Physicists Build Analog Devices' Components into Antartic 'ICE' Telescope

Buried two kilometers under solid ice on one of the coldest continents on Earth, Analog Devices' data converters and amplifiers are helping scientists at the South Pole build the world's largest telescope to search for the smallest subatomic particles known to humankind.

The innovative "underground" telescope project is called IceCube and uses a cubic kilometer of pure, ultra-translucent ice at the South Pole as a telescopic "window" or particle detector to search the universe for its smallest known particles, called neutrinos.

Neutrinos are subatomic particles that lack an electric charge produced by the decay of radioactive elements and elementary particles. Neutrinos travel at near the speed of light and are so tiny that they can typically pass through solid matter without colliding with any atoms.

However when neutrinos collide with an atom, light energy is emitted that can help detect the presence and direction of these sub-atomic particles. IceCube will search for neutrinos from the most violent astrophysical sources, including events like exploding stars, gamma ray bursts, and cataclysmic phenomena involving black holes and neutron stars.

The IceCube telescope is a powerful tool to search for dark matter, and could reveal new physical processes associated with the enigmatic origin of the highest energy particles in nature.

IceCube uses Antarctica's ice sheet as the largest instrumented volume of ice/water in the world. Neutrinos passing through the ice sheet collide with atoms creating a blue light at impact that can be detected by IceCube's digital optical modules (DOMS).

Analog Devices' data converters and amplifiers are installed in more than 5,000 of these DOMS. The DOMs, which are 13–inch-diameter glass pressure spheres, are deployed under the ice on a cable at depths of between 1.5 km and 2.5 km. Over the next 25 years while embedded in ice, the DOMs will detect and transmit experimental data about particle collisions.

"We needed low-power, reliable products capable of providing the longevity needed for this project, especially on the main board in the DOMs. Design teams at Lawrence Berkeley National Laboratory (LBNL) and the University of Wisconsin-Madison used ADI data converters and amplifiers that fit our needs and requirements," said Jerry Przyblski, LBNL design engineer. "We used ADI products, such as ADCs (analog-to-digital converters), DACs (digital-to-analog converters) and

amplifiers, in the DOMS and the communications system. So far, IceCube's scientists have gathered data equal to thousands of DOM years of operation."

The construction of the IceCube underground telescope will be completed in 2011. The National Science Foundation awarded the University of Wisconsin lead responsibility in building IceCube. The project is a collaboration among researchers from around the world, including Belgium, Germany, The Netherlands, Switzerland, Japan, the United Kingdom, New Zealand and Sweden.

To install the DOMS, a hot water drill shoots 200 gallons per minute of 190° F water at 1,000 psi to melt 1-km to 2-km holes in the Antarctica ice. After the ice-holes are opened, cables beaded with 60 neutrino-detecting DOMs are lowered into the 200,000 gallons of melted ice. The ice refreezes in about 24 hours encasing the DOMs and ADI's converters and amplifiers in temperatures ranging from -20°C to -30°C. The final seven ice holes will be drilled next year for a total of 86 ice holes with 60 DOMs each. Here's an animation that shows DOMS embedded in IceCube's Deepcore.

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