

ANTARES offline study of three alerts after Baikal-GVD follow-up found coincident cascade neutrino events

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Executive Summary

ANTARES and Baikal-GVD are both Cherenkov neutrino telescopes located in the Northern Hemisphere so their fields of view almost overlap allowing for a combined study of the sky. From December 2018 until the beginning of 2021 Baikal-GVD received 38 ANTARES alerts and followed up 32 of these as 6 alerts were received during a period of detector maintenance. After not finding any coincident events in a time window of ± 500 seconds and ± 1 hour, Baikal-GVD searched in an extended interval of ± 1 day and found coincident cascades within an angular distance of 5 degrees from the alert direction for 3 of these 32 alerts. The ANTARES collaboration decided to perform an offline study of these 3 alerts to search for additional events coming from compatible directions in the same time window.

ANTARES performed a binned analysis on the three alerts with coincident cascades. A set of cuts was optimized such that, with the resulting background inside the region of interest, a single detected event would have a significance of 3σ . The selection cuts together with the region of interest is optimized in terms of the resulting acceptance. The acceptance measures the sensitivity of the detector to a given flux. The cuts and size of the region of interest yielding the highest acceptances to a flux proportional to E_ν^{-2} are selected. This optimisation is done separately for upgoing and downgoing events as the regions of the sky above the ANTARES horizon require stricter cuts than those below it. In the same manner, for each half of the sky the optimization is divided in a study of track-like events and a study of cascade-like events.

Results after unblinding the ANTARES data for these alerts are presented and limits on the neutrino fluence from the regions of the sky corresponding to the alerts direction are computed. A first preliminary estimation of the significance of the coincident cascades from Baikal-GVD is reported.