The main purpose of the submitted project is the design, implementation and commissioning of two vital components of the upgraded LHCb (Large Hadron Collider beauty) software high level trigger system. Taking into account the innovative (revolutionary) character of the new trigger, that will not store any of the raw data, its respective components must be of the higher quality and robustness. The new high level trigger will need to process the data from the whole detector at the rate of the proton proton collisions (40 MHz) and perform full tracking and event selections with the quality of the offline system. In order to provide such demanding platform it is planned to use the latest advances in the machine learning field and brand new concurrent software framework designed especially for the LHCb upgrade.

AGH LHCb group is a part of the Real Time Analysis project that oversee the preparation of the trigger system for the data taking in 2021 and is responsible for providing two of its critical components. First is the specialised computer model of the LHCb detector that is needed for track reconstruction procedure. The second is a brand new algorithm for long-lived particle reconstruction. In order to achieve the goals of our tasks we intend to use, for the first in LHCb experiment, non-supervised machine learning methods (including clusterisation and fuzzy logic based decision making) and big data mining algorithms. Also, the additional responsibility of the AGH LHCb group will be to commission and test the components during the proton-proton collisions in 2021.

The LHCb experiment is dedicated for searching New Physics via rare decays of beauty and charm and precise measurement of the charge-parity symmetry violation. At present LHCb is a leader in detecting intriguing anomalies that seem to break the Standard Model predictions. Unfortunately, most of the results are still statistically not significant enough to claim discovery. We believe that the modernisation of the detector will play a decisive role in collecting large enough data sets to switch from exploratory to discovery mode. This potential breakthrough will be only possible with the new software trigger that will be able to store up to 20000 event per second.