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Fluke DMMS in Antarctica

Technology at Work

Astronomers from the University of New South Wales (UNSW) in Australia have been working in Antarctica's interior since 1996. In collaboration with astronomers from France, Italy and the United States, they're seeking the perfect location for the next generation of deep-space telescopes.

Most established Antarctic science bases lie on or near the coast. Few are located in the interior, given how high, featureless and difficult it is to reach. During the sunless winter, temperatures in the interior fall down to minus 80 Celsius or lower.

For the purposes of astronomical "seeing", however, the Antarctic interior is ideal. In fact, Australian astronomers have successfully demonstrated that their site 1000 km from the Antarctic coast has seeing conditions nearly as good as the orbiting Hubble Telescope. The site lies at 75 degrees south latitude and 3260 meters above sea level. A collection of odd-shaped buildings there house the new era in terrestrial astronomy.

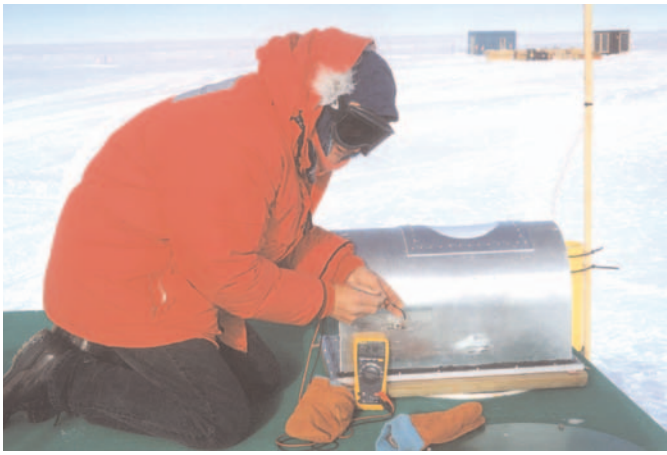
Multimeters for installation and maintenance

Because the astronomers can only get to the Antarctic interior during summer, their automated telescope equipment must operate unattended the rest of the year, reliably producing accurate measurements. The equipment is a custom mixture of analog and digital electronics developed to withstand the extreme and variable winter temperatures.

A key part of the tool kit used to install and maintain these electronics have been the Fluke 189 and 179 digital multimeters (DMM).

During their brief summer trip, the astronomers rely on the Fluke DMMs to update their instruments and repair any faults that occurred during the winter. Then, they leave several Fluke DMMs on site to monitor operations in their absence.

The cold is not a problem for the Fluke 189 DMM, seen here with the Antarctic Fibre-Optic Spectrometer.



Using the Fluke 179 DMM to test an instrument on the observatory roof.

According to the DMM it's minus 32.5 Celsius in the telescope mount!

Complex equipment and operations

To evaluate the site's long-term potential, the south pole team has installed two robotic telescopes weighing 70 kg each. The telescope engines use jet fuel to generate electric power, and the system is run by a microprocessor controller. Overall, the electronics use only 20 watts of electricity. With no heating, the systems work at ambient temperatures down to minus 80 Celsius

Designed at UNSW, the Antarctic Fibre-Optic Spectrometer points at bright stars, planets and the moon and sends the light down two bundles of optical fibers. The spectrometer's signal, measured with a CCD camera, indicates the transparency of the Earth's atmosphere from ultraviolet wavelengths to the visible red.

The Antarctic Differential Image Motion Monitor is a telescope based on 14-inch optics, used to measure the astronomical seeing in the visible spectrum, ie. how much atmospheric turbulence affects the quality of the images. This was developed by the Australian National University in the national capital of Canberra.

In the future, the site could host major new astronomical telescopes, from 2 to 100 meters in diameter. Building a large terrestrial telescope in Antarctica costs a lot less than the Hubble's US$3.5 billion outlay.

Testing procedures

During trips to Antarctica each summer, the researchers use their DMMs to test and set up the astronomical instruments and supporting electronic and electrical systems. Typically, this includes voltage, resistance and temperature measurements. The DMM is used successfully in outdoor ambient temperatures generally between minus 30 to minus 40 Celsius; indoors, about 10 degrees.

As UNSW astronomer Michael Ashley explains it, the team chose the Fluke 189 DMM based on its features and facilities, including basic accuracy, the dual display, wide range of measurements and stand-alone logging. The astronomers regularly use the data logging and averaging features. The ability to setup the instrument and leave it operating unattended, gathering data for several hours, is a big advantage for Ashley.

The team keeps a 189 DMM at the south pole site year round. Even after withstanding minus 80 degrees Celsius, "it works fine when we come back each summer," says Ashley.

The team also used two 189 DMMs to log the performance of gel cell batteries during the original equipment development. "One DMM logged battery charge and discharge current, while the other logged battery voltage. We then made a series of measurements over several weeks while maintaining the batteries at various temperatures from 20 to minus 60 Celsius. The data logged by the 189s were downloaded to a PC for plotting and analysis," explains Ashley.

"From experience, we've found cheap multimeters are susceptible to radiofrequency interference, when used near switchmode power supplies for example. And their accuracy suffers as their batteries decline, as well as having other display accuracy problems."

"We need instruments that work, from which we can guarantee results. We've never had a problem with Fluke instruments," says Ashley.

The site is cold and dry, with little wind or seismic activity and few cloudy days. Little wind means steady telescopes. High altitude means there's less distorting atmosphere to look through, and low moisture levels means less radiation from the universe is absorbed. Low temperatures make for darker skies in the infrared range. The UNSW experiment is in the green and gold structure in the foreground (photo: E. Aristidi).

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