Report on the “Baikal-GVD Deep-Underwater Neutrino Telescope: status and results”

Baikal-GVD is the neutrino telescope being constructed in Lake Baikal. It consists of clusters, with each cluster operated as an independent unit. The two more telescope clusters will be added soon to the existing set of 13 clusters. Baikal-GVD has been collecting data since 2018 with the gradually increasing sensitivity and performance. It detects neutrino-induced events as cascades and tracks.

Unfortunately, the full presentation was not available by the date fixed by us for the reports. Therefore, I have to base my note on the annotation to the report and the available publications, thus, my recommendations would possibly evolve later.

- The primary objective of this project was to confirm the observation of the astrophysical diffuse neutrino flux. For this purpose, a set of high-energy cascade events (>100 TeV from all directions and >15 TeV coming from below the horizon) were measured. The probability of astrophysical origin of such events was expected to be >50%. An outstanding result of Baikal-GVD is the fact that over the entire observation period the measurement reached a sensitivity sufficient for a statistically reliable statement that this excess was detected (>5 σ)! The results obtained are in good agreement with previous results measured using the IceCube telescope in Antarctica. The Baikal-GVD results are the first independent confirmation of the observation of the astrophysical diffuse neutrino flux. It is unclear why the measured power-law spectrum index ($\gamma=2.58\pm0.30$) and the normalization of the astrophysical flux for each neutrino flavor at 100 TeV ($\varphi=3.04$) do not differ from the values reported at one of the previous PACs and, accordingly, do not take into account the statistics collected over the past two years (half of all statistics). What is the sensitivity of the uncertainties of these quantities to the time of data collection? What are the ultimate goals of this part of the Baikal-GVD scientific program? What accuracies can be achieved in principle? How will these results affect the models of the appearance of the astrophysical diffuse neutrino flux?

- It is expected that the telescope's high angular resolution for cascade events (2-3%) will make it possible to study point sources of neutrinos in this detection channel. The sensitivity of the telescope in the cascade channel for high-energy astrophysical sources was assessed. Within the existing statistics, reliable correlations with directions to point sources (in particular, radio-bright blazars) have not yet been found, however, several candidates have been identified: a triplet of candidate events in the plane of the Galaxy, an event in the direction of the blazar TXS 0506+056. Due to the limited statistics, the authors' claim that they have confirmed the previous assumption that radio blazers in general are sources of high-energy neutrinos seems premature. However, with increasing sensitivity, this method is of great interest.

- Cascade events with energies above 200 TeV were studied. The data analysis indicated a possible galactic excess of such events. A similar indication is contained in the latest available IceCube data, which allows the authors to conclude that this effect is statistically significant at the level of 3.6σ. It would be interesting to understand more precisely which theoretical model-dependent predictions are already contradicted by the observed share of galactic events in the total astrophysical flow.

- It should be noted that it was of great importance to implement the automated data processing system that significantly reduces the analysis time and allows searching for astrophysical sources associated with alerts from other gamma-ray burst observatories, gravitational waves, neutrinos and others in real time.

My general recommendation is that this very promising project, which is already producing bright scientific results, requires strong support.