its last report. That information - accompanied by loud squeals -- looked like random letters and numbers scrolling onto the computer screen, but they were codes that gave the status of the satellite's electrical systems, levels of radiation above the atmosphere and more. About 15 minutes later, Handley lost touch with HRBE as it neared the north coast of Alaska and passed around the other side of the Earth.

"I'm having a good time. I'm getting a lot of experience," Handley said.

Handley, who is majoring in computer engineering, is one of three main students who take turns operating the satellite. The others are Nathan Fite of Wheelersburg, Ohio, and David Racek of Auburn, Wash., both master's degree students in electrical engineering. They talk to HRBE from Cobleigh Hall or at any random location where the Internet is reachable because of specialized software they built to remotely operate the Cobleigh satellite tracking station. Handley, for example, talked to the satellite from St. Albans, W.Va., when he was home for Christmas, while eating his mom's apple pie at the kitchen table.

Handley said he appreciates the opportunity to operate HRBE, because he is thinking about pursuing a career in aerospace, robotic control or artificial intelligence. He became involved with the mission after attending a fall gathering for engineering students. There he met Adam Gunderson of Kalispell, a senior majoring in electrical engineering. Gunderson told Handley about the satellite, built by approximately 125 students over five years, and the need for more student involvement.

Handley signed on to help. Since then, Handley has learned a new computer program language for some of the data analysis he is doing. He is conducting an undergraduate research project with the information he is gathering, and he has earned his ham radio license through training received from SSEL staff engineers.

Ham radio operators play an important part in the mission because they contact MSU whenever they hear HRBE's "heartbeat," a beep that occurs every 15 seconds, Klumpar said. A map in the Space Operations Center keeps track of those operators. They live in Germany, Australia, Sudan, Japan, all over the United States and the rest of the world.

HRBE's Feb. 15 milestone wasn't the only reason Klumpar and the students of the SSEL had to celebrate. That same day, they learned that NASA had chosen an MSU satellite as one of 33 small research satellites to piggy-back on rockets it plans to launch in 2013 and 2014. The SSEL will build the satellite with partners from Colorado, Maryland, North Carolina and Kentucky, Klumpar said.

"It's really a great endorsement of the fantastic work our students do that NASA selected us to participate in another NASA launch," Klumpar said. "We are training students who will be the next generation of space scientists and engineers."

The new satellites, like HRBE, are cubes that generally measure about four inches on each side and weigh 2.2 pounds. That's a standardized size that allows university-built satellites, called "CubeSats," to fit into an enclosed container called a P-POD and ride on a NASA rocket.

MSU's new satellite will be the same size as HRBE, Klumpar said. It could launch on a NASA rocket, possibly as early as 2013. The mission may last a little over seven years before the satellite reenters and burns up in Earth's atmosphere.

Unlike HRBE, the new satellite will be built out of nano-carbon-impregnated plastic instead of aluminum, Klumpar said. Since it will be built with an unusual technique using technologies that grew out of the printing industry, the mission will be called PrintSat. Members of The PrintSat Team will design the satellite on computers. Then, instead of sending their plans to a machine shop for fabrication, they will push a button. Computers will guide lasers as they build the satellite one layer at a time.

The process, called 3-D printing or additive manufacturing, is used in building Formula 1 race car components and in the sport of motorcycle racing. He and The PrintSat Team want to show that it's a viable, affordable process for satellites, Klumpar said.

"Successful demonstration of the technology used in PrintSat will further lower the costs and speed the development of very small satellites, enabling future scientific missions comprised of dozens of satellites flying in formation," Klumpar said.

Jim White, president of Colorado Satellite Services, one of Klumpar's partners, said, "Additive manufacturing (also called 3-D printing) has evolved in the past few years to be a very inexpensive and fast way to make mechanical parts. With PrintSat, the entire structure of the small satellite will be printed. As the first use of additive manufacturing for a satellite, we plan to show it's not only cheaper and faster, but that we can make parts that cannot be made in traditional ways.

"This also opens up new avenues for making specialized parts and for creating entire fleets of small satellites that can do things single satellites can't," White said.

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