One of the main goals of heavy-ion physics is to look for signs of creation of a new form of matter – quark-gluon plasma (QGP). It is believed that this state of matter existed up to a few millionths of a second after the Big Bang before quarks and gluons were bound together to form hadrons. Investigating the transition characteristics from the quark-gluon matter to the matter composed of strongly interacting hadrons is important to understand proprties and the evolution phases of the early Universe.

To recreate conditions similar to those of the early universe, powerful accelerators deliver head-on collisions between massive ions, such as lead nuclei. In these heavy-ion collisions the hundreds of protons and neutrons from these nuclei smash into one another at high energies, converting large initial kinetic energy into hot and dense matter at conditions similar to that expected in the early Universe. If the collitions energy is large enought the produced matter can be created in the form of QGP. The QGP quickly cools until the individual quarks and gluons recombine into ordinary matter that speeds away in all directions.

The QGP can not be studied directly since it lives only for a short time after the collision, but rather through the detectable particles produced in the late stage of system evolution. Physicists developed many observables that can be constructed using detected particles that are sensitive to QGP. In particular, particles containing quarks heavier than the "ordinary" *up* and *down* quarks, like charm quark, carry information about properties of the produced in the collision hot and dense matter, and by studying them one can obtaine signatures of creation of the QGP. Particles containing a charm quark is called charm particles, the lightest of such particles is D^0 meson. A challenge of measuring particles containing heavy quarks is that very few of them are produced in the collisions and moreover they live for very short time.

There are different theoretical models that try to describe the early stage of a heavy-ion collision – and by extension – the early stage of the universe. These models give different predictions for the number of D^0 mesons produced – by as much as a factor 50. Currently, the production of D^0 is not very well measured. Which theoretical model is closer to the actual production may give a hint of the production mechanisms, as different models make different assumptions. This research project is aiming to provide a measurement of the open charm production at the energies available as the SPS accelerator at CERN where the onset of deconfinement (in other words creation of QGP) is predicted.

In December 2016 a new detector based on silicon sensors called Vertex Detector was installed in the NA61/SHINE experiment at CERN SPS to provide measurements of D^0 and D^+ mesons and their antiparticles. In the test data taking with lead-lead collisions a D^0 signal has been observed for the first time at SPS energy. However, to obtain a full picture of the processes that influence on the number of produced charm mesons, a more detailed study is needed. Within this project measurements of the number of produced charm particles with the Vertex Detector will be performed, these data will be analysed to get a better understanding of the long-posed question of the mechanism of charm particle production.