Abstract

The $H \rightarrow WW^*$ channel was one of the three search channels contributing in the observation of the Higgs boson at the ATLAS experiment in July 2012. Nowadays, this channel represents an important ingredient in the determination of the couplings and properties of the newly discovered particle. This thesis reports the search for and observation of the Higgs boson in the $H \rightarrow WW^*$ decay mode using the ATLAS detector at the CERN Large Hadron Collider. The analysis of events in which the Higgs boson is produced in the gluon-gluon fusion process and is associated with no more than one jet, is outlined in detail. The datasets used are the proton-proton collisions collected with the ATLAS detector at a centre of mass energy of 8 TeV during 2012 and 7 TeV during 2011, corresponding to a total integrated luminosity of 25 fb^{-1}. An excess over the predicted number of background events is observed in the data. The significance of the excess is estimated to be 6.1 standard deviations, while the expected value is 5.8. For a Standard Model Higgs boson with a mass of 125.36 GeV, the signal strength, μ, defined as the ratio of the observed cross-section for the signal to the predicted cross section, is measured to be $\mu = 1.08^{+0.16}_{-0.15}(\text{stat})^{+0.16}_{-0.13}(\text{syst})$. At present, the results in this decay mode are compatible with expectations from the Standard Model for a Higgs boson with a mass of $m_H = 125$ GeV.

In addition, the performance of the multivariate technique, called MV1, for b-jet identification, is presented. The efficiency of the MV1 algorithm is measured using events containing dileptonic top-antitop decays and is based on a likelihood approach that exploits per-event flavour and momentum correlations between the two jets. Correction factors which take into account differences in the b-jet identification efficiencies in simulation and data are derived as a function of jet transverse momentum and pseudo-rapidity. All the results are derived using the proton-proton collision dataset at a centre of mass energy of $\sqrt{s} = 8$ TeV.