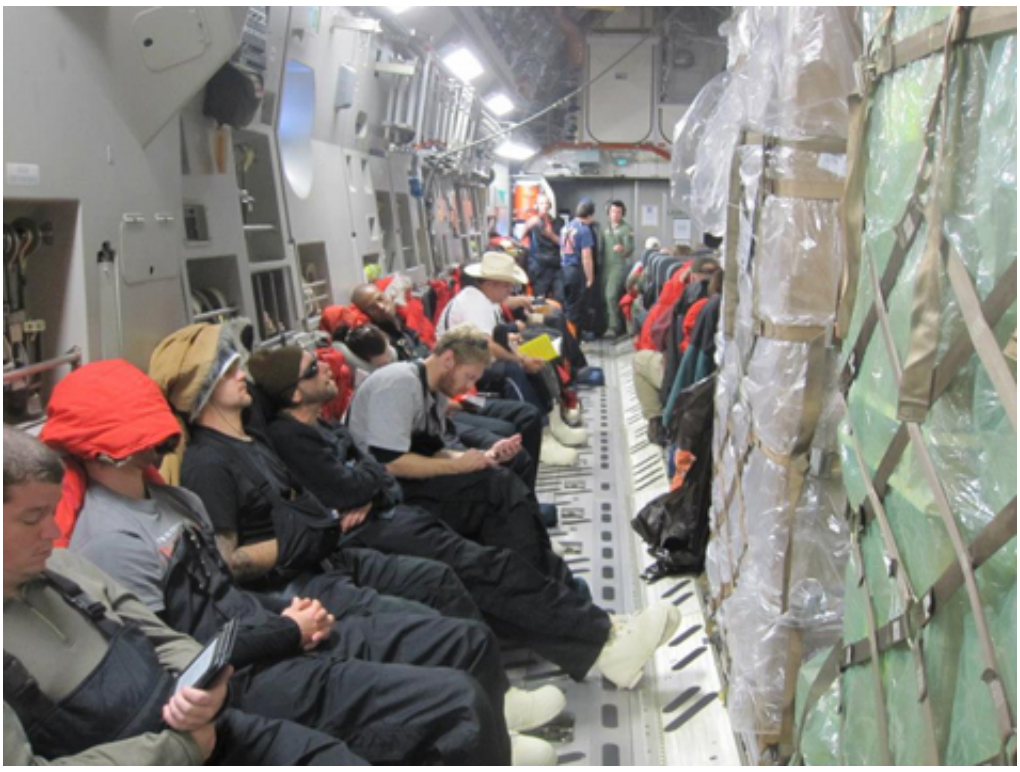
Rough guide to Super-TIGER watching: How to participate vicariously in a cosmic-ray experiment

December 3 2012, by Diana Lutz



Super-TIGER team members during the five-hour flight in a military cargo plane from Christchurch, New Zealand, to McMurdo Station in Antarctica. The temperature inside the plane is about 50 degrees Fahrenheit and passengers are required to wear cold weather gear, including the stylish ultra-cold weather Bunny Boots. Apparently nobody told them to bring sleep masks, however.

(Phys.org)—It's November 30 and a scattering of people in St. Louis, Missouri, Pasadena, California, and Greenbelt, Maryland, are getting antsy, clicking repeatedly on www.csbf.nasa.gov/antarctica/ice.htm to see whether anything is up yet.

Like a balloon, for example.

They're waiting for a two-ton balloon-borne cosmic-ray experiment called Super-TIGER to be launched into the high-altitude polar vortex over Antarctica.

The experiment, which the scientists hope will confirm that cosmic rays are created in loosely organized groups of hot, massive stars called OB associations, is a collaboration of Washington University in St. Louis, the California Institute of Technology and NASA's Goddard Space Flight Center. The team also includes people from the University of Minnesota and the Jet Propulsion Laboratory.

Once the balloon is up, the web site will go live, and the balloon will begin to trace a path in red on a blue and white satellite image of the frozen continent.

The whirlpool of the South

Filling tubes bowing in the wind as TIGER, Super-TIGER's predecessor is prepared for launch in 2003. It takes two trucks of helium to fill a balloon, which will be roughly the size of a football stadium once it ascends to the stratosphere.

There's more drama here than you might think. The balloon can't be launched until the polar vortex, a giant atmospheric whirlpool, sets up above the frozen continent.

On average the vortex strengthens around December 10, says W. Robert Binns, the principal investigator on the cosmic ray experiment and a research professor in the department of physics at Washington University in St. Louis.

"It can be earlier; it may be later," he says. "We're going to try to be ready to launch on December 1, just in case."

The Antarctic summer ends at the beginning of February when all of the planes fly north for the winter, Binns says. "So the window is basically early December through the end of January. That's when you can fly."

The neat thing about flying the vortex, other than the fact that you won't collide with commercial planes on the way up or down, is that if all goes well, the winds carry the balloon back around to close to where it started.

