

Elusives Paper of the Month: Observation of $H \rightarrow b\bar{b}$ decays at the LHC

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September 14, 2018

Abstract

The decay of the Higgs boson $b\bar{b}$ quarks has been detected by the ATLAS and CMS collaborations at the LHC. This decay, although the most probable, remained elusive until now. The discovery opens a new way of precision measurements.

The discovery of the Higgs boson in 2012, at the Large Hadron Collider, was a major breakthrough in particle physics, finding the last piece of the puzzle for the Standard Model (SM). This particle explains how fundamental particles gain their mass.

The story is not quite over yet, as there are many unsolved problems in particle physics, and we must study the new properties of the Higgs very carefully to determine if it is exactly as predicted, or perhaps slightly different.

There are several different ways the Higgs can decay to other particles. The method used to discover the Higgs in 2012 relied on the decay into two photons, which occurs only 0.2% of the time, but this is easier to detect compared to the other zoo of particle decays inside the LHC.

In contrast, the most likely decay for the Higgs boson is into a pair of bottom quarks, with a probability of about 60%. To pin down the exact properties of the Higgs, it is crucial to observe this process, but this can be challenging as there are many other processes which yield a pair of bottom quarks. In August, however, both the ATLAS and CMS collaborations have managed to observe this exact process [1], further confirming that the Higgs boson we see has the properties of the Standard Model, as predicted back in 1964 [2].

In Figure 1, the number of detected events are shown. There, it is possible to see an excess around the Z boson mass 91 GeV, and the new detected signal around the Higgs mass 125 GeV, where the mass of the proton is 1 GeV.

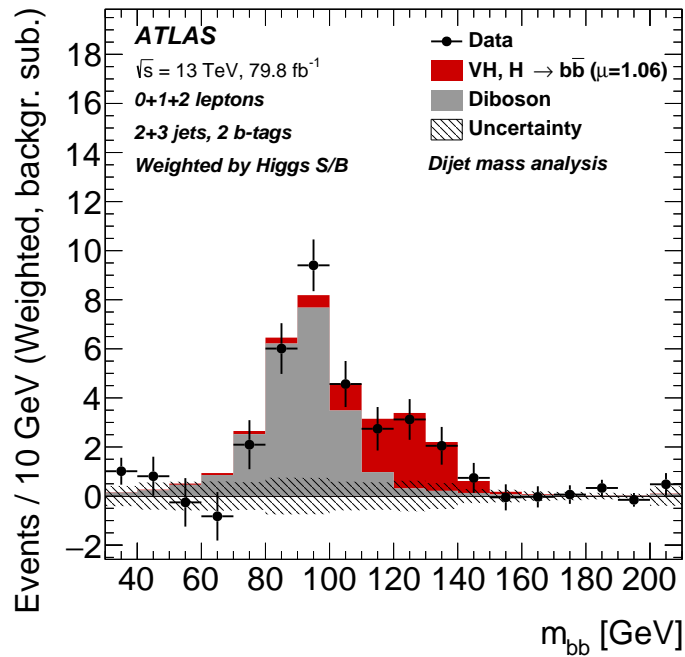


Figure 1: The vertical axis counts the number of $b\bar{b}$ events seen at the LHC, and on the horizontal axis, their energy. Shaded in red is the theoretical prediction including the Higgs boson. One can see the measured values (dots) agree well with the Standard Model prediction.

References

- [1] M. Aaboud *et al.* [ATLAS Collaboration], arXiv:1808.08238 [hep-ex].
- [2] P. W. Higgs, Phys. Rev. Lett. **13** (1964) 508.
doi:10.1103/PhysRevLett.13.508