Measurements of $H \to b\bar{b}$ decays and VH production

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Chapter 1

Introduction

In 2012 the Higgs boson was discovered by the ATLAS and CMS collaborations at the Large Hadron Collider [1, 2]. It was said to form the last piece of the Standard Model of Particle Physics, a framework that describes three of the four fundamental forces of nature, described in more detail in Chapter **??**. Despite apparent completeness after the Higgs discovery, it is known that the theory does not describe gravity, the fourth of the known fundamental forces of nature. The theory also has other shortcomings, it cannot explain the presence of dark matter [3–13] or a number of other observed phenomena [14–18]. So far the model has stood up to all experimental tests [19, 20] concerning its own predictions but there are still parameters of the model that have not been measured. Given the theory's understood shortcomings, it is hoped that continued scrutiny of the models predictions will yield unexpected results, perhaps hinting at a new way forwards in terms of a theory that describes everything or simply exposing further gaps in our knowledge of the universe. For this reason it is more important than ever to study in detail the most recently discovered piece of the model, the Higgs boson.

This work focuses on studying a specific production mechanism and decay mode of the Higgs boson, specifically a vector boson associated Higgs boson decaying to two bottom quarks, denoted $VH(bb)$. This decay mode is of importance as it is currently the only decay mode of the Higgs decaying to quarks that has been observed [21]. A summary of the full spectrum of production mechanisms and decay modes of the

Higgs will be given in Chapter **??**.

The study of this decay mode was carried out with the ATLAS detector, and made possible by the hard work of all members of the ATLAS collaboration. In Chapter **??** the detector is described in full.

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