Building 45 payloads for balloon mission

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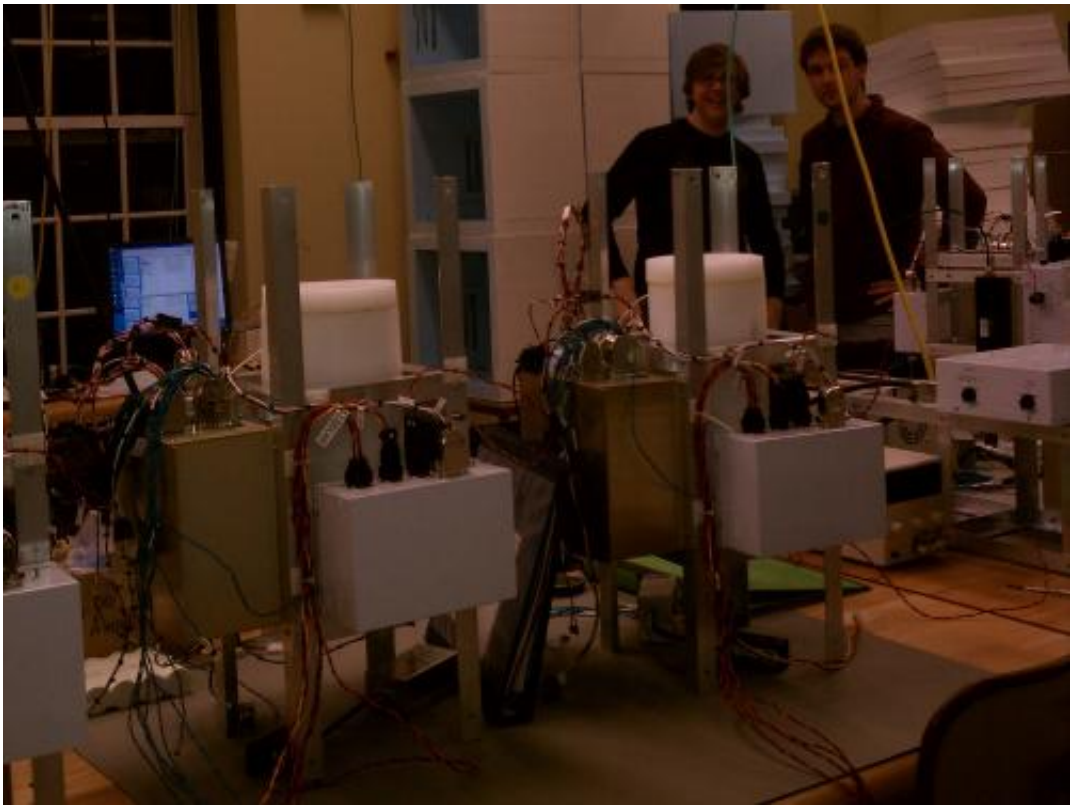

Several BARREL payloads are built all at the same time. Credit: Robyn Millan

Robyn Millan's lab is a little crowded at the moment. It overflows with electronics. And foam. And parachutes and aluminum frames and drills. Based at Dartmouth College in Hanover, NH, Millan and her students are busy building 45 payloads -- each destined for a trip on a balloon around Antarctica as part of a NASA mission called BARREL, or the Balloon Array for RBSP Relativistic Electron Losses.

"We've been drilling a lot of holes," says Millan. "My students figured out that we have almost 10,000 holes to drill."

It's all part of a plan to launch a series of instruments that will work hand in hand with NASA's Radiation Belt Space Probes (RBSP) mission, two NASA spacecraft due to launch in August 2012 to study a mysterious part of Earth's magnetic environs called the Van Allen radiation belts. The belts are made up of two regions, each one a gigantic donut of protons and electrons that surround Earth.

A BARREL payload complete with solar panels sits in the sun for a full system-test. Credit: Brett Anderson

"We're both looking at the loss of particles from the radiation belts," says Millan. "RBSP sits in space near the equatorial plane and looks at the particles along magnetic field lines there. These particles come into our atmosphere – following magnetic field lines to their base at the Poles – and produce X-rays. BARREL measures those X-rays. Together we can combine measurements of the same set of particles."

The charged particles within the radiation belts can damage sensitive electronics on spacecraft like those used for global positioning systems and communications, and can be harmful to humans in space. (The electrons don't make it all the way to Earth, so pose no danger to those of us on the ground.) Experiments like BARREL and RBSP will help us understand the processes and mitigate those risks.

One test for the 50-pound payload is to make sure it will balance when hanging from the balloon. The flight train that supports the payload consists of an in-line parachute and a “ladder” made of rope and PVC pipe for stability. Credit: Brett Anderson

In the meantime, Millan's team drills holes, builds payloads and, most importantly, tests the hardware. They will launch 20 instruments in January 2013 that must be shipped to Antarctica beginning in August. Many of the components are built elsewhere – University of California in Berkeley, University of California in Santa Cruz and University of Washington in Seattle – and are then shipped to Dartmouth. There, Millan's lab assembles the payloads and tests them both to make sure

they work and that they will withstand the rigors of their balloon trip.

"I'm proud of how much work my students did improving the mechanical design to make sure it would be faster to build," says Millan. "Every few minutes count. If some building process takes three minutes, that doesn't sound like much, but multiply that by 45 and little things become significant. Now our process is streamlined. It's almost like Legos – all the pieces just fit together."

BARREL is a balloon-based Mission of Opportunity to augment the measurements of NASA's RBSP spacecraft. BARREL seeks to measure the precipitation of relativistic electrons from the radiation belts during two multi-balloon campaigns, operated in the southern hemispheres.

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