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Signal classification and event reconstruction for acoustic neutrino detection in sea water with KM3NeT

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The research infrastructure KM3NeT will comprise a multi cubic kilometer neutrino telescope that is currently being constructed in the Mediterranean Sea. The telescope will be composed of several detection units anchored at the sea bed, which are kept taut vertically by a buoy. Each detection unit has a length of about 700 hundred meters. Modules with optical and acoustical sensors are mounted every 36 meters on each line. While the main purpose of the acoustic sensors is the position calibration of the detection units, they can be used as instruments for studies on acoustic neutrino detection, too. In this presentation, methods for signal classification and event reconstruction for acoustic neutrino detectors will be presented, which were developed using Monte Carlo simulations. The signal classification uses the disk-like emission pattern of the acoustic neutrino signal, which is often called “pancake”. For the classification, a set of features is calculated from the signature in the detector. These are used as the input for the machine learning algorithms that perform the classification. This approach improves the suppression of transient background by several orders of magnitude. Additionally, an event reconstruction is developed based on the signal classification. The direction of the incident neutrino can be derived from a fit of the “pancake” plane, while the event vertex can be reconstructed from the timing of the hits. The energy reconstruction however requires a combined fit of all these parameters for an accurate result. An overview of these algorithms will be presented and the efficiency of the classification will be discussed. The quality of the event reconstruction will also be presented.

Summary

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