The ATLAS experiment is one of the two general-purpose detectors at the Large Hadron Collider (LHC) at the European Organisation for Nuclear Research (CERN) in Switzerland. ATLAS is designed for precision measurements of particle properties, the search of the Higgs boson and new physics beyond the Standard Model. The experiment got worldwide attention in 2012, when after the collaborative efforts with the CMS experiment the Higgs boson discovery was announced. After the discovery, the precision measurements of its properties became one of the main objectives of the LHC physics programme, since a potential observation of deviations from the Standard Model predictions might lead to the discovery of new physics. In this thesis, the measurements of the Higgs boson production cross-sections in the $H \to \tau\tau$ decay channel are presented. Based on the proton-proton collision data collected at the centre-of-mass energy of 13 TeV in years 2015 and 2016, the signal over the expected background from the other Standard Model processes is established with the observed significance of 4.4σ. Combined with the data collected at 7 and 8 TeV, the observed signal significance amounts to 6.4σ, which constitutes a single experiment observation of the $H \to \tau\tau$ decays by ATLAS. All presented results are found to be consistent with the Standard Model predictions.
In addition to the analysis, we introduce the topic of time calibration of the Tile Calorimeter and its subsequent time stability monitoring during the data taking in years 2015 and 2016.