KM3NeT/ARCA sensitivity to transient neutrino sources

Executive Summary

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Multi-messenger astronomy is a field of astroparticle physics that has revolutionized the way we study our Universe. Its potential is based on the combination of the information that different messengers provide about a given source. Indeed, we now have at our disposal diverse experiments that are capable of detecting and studying, in addition to electromagnetic radiation, cosmic rays, neutrinos and gravitational waves. This fact motivates the design and implementation of systems that are able to send alerts from one experiment to the others allowing them to perform the follow-up of astronomical events rapidly. This is of particular interest in the case of transient sources, where the use of a narrow time window significantly reduces the expected background.

In this work we present a binned cut-and-count method that incorporates an event selection optimized for increasing the sensitivity of the detector KM3NeT/ARCA to transient sources for upgoing events, and which is based on the reconstruction parameters. The Model Rejection Factor[1] technique is applied to obtain the optimum radius to be used for the Region of Interest. Time windows of 1000 seconds, 1 day and 10 days have been studied with this method.

The effective area, fluence sensitivity and discovery potential are obtained. For the case of a time window of 1000 s, a value of 0.047 GeV cm^{-2} is reported as integrated fluence sensitivity. The resulting sensitivity is about two orders of magnitude more stringent than the ones from ANTARES and is comparable to the best IceCube results in similar analyses of this field, covering a broader energy range.

[1] G.C. Hill and K. Rawlins, *Unbiased cut selection for optimal upper limits in neutrino detectors: the Model rejection potential technique*, Astropart. Phys. 19 (2003) 393 [astro-ph/0209350]