# Work begins on the world's largest cosmic ray observatory

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Lake Baikal. Credit: SeaWiFS Project NASA/Goddard Space Flight Center and ORBIMAGE

Construction has just begun at the Tunka Valley near Lake Baikal, Siberia, Russia on an observatory that, once completed, will consist of an array of up to 1,000 detectors covering 100 square kilometres. Its size will allow scientists to investigate cosmic rays—the space radiation emitted from gamma rays and heavier nuclei—which are accelerated to energies higher than those achieved in the Large Hadron Collider. With the new observatory, called HiSCORE (Hundred Square-km Cosmic ORigin Explorer), scientists hope to solve the mystery of the origins of

cosmic rays, and perhaps probe dark matter too

It was a hundred years ago that Austrian-American physicist Victor Hess first discovered that radiation was penetrating Earth's atmosphere from outer space. The problem has been to track down their origin, as cosmic rays consist of charged particles and are therefore deflected in interstellar and intergalactic magnetic fields. The use of simple, inexpensive detector stations, placed several hundred meters apart, makes it possible to instrument a huge area, allowing scientists to investigate cosmic rays within an energy range from 100 TeV up to at least 1 EeV.

Cherenkov detector in front of the starry sky. Credit: Tunka Collaboration

Cosmic rays cannot penetrate our atmosphere but each detector can

observe the radiation created when cosmic rays hit the Earth's upper atmosphere, causing a shower of secondary particles that travel faster than the speed of light in air, producing Cherenkov radiation in the process. This light is weak, but can be detected on the surface of the earth with sensitive instruments like HiSCORE's photomultiplier tubes.

Cherenkov radiation can be used to determine the source and intensity of cosmic rays as well as to investigate the properties of high-energy astronomical objects that emit gamma rays like supernova remnants and blazars. The wide field of view also allows HiSCORE to monitor extended gamma ray emitting structures such as molecular gas clouds, dense regions or large scale structures such as star forming regions or the galactic plane.

HiSCORE can also be used for testing theories about Dark Matter. A strong absorption feature is expected around 100 TeV. Examination can give information about the absorption of gamma rays in the interstellar photon fields and the CMB. If the absorption is less than expected, this might indicate the presence of hidden photons or axions. Also, the decay of heavy supersymmetric particles might be detectable by HiSCORE. The data will improve as the facility grows over the years. By 2013-14 the area will be around one square kilometre, and over 10 square kilometres by 2016.

HiSCORE is a joint project between the Institute for Nuclear Research of the Russian Academy of Sciences in Moscow, Irkutsk State University in Siberia and Lomonosov Moscow State University – as well as DESY, the University of Hamburg and the Karlsruhe Institute of Technology in Germany. HiSCORE also hopes to collaborate with the Pierre Auger observatory in Argentina.

**More information:** Find out more about HiSCORE at the project's website.

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