The standard model of particle physics combines the electroweak and the strong interactions. The electroweak theory, which unifies the electromagnetic and the weak interactions within a chiral gauge theory, exploits the concept of spontaneous symmetry breaking (also known as the Higgs mechanism) to originate masses for the fermions and the weak gauge bosons. In spite of the great success of the electroweak model, which has been endorsed in electroweak precision measurements, the existence of the Higgs boson has not yet been confirmed. Large experimental effort at LHC is dedicated to the discovery of the Higgs boson which is an essential piece of the electroweak model.

Our work focuses on various properties of the Higgs boson which we determine non-perturbatively by means of Monte-Carlo simulations. Such studies have already been performed in the past but they lacked to establish the aforementioned chiral symmetry. Recent developments in lattice Higgs-Yukawa models enabled to warranty an exact chiral lattice symmetry. We consider a chirally invariant lattice Higgs-Yukawa model based on the Neuberger overlap operator and we will present final results on the upper and lower Higgs boson mass bound. The question of a fourth generation of heavy quarks has recently gained attention and we will illustrate preliminary results of the Higgs boson mass bounds within this framework. Finally we will discuss our progress on properties of the Higgs boson with respect to its unstable nature, such as the decay width and the resonance mass of the Higgs boson.