

## Declaration

This dissertation is the result of my own work. Where figures and results are taken from other sources this is indicated by an appropriate reference. Some figures referenced as from other sources were created by me, but appear in other public documents.

The description of the analysis described in Chapter 4 follows Ref. [5], which includes elements of my work, and was made public in Ref. [1]. Specifically, I was responsible for cross-checking the results of all the W+jets background estimations, I contributed to the development of the formula used to carry out the Z+jets background estimation, I calculated and cross-checked several of the systematic uncertainties, I produced plots of the discriminating variables for final publication, and I performed all limit setting and production of limit plots.

I was the main analyser for the analysis described in Chapter 5, responsible for all steps of the analysis including trigger efficiency measurement, background estimation, systematic uncertainty studies and limit setting. The QCD background estimation method was developed and implemented collaboratively with other members of the Imperial College high energy physics (HEP) group. This work was made public in Ref. [2].

I was also solely responsible for the combinations described in Chapter 6. For the interpretations of the VBF invisibly decaying Higgs boson searches as limits on dark matter models described in Chapter 7 I worked collaboratively with theorists at Rutgers University and members of the Imperial College and Bristol University HEP groups. This work was made public in Ref. [4].

As well as the work described in this thesis I have also carried out preparations for a search for VBF produced invisibly decaying Higgs bosons using Run 2 data from the LHC. These preparations have included measurements of the trigger efficiency for the triggers used in 2015 CMS data taking and

comparisons of the kinematic distributions of signal and background events at the increased 13 TeV centre of mass energy used in Run 2 with those from Run 1, this work is currently under approval. Together with a new PhD student, I have also carried out a combination of the first Run 2 invisibly decaying Higgs boson searches in the VBF and ZH channels with those in Run 1, which is currently being approved for publication.

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