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This project concerns the search for dark matter particles, a mysterious substance presumably contributing at the level of around ¼ to the total mass of the Universe. For a comparison, the abundance of ordinary matter, out of which are built stars, galaxies and we, is only 5% of the total mass-energy contained in the Universe. It is anticipated that the remaining portion is formed from two unknown components: dark matter and even more mysterious dark energy, with the latter one contributing at about 70% to the mass-energy of the Universe.

Dark matter is probably made up with some kind of elementary particles, whose origin cannot be derived from the known physics. We can only say that these relic particles should be quite massive, abundant, electrically neutral, does not emit nor reflect light, and must be very weakly interacting with ordinary matter. That would explain the fact that so far we have not detected them in any of the numerous experiments focused on their search. We can only see the gravitational influence of dark matter on the behavior of structures in the Universe, such as movements of galaxies.

This project concerns the search for evidence of dark matter particles in our Galaxy. It is expected that these relic particles would sometimes annihilate with each other and in course of this process known particles will be produced, such as electrons, protons, photons or neutrinos. And it is the latter, neutrinos produced in the annihilation of dark matter taking place in cosmos, that we hope to discover embedded in a data collected with neutrino telescopes.

This project aims at experimental data analysis from the Japanese neutrino detector Super-Kamiokande. This detector every day registers neutrinos coming from different known sources: neutrinos from the Sun or produced in the atmosphere in showers induced by cosmic rays. However, there is a chance that a small percentage of these data may contain undisclosed until now contribution of neutrinos associated with dark matter. This effect will be thoroughly checked using sophisticated statistical techniques and computing methods.

The proposal will also carry out similar studies for another experimental setup that is now being assembled in the Mediterranean See, i.e. KM3NeT neutrino telescope. Since this detector is under construction and not collecting data yet, we will carry out the simulation work to determine the ability to discover with its help dark matter particles having masses difficult to investigate with the Super-Kamiokande. The KM3NeT detector, if constructed in a full configuration, will be the largest detector ever built by mankind. It will utilize approx. 5-6 km3 of sea water in order to examine interactions of neutrinos arriving to us from the outer space.

We hope that the implementation of this project will contribute to understanding the nature of dark matter, which is one of the biggest mysteries in modern astrophysics and elementary particle physics – what really consists the Universe?