

Blueshift - December 31, 2009

Science at the End of the World, Part I

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Sara: Welcome to the December 31st, 2009 episode of Blueshift, brought to you from NASA's Goddard Space Flight Center. I'm Sara Mitchell.

The pursuit of cosmic answers can take scientists to destinations all over the globe. Whether it's sharing results at a conferences or running experiments at cutting-edge research facilities, Goddard's astrophysicists sometimes find themselves working far from home.

But how far are some willing to go? To the ends of the Earth?

NASA launches some of its balloon-borne experiments from one of the most remote research facilities in the world - McMurdo Station in Antarctica. To get there, Goddard scientists must fly nearly twenty-four hours to get to Christchurch, New Zealand... and then hop onto an eight hour flight to McMurdo.

I wanted to give our listeners a behind-the-scenes look at these Antarctic expeditions, so I talked to Dr. John Mitchell, the US lead for a joint Japanese-American balloon project called BESS. He's also my dad, and he's been to Antarctica twice. I interviewed him the night before he left for his latest trip down there and asked him to tell us more about BESS, which stands for the Balloon-borne Experiment with a Superconducting Spectrometer.

John: BESS is an instrument to measure high-energy cosmic rays, both particles and antiparticles. Cosmic rays are principally nuclei that are accelerated in galaxies to very high speeds, and therefore very high energies. They travel through the galaxy into the solar system, and we detect them near Earth. We're looking for potential signatures of the evaporation of microscopic, primordial black holes. These are black holes that are so small they couldn't be formed in today's universe. They're only about the mass of a mountain, and that's not enough mass to cause the gravitational collapse that would produce a black hole today. However, in the early universe, matter densities may have been much, much higher, and so these black holes may have been formed at that time. What we expect is that the lifetime - they do have a finite lifetime - is related to their mass. The heavier they are, the longer they live. And these very light and small black holes could very well be evaporating, or ending their lives at about this time. If they do so, they may end in a spray of particles, or a spray of particles and energy, known as Hawking radiation. And among the signatures of that might be the production of antiprotons at energies different than are produced by the nuclear interactions we understand.

Sara: The BESS payload is attached to a 40-million-cubic-foot scientific balloon that's as big as a football field. But why is it launched over Antarctica?

John: BESS goes to Antarctica for two reasons. One reason is that it needs to fly at a very high geomagnetic latitude. It needs to be at a point in the magnetic field of the Earth where very low-energy particles can enter the Earth's atmosphere - relatively low. That's Point 1. Point 2 is that in general the balloon program in Antarctica offers an opportunity for long flights because the antarctic jet stream - what's known as the Circumpolar Vortex - orbits the pole at

the right time of year. And so a balloon flying in that can just literally fly around the continent, and so it offers us the chance to fly relatively extended periods of time with the instrument coming back to a point where it can be recovered and reflown.

Sara: My father's previous two trips to Antarctica have been to launch BESS and collect data. But this time is a little bit different.

John: In our last flight which took place in the austral summer of 2007 and 2008, the instrument did not in fact come back to exactly where we would have liked it to. In fact, it was brought down and landed safely. We actually recovered our data which is stored on a large array of hard disk drives much like you use on your home computer - about 16 terabytes of storage. But we were unable to recover the instrument at that time because it was really late in the antarctic season, and logistically, even practically, it would have been very difficult. And it takes us quite a while to actually recover the instrument because it has to be taken apart. And I suppose for scale I should say BESS is about the size of a small van. It weighs about 4000 pounds. And it has to be completely disassembled to a level that it can be put into a relatively small airplane, in many, many pieces, to be brought back. And in 40 degree-below-zero weather that just wasn't feasible. So we're going down this year at the peak of the austral summer, when the weather is probably much warmer, maybe between 20 degrees Fahrenheit and perhaps -25 or so Fahrenheit. And we're going to try to take it apart and bring it back.

Sara: For launches, scientists stay in the relative comfort of McMurdo Station, which we'll talk about in our next episode. But for a recovery mission, they have to rough it.

John: Where we're going to be this time, we're be actually camping out on the ice, living in essentially a mountain tent, as you might camp in elsewhere. We will have a tent that can be used as a cooking area and to eat, but really that's about it. We're not going to have heat. We will have power, because we have a solar power system that will be capable of handling our laptop computers and recharging cameras and things like that. And so that will be nice. And we also have generators we use to operate electrical equipment to take apart the instrument. But as far as comfort goes, I think it will be relatively slim. So this will be quite an adventure.

Sara: My dad left a couple of weeks ago and his trip out to the ice is just beginning now. I got my holiday phone call over a satellite connection with a second or two of lag between each side of the conversation. So when will I see him again?

John: We'll probably be coming back about the first of February. In the meantime of course there's a lot of preparing for our camp and our recovery effort, doing the actual recovery effort which will require 2 or 3 weeks, and then preparing the instrument to be shipped back to the United States. And hopefully I will be back at the beginning of February, and the instrument will be back around April.

Sara: I'm always envious of my dad's trips to Antarctica, though I'm not so sure I'd enjoy a few weeks of camping in sub-freezing conditions. To learn more about the BESS mission and its hardware recovery, visit our website at: universe.nasa.gov/blueshift.

We'll also be posting updates about the recovery on Twitter. You can follow us at @NASABlueshift. Send us your questions about science in Antarctica through our website or on Twitter, and we'll see if we can get them answered during the next satellite phone call with the BESS

recovery crew.

Join us in January for the conclusion of this two-part series about working and living in Antarctica. For Blueshift, I'm Sara Mitchell, looking forward to bringing the Universe closer to you in 2010.

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