Starlight beneath the waves : in search of TeV photon emission from Gamma-Ray Bursts with the ANTARES Neutrino Telescope

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At any given time, cosmic rays constantly shower the Earth from all direction. The origin of cosmic rays is still a mystery as their paths are deflected by magnetic fields to random directions.

The most likely sources of cosmic rays are Gamma-Ray Bursts (GRB). As the most energetic events known in the universe, GRBs are the death throes of massive stars that end in the explosion of stellar materials into interstellar matters. The interactions between cosmic rays and materials surrounding the GRB can produce neutrinos and very-high energy gamma-rays. Studying these high-energy neutrinos and gamma-rays can enlighten us further on the origin of cosmic rays.

Very-high energy gamma rays can be observed by very large volume neutrino telescopes such as ANTARES in the Mediterranean Sea and IceCube in the South Pole. This dissertation focuses on ANTARES telescope operated as a gamma-ray telescope, which is possible by searching for downgoing muons produced from the interaction of gamma-rays with the Earth's atmosphere. Analytical calculations necessary to estimate the rate of photon-induced muons from GRBs has been performed. The responses of the detector to downgoing muons have been understood by using Monte Carlo simulations. The findings also provide a discussion on the future prospect of this venture.

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