

Time synchronization of Baikal-GVD clusters

Summary

The Baikal-GVD neutrino telescope is currently under construction in Lake Baikal. The basic structural units of the telescope are a *section* consisting of 12 photodetectors (OMs), a *string* that contains three *sections*, and a cluster of 8 *strings*. At present, 8 such clusters are installed. The purpose of this work is to study the influence of the accuracy of Baikal-GVD synchronization system on the angular resolution of the telescope.

The Baikal-GVD synchronization system includes two subsystems that provide intra cluster channel synchronization, and sync between different clusters. Sync within a single cluster is achieved with a common trigger signal received by all sections in the cluster. To sync the clusters with each other, a single clock frequency is used, formed by the equipment at the shore station. The measurements are carried out by two independent systems: White Rabbit and specially designed for the Baikal-GVD *SSBT*.

In order to study the sync accuracy, we analyzed the measurements of laser series which illuminated multiple clusters. The standard deviation (RMS) of the measured difference in the channel response time was used for accuracy estimation. For the channels within one section, the measured RMS was 0.25 ns. For different sections, the RMS was 2.1 ± 0.05 ns, which is in a good agreement with the expected value of 2.04 ns. The RMS of the time difference on two clusters obtained with WR was 3.9 ns. For *SSBT*, this value is expected to be higher and is 4.4 ns. Monte-Carlo modeling shows that the cluster sync system does not negatively affect the angular resolution of the Baikal-GVD cluster. Under these conditions, the angular resolution of the Baikal-GVD cluster is about 1 degree.