Summary: Expectations for the high-energy neutrino detection from starburst galaxies with KM3NeT/ARCA

The KM3NeT/ARCA is a three-dimensional Cherenkov neutrino telescope in contruction phase, which will be installed at a sea bottom depth of about 3500 meters near Capo Passero (Sicily). The detector consists of so-called Digital Optical Module (DOM): a glass spheres resistant to water pressure instrumented with 31 photomultiplier (PMTs). A vertical line of eighteen DOMs composes a so-called Detection Unit (DU). The project of ARCA consists of two building block (BB): each one with 115 DUs. The principal aim of ARCA is to observe the astrophysical neutrino flux and to identify possible high-energy neutrino originated from Galactic and extra-Galactic sources. Furthermore, the ARCA telescope is projected to be optimized to have a efficiency for neutrino energy 1 TeV - 10 PeV. For this reason, in order to obtain a km^3 dimension, it is built with a vertical spacing of 36 meters between the DOMs and a 90 horizontal distance between the DUs.

What is this contribution about?

In this contribution we study the possibility for KM3NeT/ARCA telescope to observe the astrophysical diffuse neutrino flux from Star-forming (SFG) and Starburst (SBG) Galaxies. The SBGs are a class of galaxies with a high star formation rate, and are known as “reservoirs” of high-energy cosmic-rays. Furthermore, can be considered as garanteed “factories” of high-energy neutrinos. Since the IceCube collaboration observed in the northern sky a hotpost of neutrino events coming from NGC 1068, which is one the SBG observed by the Fermi-LAT telescope, the SBGs could play an important rule concerning the diffuse neutrino flux measured by IceCube. In this work we calculate an expectation for the diffuse neutrino signal from these class of galaxies with the KM3NeT/ARCA detector.

What have we done?

In order to make a prediction for ARCA phase 2.0 to observe a possible diffuse neutrino signal from SBGs, a calculation of an appropriate sensitivity was performed. The sensitivity is calculated at 90% confidence level (C.L.) using the statistic Neyman method. We used the latest simulation MC of ARCA115: in particular we selected only both for signal (neutrino SBG) and background (atmospheric muon and neutrino) only charge-current muonic neutrino and anti-neutrino. Furthermore, to avoid a calculation for a differential sensitivity we considered a interval energy between 100 GeV - 10 PeV: this range was divided in 11 bins. The optimization of this study was obtained applying event quality cuts bin-per-bin: as a first selection we considered only up-going events, and in order to improve the rejection of background events was used a multivariate analysis involving machine learning. Indeed, an appropriate algorithm able to distinguish if a event is classified as a "signal-like" or "background-like". Furthermore, using the ROOT:TMVA framework was implemented an appropriate Boost Decision (BDT).

What is the result?

We performed the calculation of the differential sensitivity (considering the interval energy 100 GeV - 10 PeV) for the SBGs diffuse neutrino signal with ARCA detector: we estimate the sensitivity considering 5 year of data taking, two BB and using only track-like events. The signal from SBGs can potentially be observed with KM3NeT/ARCA. In fact we found the minimum of sensitivity at a energy of 100 TeV, namely where the SBG spectral energy distribution (SED) is expected to peak. On the whole, our contribution can demonstrate how important SFGs and SBGs might be for the high-energy neutrino production and that the next decade of upcoming KM3NeT/ARCA will be a crucial to constrain their effective contribution with respect to IceCube's measurements.