

The Standard Model (SM) describes known elementary particles and their interactions. The ATLAS experiment is located at the Large Hadron Collider (LHC) in CERN (Geneva). The ATLAS detector measures data from proton-proton collisions at high centre-of-mass energy. The collected data allow physicists to precisely study SM and look for evidence of particles beyond the Standard Model.

The presented thesis describes the analysis of Higgs boson decay to a pair of tau-leptons. The measurement of the Higgs boson production cross section is based on the data set collected by the ATLAS detector in proton-proton ( $pp$ ) collisions at a centre-of-mass energy of 13 TeV in the years 2015-18 (so-called Run 2). This dissertation presents the update of the algorithm of Higgs boson mass reconstruction for the Run 2 ATLAS conditions. The evaluation of fake tau-lepton background is also discussed.

Further, this dissertation is dedicated to the search for excited tau-leptons in the Run 2 ATLAS data set. Contact interaction of the excited tau-leptons is assumed, which would occur if fermions were composite rather than elementary. The analysed ATLAS data from  $pp$  collisions in Run 2 set do not contain signatures of excited tau-leptons production. Within the considered model with the compositeness scale  $\Lambda = 10$  TeV, the upper limit on the excited tau-lepton mass is set to 2 TeV.