ADVANCED RESPONSE OF THE BAIKAL MACROSCOPIC NONLOCAL CORRELATION DETECTOR TO THE HELIOGEOPHYSICAL PROCESSES

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Abstract. Macroscopic quantum entanglement is the manifestation of nonlocality, the consistent theory of which has been undeveloped yet. The heuristic consideration of the problem leads to the conclusion that the advanced nonlocal correlations are present in the dissipative random processes, which have been really observed in the previous experiments. The key experimental idea is to establish correlation between entropy productions in the source-process and perfectly protected against any local impacts probe-process in the detector. The strongest macroscopic nonlocal correlations are observed at extremely low frequencies; therefore, the long-terms experiments therewith under very stable conditions are necessary. Since 2012, a new experiment is carried out at the Baikal Deep-Water Neutrino Observatory. Two nonlocal-correlation detectors, measuring spontaneous variations of potential difference of weakly polarized electrode pairs, were installed at depths of 47 and 1290 m; there can be no classical correlations between them. The data processing has revealed the correlations between the signals of the bottom and top detectors and the 4200 km distant land detector located in Troitsk. The detectors respond nonlocally to the external (heliogeophysical) random processes; their signal correlation, determined by the causal analysis, is directed downwards: from the detector on the earth's surface to the detector near the Baikal floor. However, this correlation obeys the quantum weak causality principle: the bottom detector responds earlier than for the top one and the top detector responds earlier than the surface one. The retarded response component is presented too, but it is always less than the advanced one. The main source-process is solar activity. The highest signal-to-noise ratio in relation to this process appears at the top Baikal detector. By data of this detector, time-reversal causal connections of its signal with the random components of solar radio and X-ray fluxes have been revealed. The possibility of the forecast of solar activity by nonlocal correlation with several months' advancement has been demonstrated. According to entanglement monogamy property, great nonlocal correlation with one subsystem implies only small correlations with other ones. Indeed, nonlocal correlations of detector signal with other natural (geophysical) random dissipative processes turned out smaller. Nevertheless they are also of interest; in particular, nonlocal nature of observed correlations has been verified by violation of Bell-like inequality with combination of solar and geomagnetic source-processes. The main results of the Baikal experiment are demonstration of macroscopic entanglement on the solar system scale, and demonstration of validity of the quantum weak causality principle, which, in turn, allows observing the random future.

Keywords: time, entanglement, causality