

Abstract

Despite the success of the Standard Model of particle physics, a number of hints suggest the existence of new physics beyond the scope of phenomena that can be explained in the theoretical framework of the Standard Model. One class of theories that could be able to explain some of the open questions of the Standard Model is Supersymmetry. It introduces supersymmetric partners to each of the Standard Model particles, and could, for example, provide a candidate for Dark Matter.

This thesis presents a search for electroweak production of supersymmetric particles in events with a lepton, missing transverse momentum and a Higgs boson decaying into two b -quarks. The search analyses 139 fb^{-1} of proton–proton collision data at a centre-of-mass energy of $\sqrt{s} = 13\text{ TeV}$, recorded by the ATLAS detector at the Large Hadron Collider. A likelihood-based simultaneous fit in all search regions is introduced in order to achieve sensitivity to a large variety of kinematic regimes. No significant deviation from the Standard Model predictions is seen in data in any of the search regions. The results are subsequently interpreted in a simplified model for pair production of the supersymmetric partners of the Higgs and gauge bosons. Lightest chargino and next-to-lightest neutralino masses of 740 GeV (600 GeV) can be excluded for lightest neutralino masses of $\lesssim 100\text{ GeV}$ ($\approx 250\text{ GeV}$).

Given that the particle physics experiments at the Large Hadron Collider are not easily reproducible, and a large number of phenomenologically viable models for physics beyond the Standard Model exist, special focus is put on the reusability and reinterpretability of the search. The full likelihood function of the search is published in a readily available format, and a fully reusable implementation of the search using containerised workflows with parameterised job templates is provided. In light of conceptually interesting but computationally challenging reinterpretations in high-dimensional model spaces, a method for generically approximating the likelihood functions of ATLAS searches for Supersymmetry is introduced and validated. Using this approach, a reinterpretation of the search in a subspace of a 19-dimensional set of more complete supersymmetric models is performed and its results are discussed.