For several decades, the continuous development of experimental techniques in the field of high-energy physics has been observed. The experiments conducted during this period made a huge number of measurements concerning the phenomena of the microworld. Apart from the observations of non-zero neutrino masses and the resulting phenomenon of neutrino oscillations, all measurements so far have fully confirmed the predictions of the theory formulated already in the seventies of the last century, the Standard Model (SM). In 2012, the last element postulated in this theory was discovered. Two experiments, ATLAS and CMS, conducted at CERN near Geneva announced the discovery of the Higgs boson. However, despite its tremendous success, SM fails to explain several important experimental observations, including the asymmetry between matter and antimatter observed in the universe. For this reason, searches for physics beyond SM, the so-called New Physics, have been conducted for many years. These hypothetical phenomena are expected to be very rare and therefore extremely difficult to observe in the predominant background of already known processes. The key to this search is the necessity to analyze the huge number of interactions in the collisions taking place in accelerators. In the case of the LHC collider, there are 40 million collisions per second. Such a large data stream is a huge challenge for the experimental equipment. To meet this challenge, new detector techniques have been rapidly developing in recent years.

The proposed project concerns a contribution to the development of innovative detection techniques. The scope of the project includes the development of a prototype of a detector module equipped with a full chain of reading electronics for ultra-fast reconstruction of particles produced in collisions. The project includes research and development of scintillation detectors and light transmission elements, readout electronics based on silicon photomultipliers and data pre-processing with the use of dedicated electronic systems. The technology being developed is universal and may be incorporated into current experiments or applied to future detectors.

One of the experiments searching for the effects of New Physics is the LHCb experiment at the LHC collider. The analysis of the data collected so far has revealed some interesting anomalies that could be the result of unknown processes. To increase the precision in order to confirm these anomalies, it is necessary to significantly increase the statistics of the experimental samples. To this end, the LHCb detector is currently being upgraded to operate at increased LHC luminosity. The developed detector prototype under the project will be used as a base for production a full version of the detector to be used in the LHCb experiment. This technology also has potential to be used in other fields, in particular for medical applications.