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Real-time analysis framework for multi-messenger astronomy with the KM3NeT neutrino telescope

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KM3NeT is a multi-site and multi-purpose neutrino telescope under construction in the depth of the Mediterranean Sea. It consists of two Cherenkov telescopes, ARCA (in Italy) and ORCA (in France), both of which are currently taking data with partial detector configurations. Among the primary scientific goals of KM3NeT is the observation of cosmic neutrinos and the identification of their sources. Although having different primary goals, ARCA and ORCA allow for the exploration of neutrino astronomy from MeV to tens of PeV, being optimized in complementary energy ranges.

KM3NeT is involved in a global multimessenger programme, which includes sending public/private neutrino alerts in real-time to the astronomy community to trigger electromagnetic follow-up observations of interesting events, as well as searching for neutrinos in spatial and temporal coincidence with promising transient astrophysical sources seen in gravitational waves, X rays, gamma rays, and other wavelengths. Neutrino data provide improved power to detect high-energy transient sources: contrary to traditional telescopes, underwater Cherenkov-based neutrino detectors have a field of view comprising the whole sky, thus they are ideally suited to detect and promptly inform other research infrastructures about interesting events. As emission from transient astrophysical sources can rapidly fade, neutrino alerts need to be shared with low latency, in order to allow for a prompt follow-up in the multi-messenger and multi-wavelength domains, particularly for the detection of transient and variable sources. In the case of poorly localized triggers, such as gravitational waves, KM3NeT can provide refined pointing directions, representing a further advantage.

The real-time multimessenger analysis framework is currently being implemented in KM3NeT. This contribution reports on the status of the software architecture that is being implemented for a fast reconstruction and classification of events occurring in both ORCA and ARCA, as well as the first results achieved though online analyses.

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