As a rule of thumb, Binns says, it takes 15 days to make one orbit of Antarctica. "The longest flight on record is 42 days," he says. "We would love to get that, but we would be deliriously happy if we got even 30 days. "

Cliffhanger I: the Launch

The Boss, the launch vehicle that must position the instrument package under the balloon once the balloon starts to rise. Note that it parked on the hard-packed snow near the launch area — and that it has a flat tire.

Once a launch starts, webcams at the tracking site will allow kibitzers to see what is happening, and physics graduate student Ryan Murphy will be providing play-by-play commentary from Antarctica via his blog supertigerldb.blogspot.com/ and twitter account (@ryangoesboom).

Spectators can also follow the action on the expedition's Facebook page facebook.com/thesupertiger or shared twitter account (@SuperTigerLDB).

There are three nail-biter moments during a flight, according to Binns: the launch, the landing, and everything in between.

Remember that the instrument itself weighs two tons. It is carried to the launch site by a vehicle called the Boss, an affectionate reference to polar explorer Ernest Shackleton, who famously brought all his men home after their ship was caught and crushed by the southern pack ice.

At the launch site, the balloon, which is longer than the St. Louis arch is tall, is laid out in line with the surface winds. The Boss, downstream from the balloon, holds aloft the instrument package at the end of a crane.

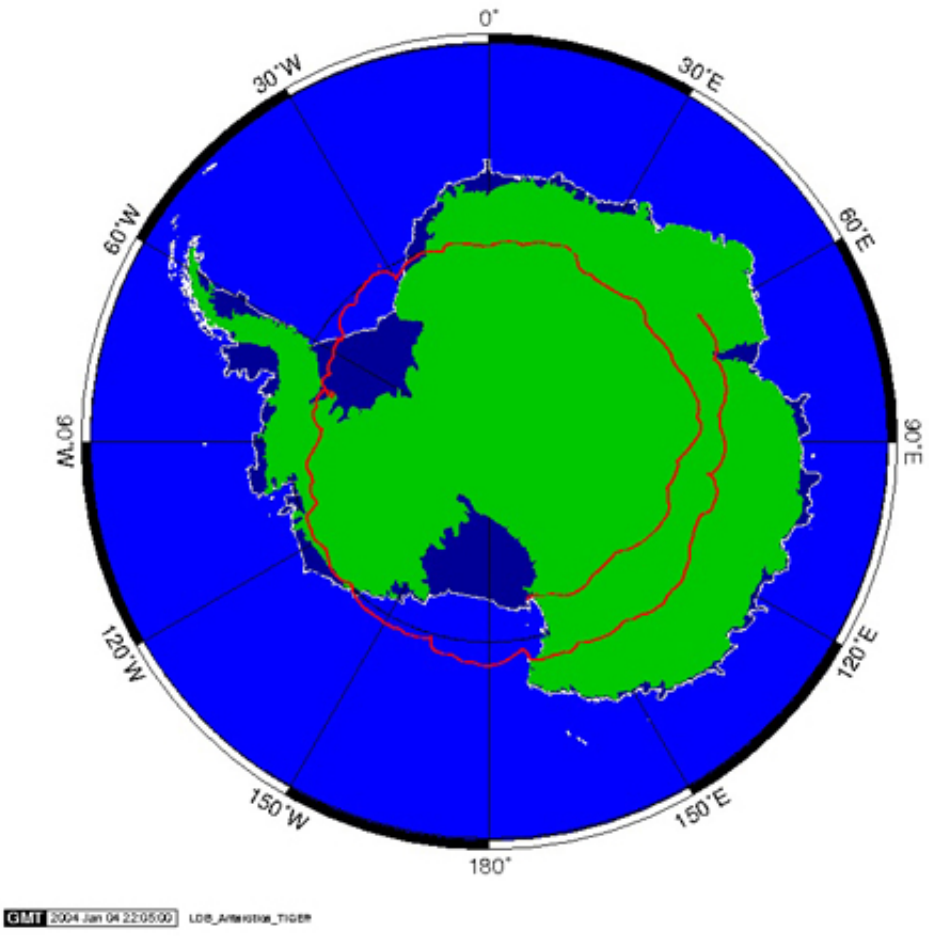
As the balloon is filled with helium and begins to rise, everyone is praying that the winds won't shift. If they do and the instrument package is not directly below the balloon when the Boss lets go, it becomes a giant pendulum that swings down and bashes into the snow.

If the winds shift between the time the balloon is laid out and the launch, the Boss has to race around trying to position the instrument under the balloon.

The catch is that the Boss has to get the instrument under the balloon while staying within the groomed and hard-packed launch area. If it drives off the hard-pack, it will sink into the snow under its own weight.

"On our first launch, the winds shifted a lot," Binns says. "The crew released the balloon just before they went off the launch area. It was pretty scary."

Cliffhanger II: The Flight



Flight track to nowhere. On the second TIGER flight the balloon appeared to be veering toward the Southern Ocean and was brought down in East Antarctica,

where its remains can still be found to this day.

Once the balloon is up you might think things would be more relaxed. You would be wrong.

