Available online at www.sciencedirect.com

ScienceDirect

Physics Procedia 00 (2014) 1–6

Physics Procedia

www.elsevier.com/locate/procedia

# Status and first results of Tunka-Rex, an experiment for the radio detection of air showers

R. Hiller[2], N.M. Budnev[1], O.A. Gress[1], A. Haungs[2], T. Huege[2], Y. Kazarina[1], M. Kleifges[3], A. Konstantinov[4], E.N. Konstantinov[1], E.E. Korosteleva[4], D. Kostunin[2], O. Krömer[3], L.A. Kuzmichev[4], R.R. Mirgazov[1], L. Pankov[1], V.V. Prosin[4], G.I. Rubtsov[5], C. Rühle[3], F.G. Schröder[2], R. Wischnewski[6], A. Zagorodnikov[1] (Tunka-Rex Collaboration)

[1]*Institute of Applied Physics ISU, Irkutsk, Russia*
[2]*Institut für Kernphysik, Karlsruhe Institute of Technology (KIT), Germany*
[3]*Institut für Prozessdatenverarbeitung und Elektronik, Karlsruhe Institute of Technology (KIT), Germany*
[4]*Skobeltsyn Institute of Nuclear Physics MSU, Moscow, Russia*
[5]*Institute for Nuclear Research of the Russian Academy of Sciences, Moscow, Russia*
[6]*DESY, Zeuthen, Germany*

**Abstract**

Tunka-Rex is a new radio detector for extensive air showers from cosmic rays, built in 2012 as an extension to Tunka-133. The latter is a non-imaging air-Cherenkov detector, located near Lake Baikal, Siberia. With its 25 radio antennas, Tunka-Rex extends over an area of 1 km$^2$ with a spacing of 200 m and therefore is expected to be sensitive to an primary energy range of approximately $10^{17}$-$10^{18}$ eV. Using Trigger and DAQ from Tunka-133, this setup allows for a hybrid analysis with the air-Cherenkov and radio technique combined. The main goals of Tunka-Rex are to investigate the achievable precision in the reconstruction of energy and composition of the primary cosmic rays by cross-calibrating to the well understood air-Cherenkov detector. While the focus in the first season was to understand the detector and calibrate the detector, an early analysis already proves the detection of air-shower events with dependencies on energy and arrival direction as expected from a geomagnetic emission mechanism. Furthermore, in near future tests will be conducted for a joint operation of Tunka-Rex with Tunka-HiSCORE, a prototype gamma ray observatory at the same site, and the upcoming scintillator extension of Tunka-133.



*Keywords:* Tunka-Rex, Tunka, Radio, cosmic rays, extensive air showers

## 1. Introduction

The measurement of high energy cosmic rays remains to be a challenging research field and therefore many riddles, especially about the origin of cosmic rays, remain unsolved. One of the problems is the low flux at high energies above $10^{15}$ eV, making it impossible to measure these cosmic rays directly in balloon or satellite borne experiments. Sparsely spread ground arrays of particle detectors or optical devices, observing vast volumes of the earths atmosphere extend the measurable energy range up to at least $10^{20}$ eV. Extending over up to many km$^2$ on ground, they use the earths atmosphere as a calorimeter to measure air showers, induced by the high energy particles. But these arrays bring their own problems: the convoluted process of shower development makes it very challenging to reconstruct certain parameters of the primary