

The project focuses on the investigation of the atmospheric muons, particles produced in large numbers in interactions of particles from the outer space taking place in the Earth's atmosphere in form of particle cascades called extensive air showers (EAS).

The analysis will be based on computer simulations and experimental data coming from an international experiment KM3NeT. It is based in Europe and consists of two detectors placed at the bottom of the Mediterranean Sea near the coasts of France (ORCA) and Italy (ARCA). They both look for the light emitted by very fast particles travelling through the water (called Cherenkov radiation), similarly to a shockwave emitted by a jet plane flying faster than the speed of sound in the air.

ORCA and ARCA detectors are currently under construction and the first units are already taking data since 2015. Atmospheric muons are the most abundant particles seen by KM3NeT detectors and they may seem like neutrinos (very light particles with a low interaction probability) when interacting in the detector. This leads directly to the first motivation for this work: ORCA and ARCA are primarily designed to look for neutrinos, hence it is extremely important to first understand the muon background well. No neutrino is possible without suppressing the muons.

A further reason to start this project is the fact that some properties of the muon bunches arriving at the Earth and the processes that create them are not yet fully understood. This poses a big challenge but also an opportunity for KM3NeT detectors to shed some light on the nature of the muon production in air showers. Better understanding of EAS would give us an insight into the properties of the cosmic radiation causing them and perhaps even allow to track down its sources.

The results of this project will contribute to the understanding of formation, composition and development of EAS and muon production associated with them. The project will also contribute to the development of reconstruction and analysis methods used in particle physics. We hope to lay a solid foundation for future searches with the full KM3NeT detectors by demonstrating their potential to explore the properties of the atmospheric muons and indirectly study the cosmic radiation.