There's a reason balloons are tracked in real time. Antarctica, after all, is surrounded by water, and while the vortex tends to keep the balloon sketching stately circles over land, this flight doesn't come with travel insurance.

Sometimes the circles get loopy or the balloon goes off at a tangent, heading out to sea. Since it is bearing million-dollar instrument packages, the tension rises when this happens, as Binns can testify.

"On TIGER's first flight it made a beautiful, almost perfect, circle the first time around, and the second time it made a smaller circle, but we got a total of 32 days of data, which is really, really good," Binns says. (TIGER is Super-TIGER's predecessor, an experiment that flew in 2001 and again in 2003.)

"The second time we launched TIGER, "he says, "it made a nice circle but then it got to close too the edge of the continent. The balloon facility people were afraid it was spiraling out over the ocean, so they brought it down over East Antarctica."

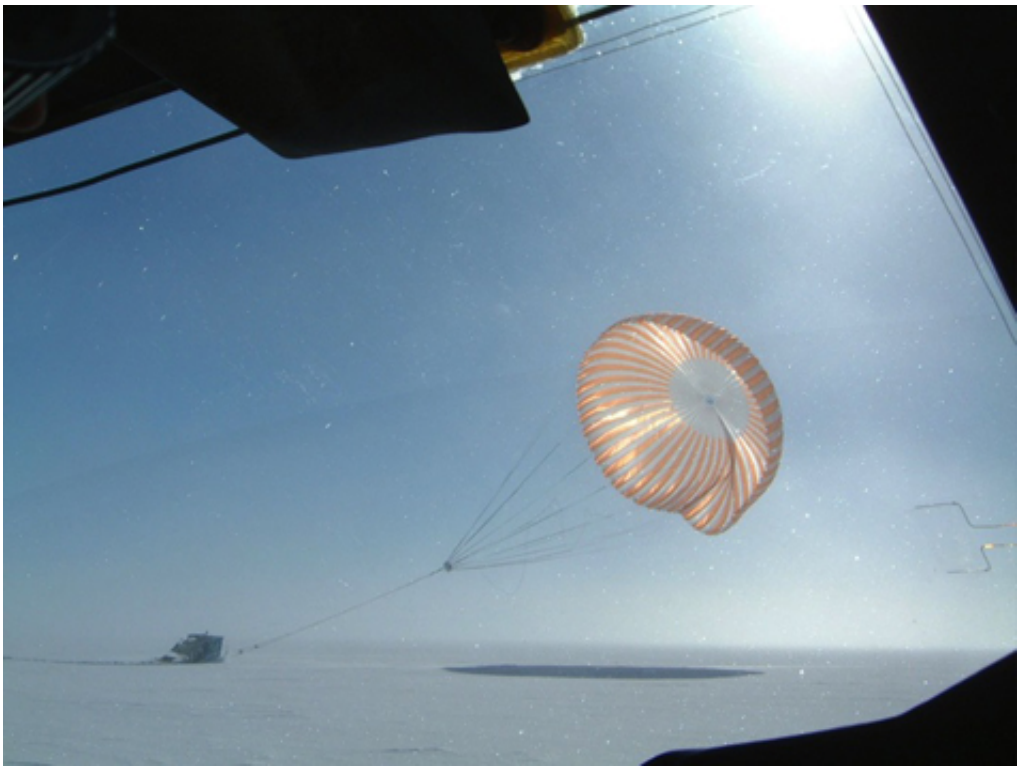
East Antarctica is the coldest, windiest, driest and –crucially— the most isolated land mass on Earth.

"The Australians flew out and got our hard disk and a few other things for us," Binns says, "but the National Science Foundation, which is responsible for the U.S. Antarctic program evaluated the cost of

recovering the instrument, and NASA decided it was too high.

"So the instrument is still out there," Binns says. "It will never be recovered."

Cliffhanger III: The Landing



The payload being dragged across the ice after the parachute failed to separate on landing at the end of the first TIGER flight in January 2002. Project engineer John Epstein, since retired, had the presence of mind to snap a photo. Credit: John Epstein

Assuming the experiment doesn't bash itself into the ice during launch or wander over the ocean during flight, it has to be brought back to land eventually and this, too, is a ticklish moment and one that involves two

small explosions.

The first separates the balloon from the landing parachute and pulls a rip cord on the balloon to let the helium escape. The instrument then floats gently to the ground under its parachute.

Once it strikes the ground a second squib fires to separate it from its parachute so that it won't be dragged across the ice.

At any rate that is what is supposed to happen. On the first TIGER flight the battery for this mechanism failed, Binns says. "The balloon crew knew it had failed before they brought the balloon down, so they tried to bring the balloon down when the winds were very light.

"The winds were only about eight or nine knots," he says, "but that wasn't light enough, and the wind caught the parachute and dragged the payload 70 miles across the ice.

"It was headed for what the old explorers called Great Ice Barrier, the edge of the Ross Ice Shelf. Another 50 miles and it would have gone into the ocean.

"Miraculously, the wind died, the payload stopped, and every bit of the instrument was recovered and sent back to the States," he says.

Provided by Washington University in St. Louis