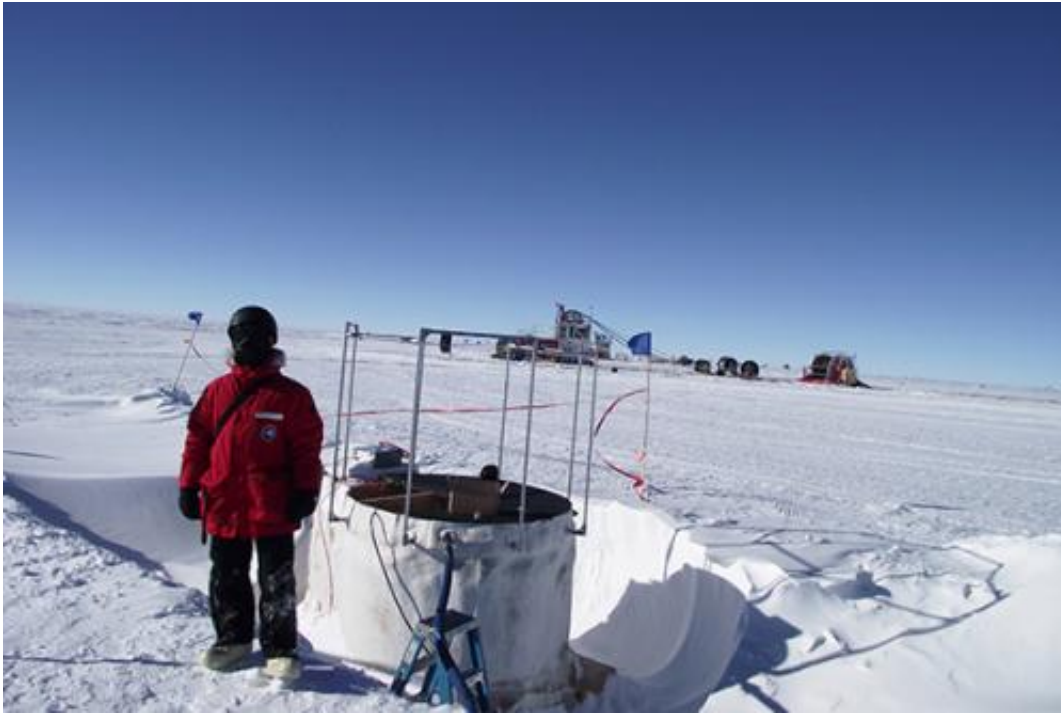


Cosmic ray finding: Researchers take a step closer to finding cosmic ray origins

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UD's Bakhtiyar Ruzybayev works on an IceTop cosmic ray detector, part of an extensive array at the surface of the IceCube Neutrino Observatory at the South Pole.

(Phys.org) —The origin of cosmic rays in the universe has confounded scientists for decades. But a study by researchers using data from the [IceCube Neutrino Observatory](#) at the South Pole reveals new information that may help unravel the longstanding mystery of exactly how and where these "rays" (they are actually high-energy particles) are

produced.

Cosmic rays can damage electronics on Earth, as well as human DNA, putting astronauts in space especially at risk.

The research, which draws on data collected by IceTop, the IceCube Observatory's surface array of detectors, is published online in *Physical Review D*, a leading journal in elementary particle physics.

University of Delaware physicist Bakhtiyar Ruzybayev is the study's corresponding author. UD scientists were the lead group for the construction of IceTop with support from the National Science Foundation and coordination by the project office at the University of Wisconsin, Madison.

The more scientists learn about the energy spectrum and chemical composition of cosmic rays, the closer humanity will come to uncovering where these [energetic particles](#) originate.

Cosmic rays are known to reach energies above 100 billion giga-electron volts (1011 GeV). The data reported in this latest paper cover the energy range from 1.6 times 10^6 GeV to 10^9 GeV.

Researchers are particularly interested in identifying cosmic rays in this interval because the transition from cosmic rays produced in the Milky Way Galaxy to "extragalactic" cosmic rays, produced outside our galaxy, is expected to occur in this energy range.

Exploding stars called supernovae are among the sources of cosmic rays here in the Milky Way, while distant objects such as collapsing massive stars and [active galactic nuclei](#) far from the Milky Way are believed to produce the highest [energy particles](#) in nature.

As Ruzybayev points out in a scientific figure submitted to the journal, the cosmic-ray [energy spectrum](#) does not follow a simple power law between the "knee" around 4 PeV (peta-electron volts) and the "ankle" around 4 EeV (exa-[electron volts](#)), as previously thought, but exhibits features like hardening around 20 PeV and steepening around 130 PeV.

"The spectrum steepens at the 'knee,' which is generally interpreted as the beginning of the end of the galactic population. Below the knee, cosmic rays are galactic in origin, while above that energy, particles from more distant regions in our universe become more and more likely," Ruzybayev explained. "These measurements provide new constraints that must be satisfied by any models that try to explain the acceleration and propagation of cosmic rays."

IceTop consists of 81 stations in its final configuration, covering an area of one square kilometer on the South Pole surface above the detectors of IceCube, which are buried over a mile deep in the ice. The analysis presented in this article was performed using data taken from June 2010 to May 2011, when the array consisted of only 73 stations.

More information: prd.aps.org/abstract/PRD/v88/i4/e042004

Provided by University of Delaware

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