iProgress working report

Oleg Fedorov
Applied Physics Institute of Irkutsk State University
Supervisor: Dr. D. Kostunin (IKP)

Obtained results

Main goals of my work at KIT have been the design of a ROOT container for Tunka-Rex data and the reconstruction of the air-shower core with radio measurements.

Tunka-Rex data container

I created an unified data container for storing Tunka data from scintillator and air-Cherenkov stations. The size of raw data stored in this Tunka-Rex data container (TRDC) is reduced by a factor of 7.6 to 16.4. The TRDC reader was also implemented in the Tunka-Rex branch of Auger Offline. Structure of the TRDC:

Metadata

- Version
- Creation date
- Comments

Branch structure

- ID
- Timestamp
- Shower duration
- Trigger information
- List of stations (ID, Status, Timestamp, Delay, List of traces)

During implementation, several bugs in the Tunka-Rex branch of Auger Offline were fixed.

Core reconstruction with radio

I made a preliminary core reconstruction with radio using computer simulations made with CoREAS.

Configuration of simulations (several events per geometry)

- Energy of $0.3 \cdot 10^{18}$ eV
- Air showers angles
  - Zenith: 15, 30, 45 degrees.
  - Azimuth: 0, 90, 180, 270 degrees.
- Core positions

  - Distance from the center: 0, 200, 500 meters.
  - Azimuth: 0, 120, 240 degrees.

- Total - 1076 events.

For the core reconstruction I fitted a LDF function with 5 free parameters

$$\mathcal{E} = \mathcal{E}_0 \exp(a_1 r + a_2 r^2)) \sqrt{\sin^2 \alpha_g + \varepsilon^2 + 2\varepsilon \cos \phi_g}$$
$$r = r(x_0, y_0)\,, \quad \phi_g = \phi_g(x_0, y_0),$$

where $\mathcal{E}_0$ is normalizing factor, a_1 is the LDF slope, a_2 is the LDF width, ε is the asymmetry fraction, α_g is the geomagnetic angle and (x_0, y_0) is the core position.

I selected events with reconstructed distance of 250 meters from the center of the setup and more than 6 stations with detected signal. The theoretical precision of core reconstruction without noise for central part of detector is about 15 meters after optimization of the reconstruction method (see Fig.1). The next step of this study is the adding noise samples to the simulations and cross-check with core reconstruction of Tunka-133.

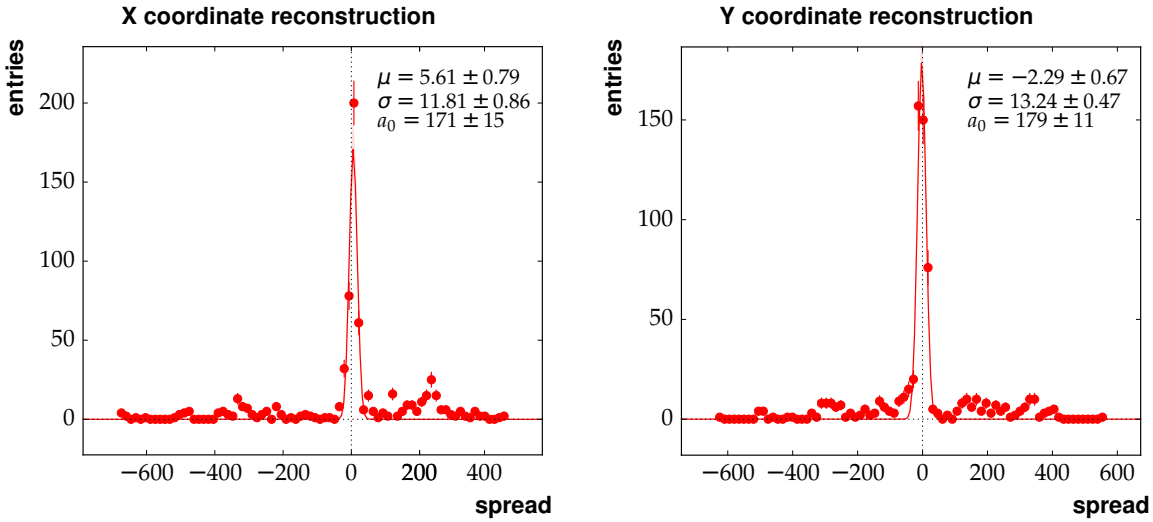

Figure 1: Difference between simulated and reconstructed core positions (without adding noise samples).

Given talks

- Internal IKP meeting, 20th May 2016
- TAIGA collaboration meeting, 3th June 2016