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Amplitude Calibration of the Tunka Radio Extension (Tunka-Rex)

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

[1] Institut für Kernphysik, Karlsruhe Institute of Technology (KIT), Germany
[2] Institute of Applied Physics ISU, Irkutsk, Russia
[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

E-mail: roman.hiller@kit.edu

Abstract. Tunka-Rex is an experiment for the radio detection of cosmic-ray air showers in Siberia. It consists of 25 radio antennas, distributed over an area of 1 km^2. It is co-located with Tunka-133, an air-Cherenkov detector for cosmic-ray air showers. Triggered by Tunka-133, Tunka-Rex records the radio signal, emitted by air showers with energies above 10^{17} eV. Its goal is to probe the capabilities of a radio detector, especially for the determination of the energy and elemental composition of cosmic ray primaries. To compare the measurements of Tunka-Rex to other radio detectors or to models describing the radio emission, the radio signal in each station has to be reconstructed in terms of physical units. Therefore, all hardware components have to be calibrated. We show how the calibration is performed and compare it to simulations.

1. Introduction

Cosmic rays are a unique window in the close universe, possibly providing a look at the most violent processes in the universe in the high energy range. Because of the low flux of high-energy cosmic rays, huge devices are necessary to detect air showers in the Earth's atmosphere, with areas of up to thousands of km^2. Additionally, the different types of detectors suffer from systematics, e.g. due to the extrapolation of physics to high energies. Therefore, hybrid detectors are used, comprised by different systems, to allow for cross-checks and exploit the advantages of the different devices. Thus, there is a need for new types of detectors, which provide a new view on the measurement.

One possible candidate is the radio technique. The corresponding detector consists of several antennas, distributed in the detector field. Radio pulses were already measured and to some extent understood in the 1960s [1, 2]. Mainly due to the deflection of charged particles in the Earths atmosphere, the air shower produces a radio pulse of several 10 ns width. A second order