Abstract

The search for sources of cosmic rays has significantly advanced multi-messenger astronomy, highlighting the importance of neutrinos as key cosmic messengers. These particles can traverse vast cosmic distances without obstruction, providing unique insights into various astrophysical phenomena. However, detecting neutrinos poses considerable challenges, as it depends on the Cherenkov radiation emitted by secondary charged particles produced during rare interactions of neutrinos with matter. Consequently, specialized neutrino telescopes have been constructed worldwide, located in depths of the Mediterranean Sea, Lake Baikal, the Pacific Ocean, and the Antarctic ice. This thesis examines two neutrino telescopes: Baikal-GVD and KM3NeT. For Baikal-GVD innovative selection techniques have been developed to differentiate neutrino-induced cascades from the background noise generated by atmospheric muons. The selection method was applied to experimental data, leading to the identification of an intriguing, upgoing, high-energy event. This reconstructed event was then analyzed using a multicluster approach, and preliminary waveform analysis was utilized to examine its characteristics, focusing on its cascade-like light signature. An initial exploration of deep learning techniques is also presented, explicitly focusing on the GraphNeT software applied to simulated data from Baikal-GVD, including an assessment of its performance. A significant improvement in the reconstruction time for determining the direction of cascades has been achieved. Finally, the intrinsic optical background of KM3NeT's basic detection unit, the digital optical module, has been investigated through measurements conducted in the Modane Underground Laboratory and verified with the corresponding simulations. New parameters for calibrating KM3NeT detectors have been determined, utilizing the presence of decay from ^{40}K radioactive isotopes in seawater.

Keywords: neutrino, Baikal-GVD, cascades, KM3NeT, digital optical module