A DEEP UNDERWATER ACOUSTIC DETECTOR NEAR KAMCHATKA FOR SUPER-HIGH ENERGY NEUTRINO ASTROPHYSICS

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Abstract

It was argued recently that on the basis of the existing Kamchatka deep ocean acoustic array of 2400 hydrophones, a special measurement system could be developed for seeking elementary particle cascades induced by super-high energy cosmic neutrinos with $E > 10^{20} - 10^{21}$ eV energies in water volumes on many cubic kilometer scale. This supplement to Cherenkov km^3 neutrino telescopes which are now under development, is capable of detection of some models of the sources of the highest energy cosmic neutrinos (cosmic rays). For example, GUT models with super massive particles and topological defect models, as well as other exotic sources may be seen in the unrivalled monitoring volume of such an acoustic instrument.

In this paper we report calculations of acoustic signals emitted by electron- photon cascades with energies $10^{20} - 10^{21}$ eV, taking into account the Landau-Pomeranchuk-Migdal effect. Expected acoustic signals from neutrino induced electron-photon and hadron cascades were generated. Ocean acoustic background conditions near the detector site were analysed, and algorithms for cascade detection and pulse signal processing were developed. Calculations of the effective detection volume of the acoustic neutrino telescope in winter and summer conditions were performed. For calm summer conditions the effective volume of registration of cascades with energy 10^{21} eV may be near 100 cubic km for a probability of false event detection of ¡1 per month (and of course this improves with neutrino energy). Further signal optimization seems possible with experimental data.